ADIR

Compact control system

Operation manual

Version 1.05

AMiT

Contents

History of revisions

Document name: adir_g_en_105.pdf

Author: Stanislav Podolák

Revision	Date	Changes
100	16/05/2006	New document
101	17/05/2006	Changes according to consultation with EZÚ
102	08/08/2006	Changes according to consultation with EZÚ
103	17/10/2006	Changes according to consultation with EZÚ
104	15/02/2008	ADIR-4 cancelled, update
105	10/09/2008	1024 KB RAM (originally 512 KB), conformity assessment

Related documentation

1. DetStudio Development Environment Help
2. Application Note AP0016 – Principles of using RS485 interface
   file: ap0016_en_xx.pdf
3. Application Note AP0022 – Counter inputs implemented in control systems
   file: ap0022_en_xx.pdf

1. Introduction

ADIR is a small, compact control system built in plastic box.

Basic features

- 6 universal inputs / outputs (AI / DI / DO)
  inputs / outputs are configured by program
- 8 relays with switching contacts
- RS232 serial interface
- RS485 serial interface with galvanic separation
- DIN 35 mm rail mounting
- Character display, (2 × 8) characters
- Keyboard with 6 buttons

2. Technical parameters

CPU

CPU	SAB C167CR-LM
FLASH	512 KB
RAM	1024 KB
EEPROM	2 KB
RAM backup	Panasonic BR2477 Lithium battery
Battery lifetime	5 years

Display

Display	Text, (2 × 8) characters, 1 character (5 × 7) pixels
Character height	4.75 mm
Backlight	Green LED
Keyboard	6 buttons
Buttons lifetime	10^6 touches

Universal I/O

Quantity	6 ×
Type selection	By application program
Digital inputs Analogue inputs Digital outputs	Dry contact Ni1000 / Pt1000 / U / I *) 15 V via 3K92 resistor
Connection points	WAGO 231 connectors, (5.08 mm)
Maximum wire cross section	2.5 mm^2

Dry contact

Common pole	GND
Galvanic separation	No
Maximum frequency	250 Hz
Maximum current through contact	3.8 mA DC
Normally closed maximum resistance	100 Ω
Normally open minimum load resistance	10 kΩ

Ni1000 input

Measuring range	-50 °C to +150 °C
Ni1000 sensor constant	6180 ppm / °C
AD converter resolution (LSB)	0.3 °C *)
Accuracy, Ni1000 range depends on measured value. Interpolation needs to be performed.	T = -50 °C 0.8 °C T = 0 °C 0.9 °C T = 150° C 1.2° C
Input temperature dependence	75 ppm/ °C
Input circuit time constant	1 ms
Input overvoltage protection	Diodes **)

Note *) While NOS operating system is used.

**) Only a resistive sensor can be connected to this input. According to technical design, when sensor is not connected, voltage of 15 V occurs on Alx input. Voltage is switched on for 10 ms in 110 ms interval, common voltmeter will show average value.

Pt1000 input

Measured temperature range	-50 °C to +250 °C
Pt1000 sensor constant	3900 ppm / °C
AD converter resolution (LSB)	1 °C *)
Accuracy	T = -50° C 1.0 °C T = 0 °C 1.3 °C T = 250 °C 2.6 °C
Input temperature dependence	75 ppm/ °C
Input circuit time constant	1 ms
Input overvoltage protection	Diodes **)

Note *) While NOS operating system is used.

**) Only a resistive sensor can be connected to this input. According to technical design, when sensor is not connected, voltage of 15 V occurs on Alx input – voltage is switched on for 10 ms in 110 ms interval, common voltmeter will show average value.

Input range 0 V to 5 V

AD converter resolution (LSB)	5 mV
Accuracy at U range	5 %
Accuracy at I range	5 % + sensing resistor tolerance
Input overvoltage protection	Diodes
Maximum input voltage	15 V DC permanently

Digital output

Maximum output voltage	15 V DC
Maximum output current	3.8 mA
Output internal resistance	3.92 kΩ
Galvanic separation	No

Note *) With external sensing resistor.

Relay outputs

Quantity	8 × switching contact
Insulation strength	4200 V AC
Galvanic separation maximum operation voltage	300 V AC
Configuration	1 – 3 – 3 – 1
Switched power (resistive load)	500 VA AC / 70 W DC
Maximum switched current (resistance load)	2 A
Max. switched output voltage	250 V AC / 250 V DC
Contact lifetime without load / nominal load	30×10^6 / 1×10^5 switches
Maximum switching frequency without load / nominal load	72000 / 360 hr^{-1}
Connection points	WAGO 231 connectors, (5.08 mm)
Maximum wire cross section	2.5 mm^2

RS232

Galvanic separation	No
Logical level 0 (input)	Min. +3 V, max. +30 V
Logical level 1 (input)	Min. -30 V, max. -3 V
Logical level 0 (output)	Min. +5 V, max. +10 V
Logical level 1 (output)	Min. -10 V, max. -5 V
Maximum cable length	10 m
Operation indication	LED on panel
Connector	RJ45 connector, according to EIA-561

RS485

Galvanic separation	Yes
Insulation strength	500 V AC /1 minute *)
Overvoltage protection	Transil 600 W
Termination resistor **)	120 Ω on CS **ADIR**
Idle state definition **) to +5 V to 0 V	 1 kΩ on CS **ADIR** 1 kΩ on CS **ADIR**
Maximum wire length	1200 m / 19200 Bd
Maximum stations count	32
Operation indication	LED on panel
Connection points	WAGO 231 connectors, (5.08 mm)
Maximum wire cross section	2.5 mm^2

Note *) Isolation must not be used for dangerous voltage separation.
**) Termination resistor and idle state definition are connected concurrently.

Mechanics

Mechanical design	Plastic box
Mounting	DIN 35 mm rail mounting
Cover mounted unmounted	IP20 #) IP00
Signal connection	WAGO 231 connectors, (5.08 mm)
Maximum wire cross section	2.5 mm^2
Dimensions (w × h × d)	(106 × 95 × 74) mm
Weight	400 g

Note #) Mounting principles, see chapter 8. Mounting.

Power supply

DC power supply	24 V DC ±20 %
Maximum power consumption	200 mA at 24 V DC
AC power supply	18 V AC ±20 %
Maximum power consumption	250 mA at 18 V DC
Transformer supply fuse	T 50 mA

Temperatures

Operating temperature	0 to 50 °C
Storage temperature	-20 to 70 °C

Others

Maximum ambient humidity	< 95 % non-condensing
Programming	DetStudio (NOS)

2.1. Dimensions

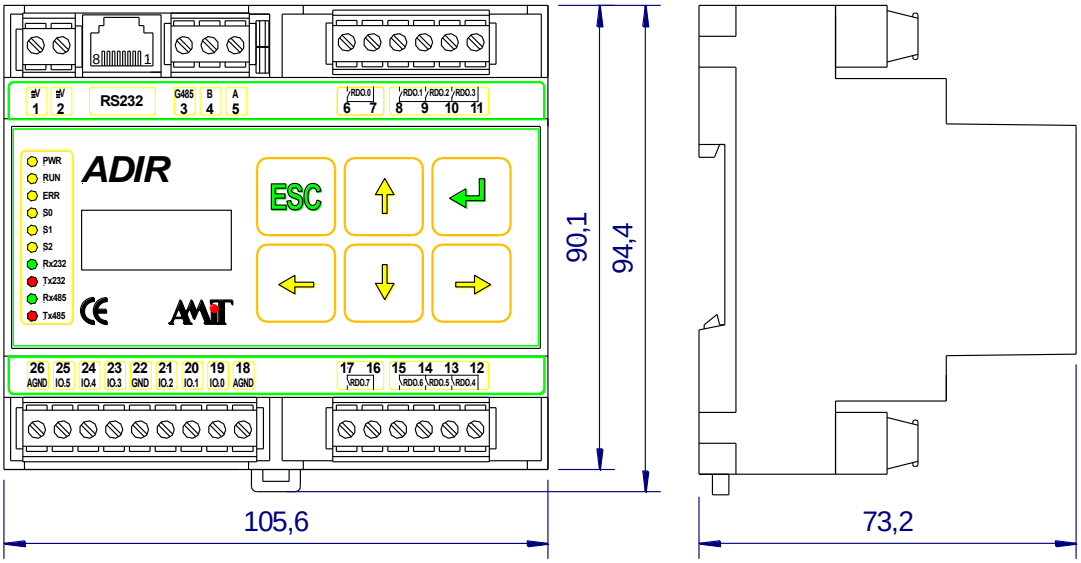

Fig. 1 - **ADIR** control system mechanical dimensions

2.2. Conformity assessment

Provided fair use, this product complies with requirements of Czech Government Decree NV616/2006 and NV17/2003. The compliance assessment with NV616/2006 has been performed in accordance with harmonized standard EN 61326, compliance assessment with NV17/2003 has been performed in accordance with harmonized standard EN 61010-1.

Tested in accordance with standard	Type of test	Class
EN 55022:2010	Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement	B *)
EN 61000-4-4:2004	Electromagnetic compatibility (EMC) – Part 4-4: Testing and measurement techniques – Electrical fast transient/burst immunity test, power supply	4 kV
EN 61000-4-4:2004	Electromagnetic compatibility (EMC) – Part 4-4: Testing and measurement techniques – Electrical fast transient/burst immunity test, input	2 kV
EN 61000-4-5:2014	Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement techniques – Surge immunity test, RS485	4 kV
EN 61000-4-5:2014	Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement techniques – Surge immunity test, power supply	4 kV

Tested in accordance with standard	Type of test	Class
EN 61000-4-11:2004	Electromagnetic compatibility (EMC) – Part 4-11: Testing and measurement techniques – Voltage dips, short interruptions and voltage variations immunity tests	complies
EN 61010-1:2010	Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 1: General requirements	complies

*) This is a class B product. The product meets more stringent criteria for indoor use. If the product still causes radio interference, the user can be requested to take the appropriate measures. In case of problems, contact the manufacturer's technical support.

2.3. Recommended drawing symbol

Following drawing symbol is recommended for **ADIR** control system. Only part of it will be visible in following examples.

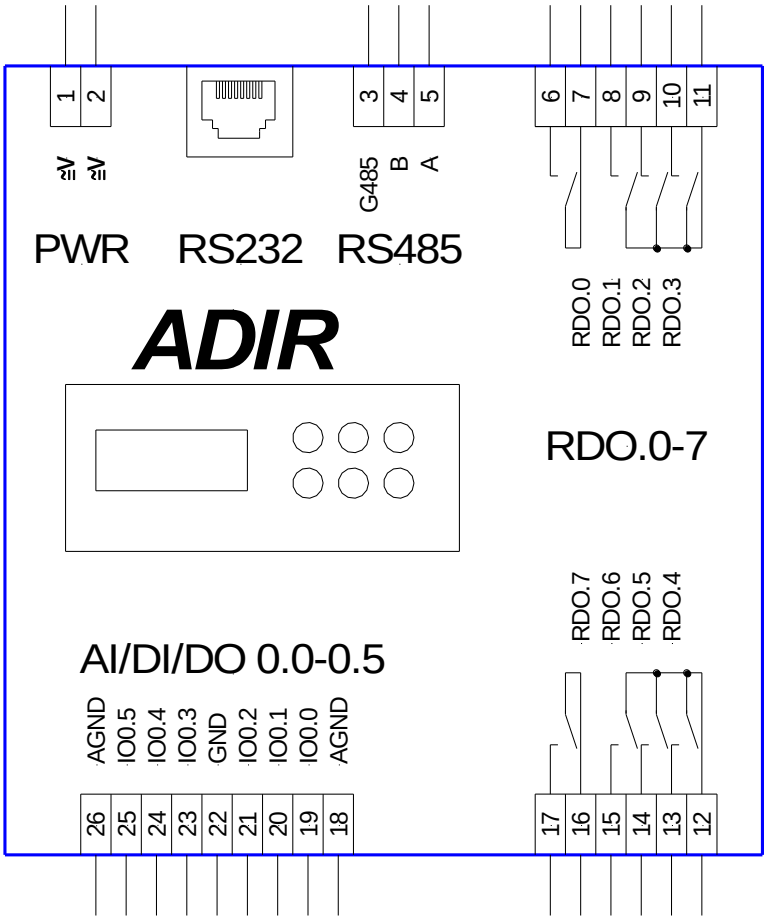

Fig. 2 - Recommended drawing symbol for **ADIR**

3. Power supply

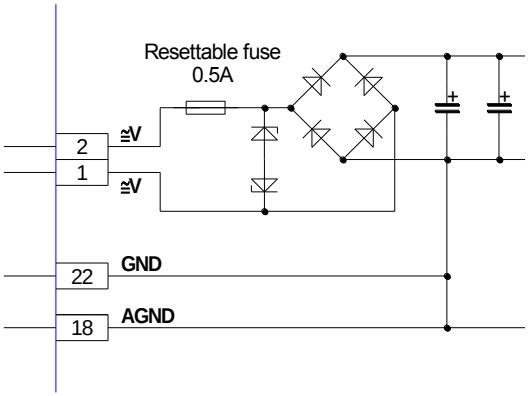

Fig. 3 - Internal wiring scheme, **ADIR** control systém

Control system **ADIR** can be supplied by either DC or AC power supply.

Not a single ADIR control system power supply terminal must be connected with control system GND or AGND terminals! Otherwise the system will be irreversibly damaged.

Power supply 24 V DC

Control system **ADIR** can be supplied by standard DC power supplies made by AMiT.

Wiring example

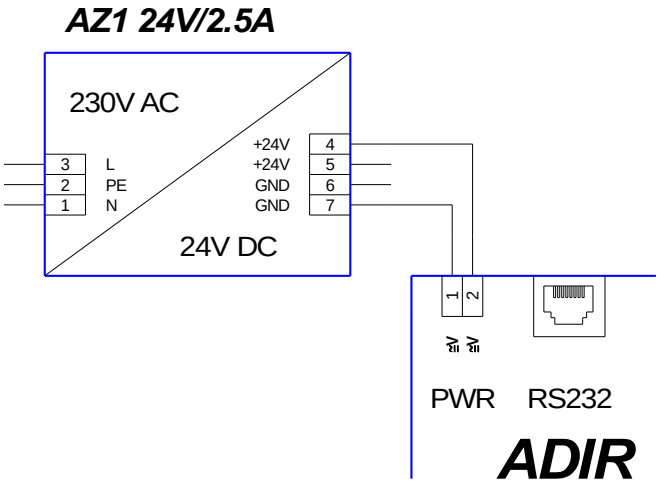

Fig. 4 - Wiring example of **ADIR** control system power supply

In this case, not a single ADIR control system power supply terminal must be connected with control system GND or AGND terminals!

In case the system must be supplied simultaneously with other devices from one DC power supply, the system must be connected according to Fig. 5. Power supply voltage must be led to terminal 2 (protected by a resettable fuse) and terminal 22 (GND for digital inputs)

In this case, the connector number 1 must remain disconnected!

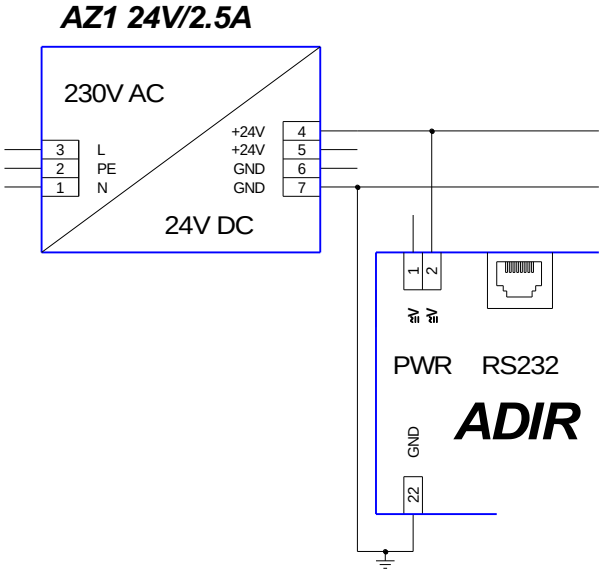

Fig. 5 - An example of the power of **ADIR** and other devices

Power supply 18 V AC. It is possible to power **ADIR** Control system directly from **TRF01** transformer or from a similar transformer. The power supply transformer must supply at nominal load of 18 V AC. Open circuit voltage from this transformer must not exceed 22 V AC. The primary winding of the transformer must be protected by a fuse. In case of transformer **TRF01**, it is a transformer fuse T50 mA.

Wiring example

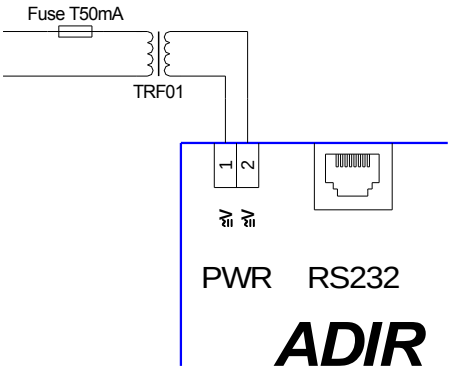

Fig. 6 - Wiring example of **ADIR** control system power supply

Not a single ADIR control system power supply terminal must be connected with control system GND or AGND terminals!

4. Inputs/outputs

4.1. Universal inputs / outputs

ADIR Control System has six universal inputs/outputs. These can be used as:

- digital input for dry contact
- input counter for dry contact
- analogue input 0 to 5 V
- Ni1000 / Pt1000 input
- digital output (15 V through resistor 3K92).

Configuration is being set up by an application program, each input / output can be set separately.

Caution! **No other modes other than those listed below are allowed. Incorrect settings can lead to the control system malfunction.**

I/O configuration settings

Following configuration can be applied to each I/O type:

For analogue input	**DEFAULT** **Ni1000**
For digital input	**DEFAULT** **CONTACTDI**
For digital output	**DEFAULT** **ACTIVE**

DEFAULT configuration is set automatically after system RESET, and there is no need to change it via program.

Each input/output not configured as **DEFAULT** needs to be set via function module **`ChanMode`** in the DetStudio parameterization environment.

Each signal is linked to three different I/O channels.

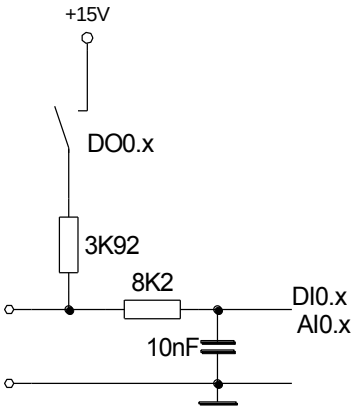

Fig. 7 - Schematic of single input/output wiring

Analogue input 0 V to 5 V

Configuration:
- AI DEFAULT
- DI DEFAULT
- DO DEFAULT

DEFAULT mode is set automatically after system RESET.

Dry contact

Configuration:
- AI DEFAULT
- DI CONTACTDI
- DO DEFAULT

Logical 1 status corresponds to closed output contact – 0 V on input. Switch is permanently closed, maximum current on the contact is 3.8 mA DC.

Configuration example

Configuration example IO. 0 as a dry contact:

```
ChanMode DI, 0, 0, CONTACTDI, 0
```

Counter input

Configuration:
- AI DEFAULT
- DI CONTACTDI
- DO DEFAULT

Logical 1 status corresponds to closed output contact – 0 V on input. Switch is permanently closed, maximum current on the contact is 3.8 mA DC.

Each digital input can be operated by program in Hi_x processes. These inputs can be programmed as counters. Limitation of input signal frequency is given by program. It can be used typically up to 250 Hz frequency.

Other information about counter inputs can be found in Application Note AP0022.

Analogue input Ni1000

Configuration:
- AI NI1000
- DI DEFAULT
- DO DEFAULT

In this mode, the switch is closed for 10 ms and open for 90 ms. This ensures, that the temperature sensor will not be heated up by the measuring current.

Configuration example

Configuration example – IO 1 as input Ni1000

```
ChanMode AI, 0, 1, NI1000, 0
```

Digital output

Configuration:
- AI DEFAULT
- DI DEFAULT
- DO ACTIVE

Caution! **This output is not able to excite a standard digital input of AMiT control systems – not in accordance with the EN 61131-2 standard.**

Configuration example

Configuration example – IO 2 as output

```
ChanMode DO, 0, 2, ACTIVE, 0
```

4.1.1 Dry contacts

Wiring example

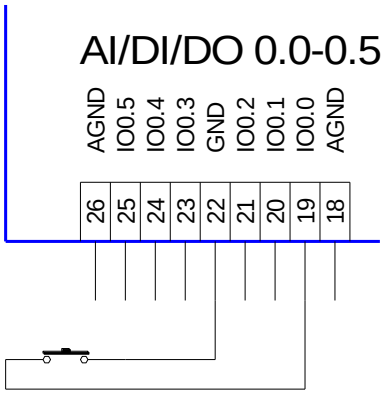

Fig. 8 - Dry contact wiring example

4.1.2 Analogue inputs

Wiring examples

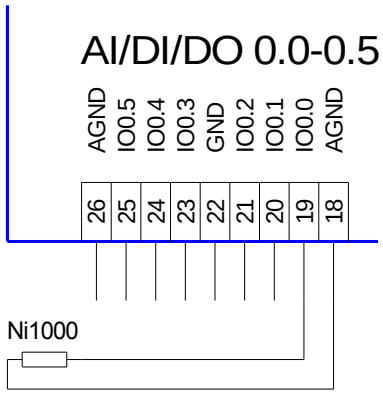

Fig. 9 - Coupling of Ni 1000 sensor to analogue input

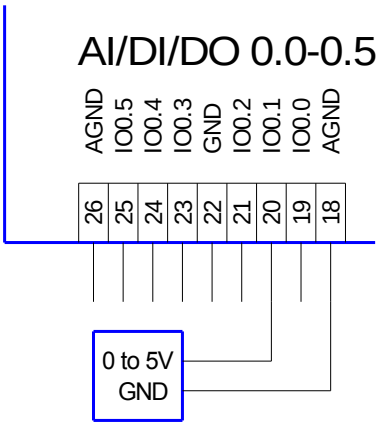

Fig. 10 - Coupling of sensor with current output 0 to 5 V DC

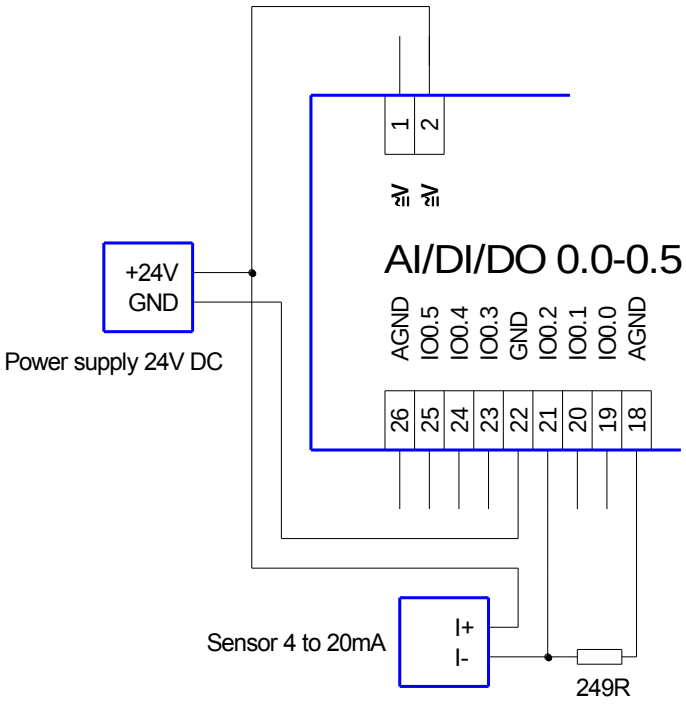

Fig. 11 - Coupling of sensor 0 to 20 mA DC with external sensing resistor

If same power supply is used for both sensor and **ADIR**, wiring must be done according to Fig. 11.

Because the **ADIR** control system does not have an internal reference, the guaranteed accuracy on this range is only 5 % plus tolerance of the sensing resistor.

4.1.3 Digital outputs

This digital output is not able to excite a standard digital input of the AMiT control systems. It is intended only for use with the AMiT products.

For example – can be used to excite high luminosity LED, or LED's optocoupler.

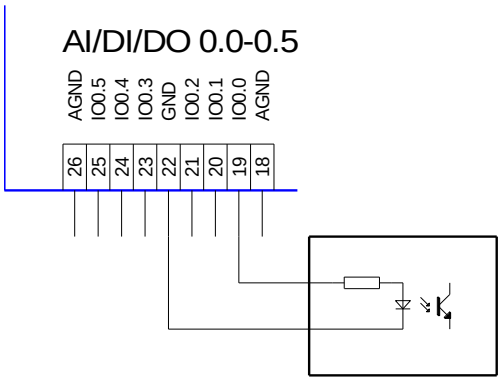

Fig. 12 - Example of using digital output.

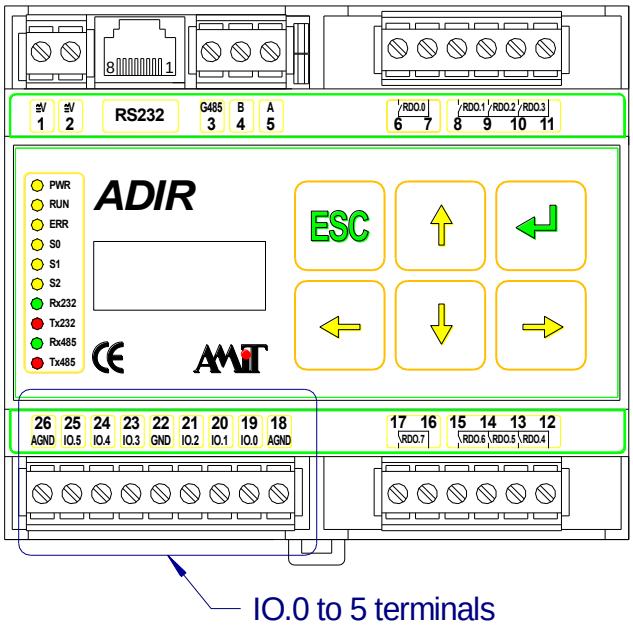

Fig. 13 - Location of terminals

Connectors numbering

Terminal	Label	Description
18	AGND	Ground terminal
19	IO.0	Universal input/output 0
20	IO.1	Universal input/output 0
21	IO.2	Universal input/output 0
22	GND	Ground terminal
23	IO.3	Universal input/output 0
24	IO 4	Universal input/output 0
25	IO 5.	Universal input/output 0
26	AGND	Ground terminal

Caution! Terminals GND and AGND are internally linked. For compliance with the technical parameters it is necessary to correctly distinguish between GND and AGND. See examples of involvement.

4.2. Relay outputs

The outputs are only available to the switching contact and are organised in groups 1-3-3-1. The relay contacts do not have any contact protection inside the control system.

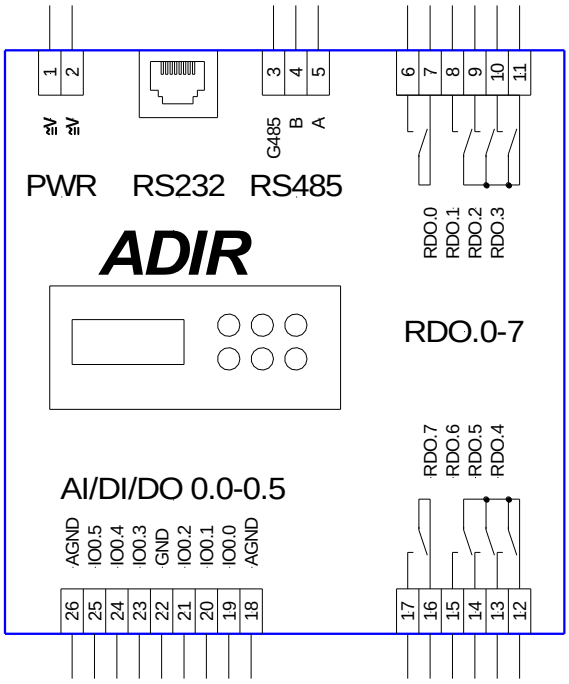

Fig. 14 - Relay outputs distribution

Output contacts are led out on 5.08 mm PA256 VE screw connectors.

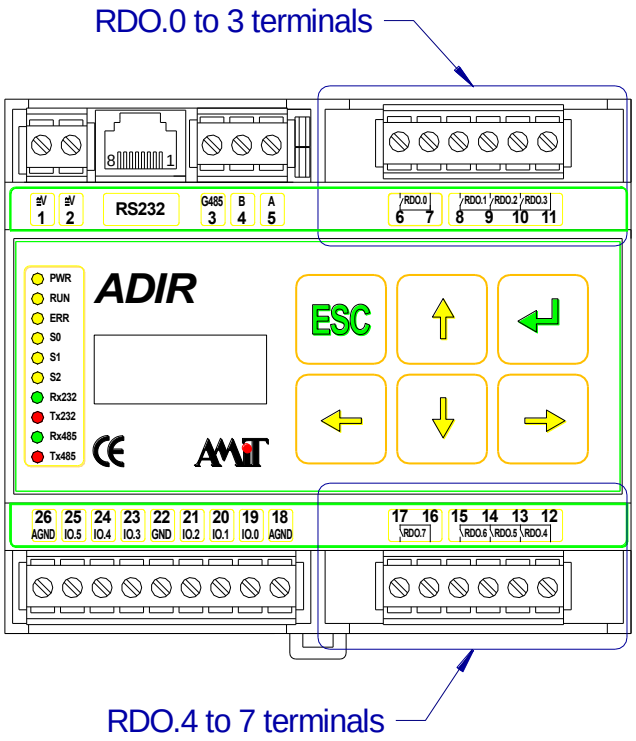

Fig. 15 - Connector location

Connectors numbering

Terminal	Label	Description
6	RDO.0	RDO.0 output
7	RDO.0	RDO.0 output
8	RDO.1	RDO.1 output
9	RDO.2	RDO.2 output
10	RDO.3	RDO.3 output
11	RDO.1..3	Common contact RDO.1 to 3
12	RDO.4..6	Common contact RDO.4 to 6
13	RDO.4	RDO.4 output
14	RDO.5	RDO.5 output
15	RDO.6	RDO.6 output
16	RDO.7	RDO.7 output
17	RDO.7	RDO.7 output

5. Communication lines

ADIR control system is equipped with single RS232 serial interface and single RS485 serial interface.

The RS232 interface without galvanic separation is led out on RJ45 connector.

RS485 interface is galvanically separated from the rest of the control system electronics and is led out on screw terminal connector. RS485 interface is equipped with configuration jumpers near the connector, which are used for line termination and idle state definition.

5.1. RS232

According to RS232 standard, this interface is intended for connection of two devices. By default, personal computers are equipped with RS232. Relatively short range and low immunity to disturbances are disadvantageous. For bi-directional communication the three wires are sufficient, for modem control – a fully feated of RJ45 connector is required.

Line reset This control system does not have any configuration switches, thus it is not possible to enable RESET via serial line. Only by holding the ESC key during booting, the control system can be initialized into Bootstrap mode, in which it is possible to load the OS.

Connector wiring RJ45 on **ADIR** control system

PIN	Description	Type
1	RI	Input
2	DCD	Input
3	DTR	Output
4	GND	–
5	RxD	Input
6	TxD	Output
7	CTS	Input
8	RTS	Output

Note The **Description** item corresponds to **ADIR** control system signals. When connected to PC, it must be cable-crossed. The **Type** item represents the signal type on **ADIR** control system. Use the **KABEL 232RP** cable for connection of control system to PC.

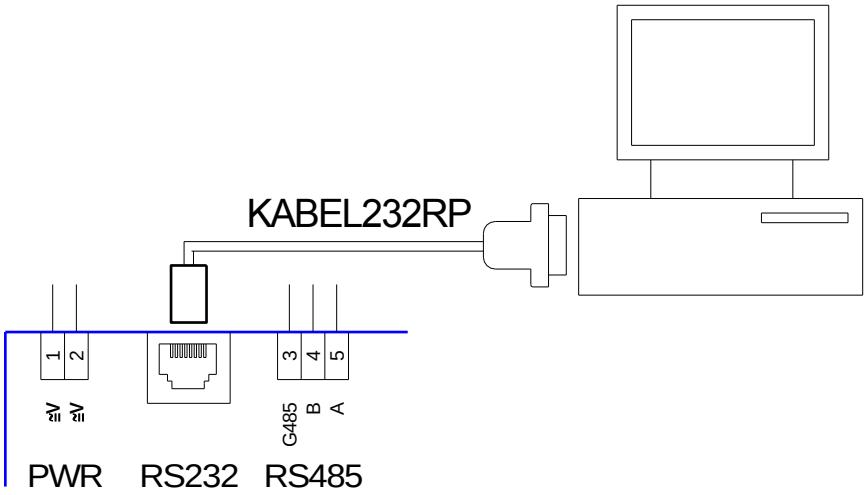

Fig. 16 - Interconnection of control system with PC

Connector location

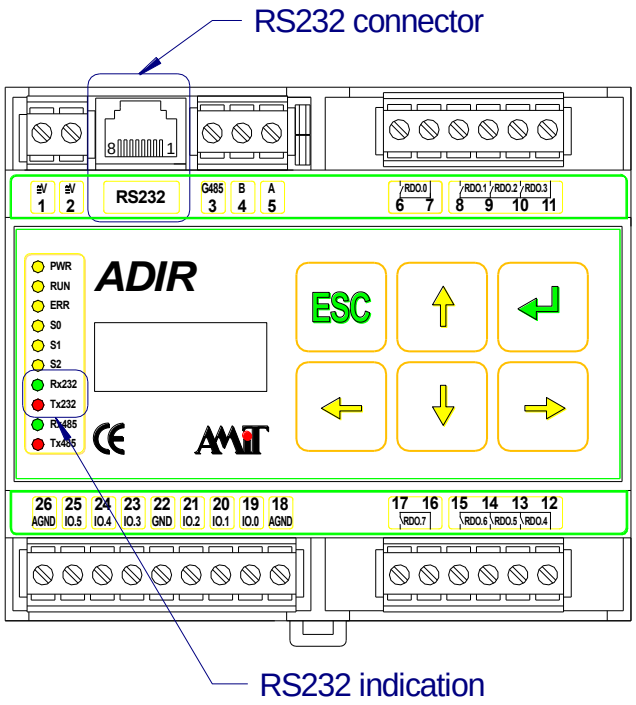

Fig. 17 - Connector and RS232 line indication

Modem connection **DM-GSM** or **DM-GPRS** modem can be connected directly to **ADIR** control system. **KABEL232RR** cable can be used.

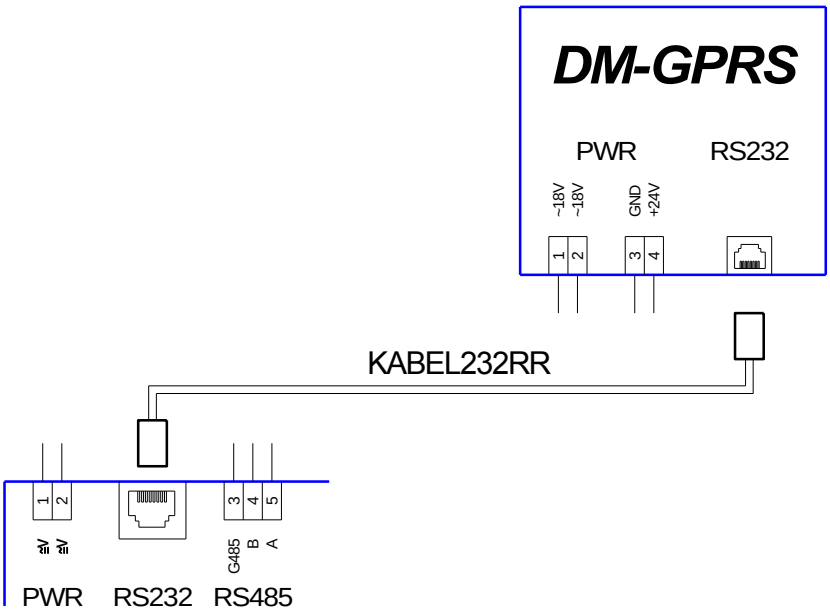

Fig. 18 - Interconnecting with GPRS modem

5.2. RS485

RS485 is a half-duplex serial interface. It can be utilized for interconnection of multiple units (up to 32 within single line segment). All units can communicate through single signal pair.

Location of RS485 line terminals

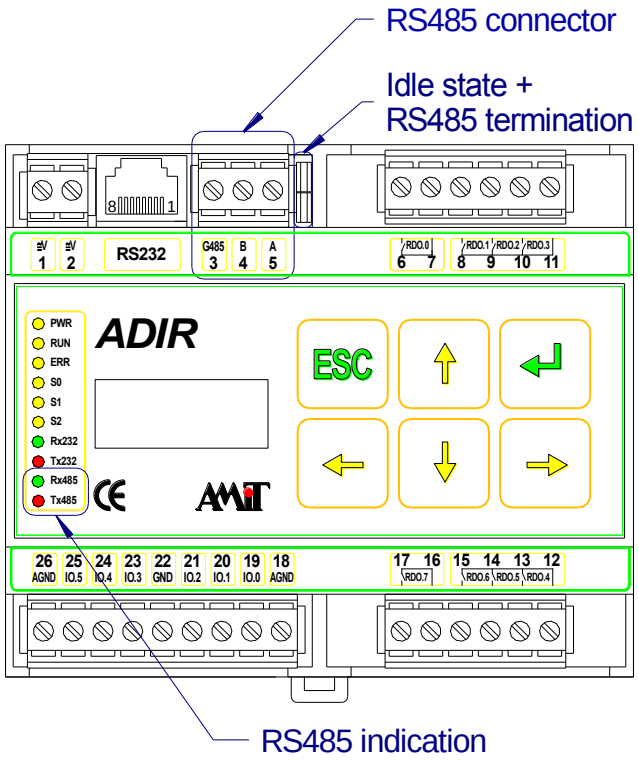

Fig. 19 - Connector and RS485 line indication

Connector numbering

Terminal	Label	Description
3	G485	RS485 line ground
4	B	RS485 line, signal B
5	A	RS485 line, signal A

Wiring example

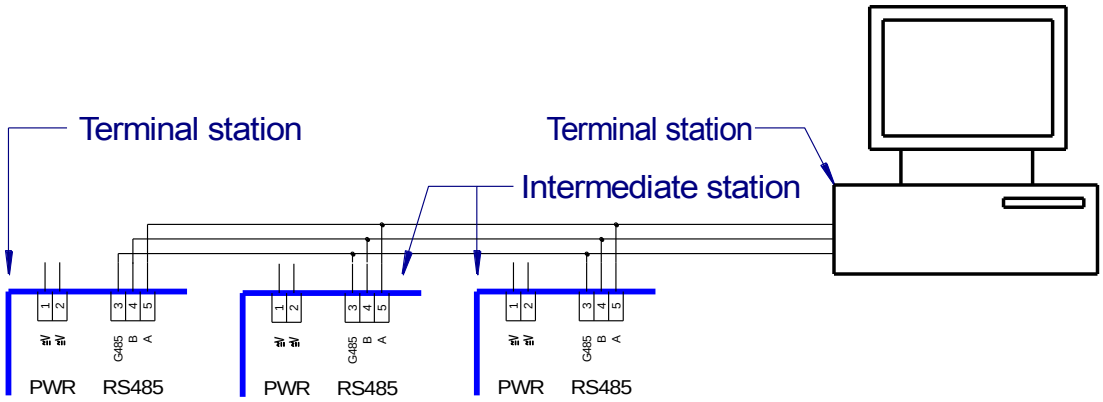

Fig. 20 - Single segment of RS485 line

Terminal stations Both jumpers are installed.

Intermediate stations Both jumpers not installed.

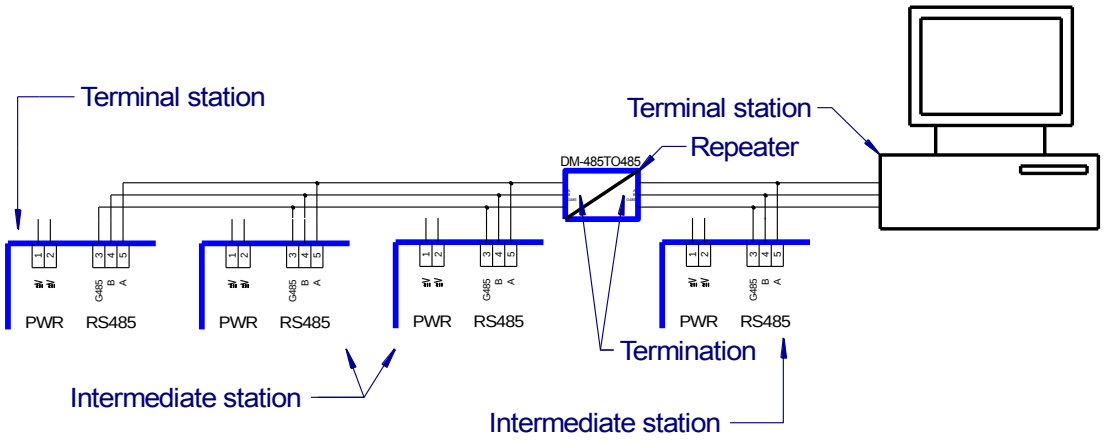

Fig. 21 - Separation of RS485 line segment

Wiring scheme Wiring diagram of the protective circuits and connection of termination and idle state defining resistors.

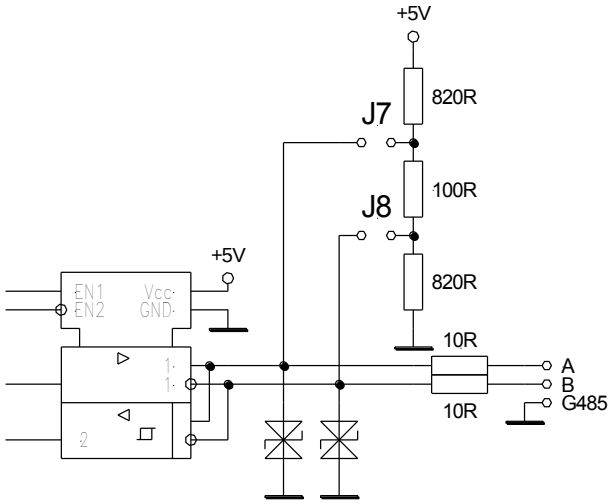

Fig. 22 - Wiring diagram of protections and RS485 line termination

Rules for using

- Maximum segment length 1200 m / 19200 Bd
- Maximum 32 stations
- Maximum station distance from ongoing line (T segment length) 3 m
- Connect the termination resistors on terminal stations (as well as resistors for idle state definition)
- Termination resistors must not be used on intermediate stations
- Cable: Shielded twisted cable
- Cable shielding shall be connected to the RS485 line connector shielding terminal. PE terminal (direct earthing) is connected to the line segment at single point.
  In other connecting points the shielding shall be connected with switchboard PE terminal over lighting arrester (indirect earthing)
- For reliable function, it is necessary to carefully consider the use of surge protectors

6. Connectors and terminals layout

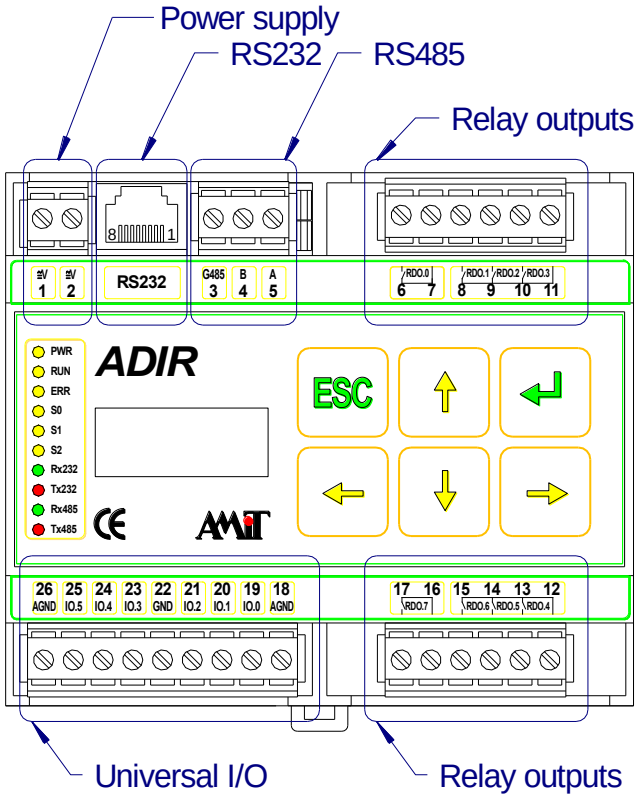

Fig. 23 - Connectors on the control system **ADIR**

Terminal	Label	Description
1	≅V	Control system power supplying
2	≅V	Control system power supplying
3	G485	RS485 line ground
4	B	RS485 line, signal B
5	A	RS485 line, signal A
6	RDO.0	RDO.0 output
7	RDO.0	RDO.0 output
8	RDO.1	RDO.1 output
9	RDO.2	RDO.2 output
10	RDO.3	RDO.3 output
11	RDO.1 to 3	Common contact RDO.1 to 3
12	RDO.4 to 6	Common contact RDO.4 to 6
13	RDO.4	RDO.4 output
14	RDO.5	RDO.5 output
15	RDO.6	RDO.6 output
16	RDO.7	RDO.7 output
17	RDO.7	RDO.7 output

Terminal	Label	Description
18	AGND	Ground terminal
19	IO.0	Universal input/output 0
20	IO.1	Universal input/output 0
21	IO.2	Universal input/output 0
22	GND	Ground terminal
23	IO.3	Universal input/output 0
24	IO 4	Universal input/output 0
25	IO 5.	Universal input/output 0
26	AGND	Ground terminal

Caution Terminal AGND (18, 26) are internally connected to the Terminal GND (22).

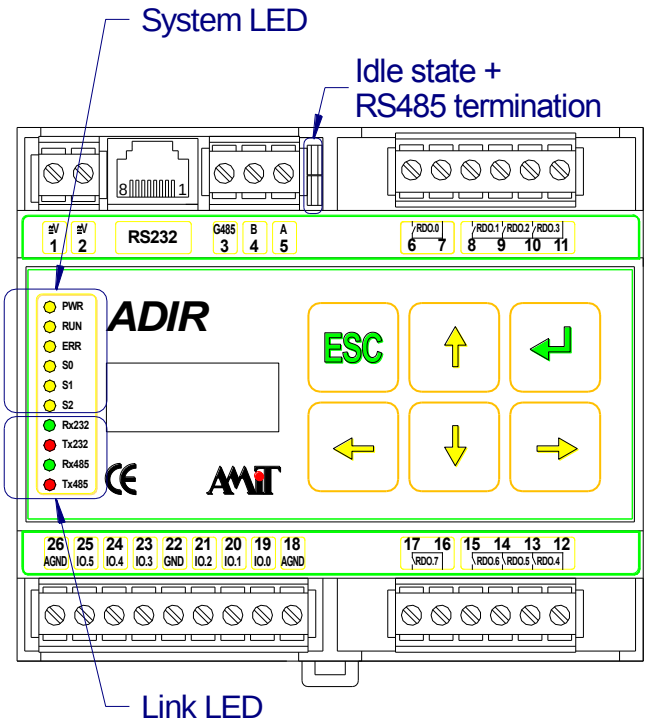

Fig. 24 - Distribution of switches and indicators

7. Configuration

7.1. Configuring the RS485 line

Only the RS485 line termination and idle state definition needs to be set on **ADIR** control system. Configuration jumpers are accessible without control system dismounting.

Jumpers fitted – termination is connected
Jumpers not fitted – termination is not connected

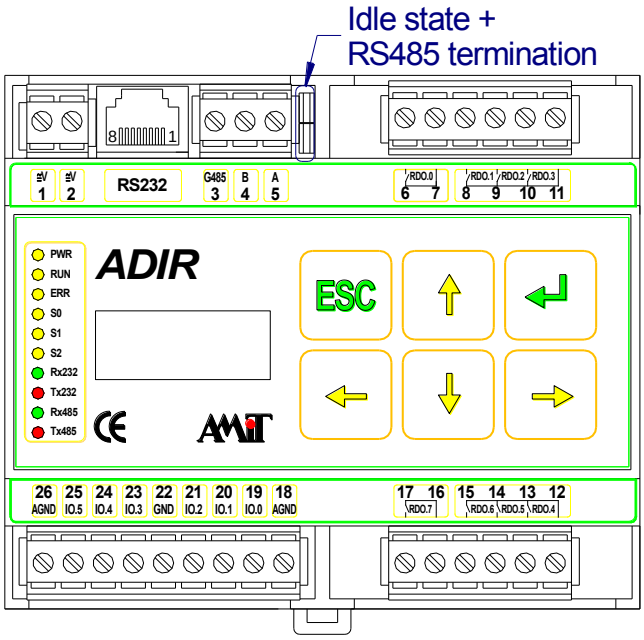

Fig. 25 - RS485 line termination

Other inputs, outputs, or RS232 line does not need to be set neither by switches, nor jumpers.

7.2. Control system settings

ADIR control system does not have any HW or SW configuration switches. HW and SW configuration is performed by keyboard and LCD.

If the **ESC** key is held during switching on the power supply voltage, the control system is switched into the bootstrap mode, where it is possible to upload the operating system.

After loading the OS, configuration menu can be invoked by pressing and holding the **ENTER** key during switching on the power supply voltage.

Menu item can be selected with up and down arrow, value can be changed with left and right arrow.

Settable parameters:

- System address in DB-Net network (0 – 31)
- DB-Net communication speed (9600 / 19200 / 38400 / 57600
- Communication interface for DB-Net (RS232 / RS485)
- Application run / block
- Repeated button pressing off / slow / fast
- Backlight intensity
- Contrast adjustment

After pressing **ENTER** – dialog window for saving is displayed, pressing **ESC** will exit configuration menu without saving changes.

8. Mounting

Control system is intended for DIN 35 mm rail mounting into plastic or metal switchboards.

8.1. Installation rules

EMC filter Depending on the design and character of wiring, we recommend to use EMC filter on the supply voltage 230 V AC input.

Connecting to PE Connect the terminal 22 (GND) to PE switchboards.

Digital I/O In environments with higher levels of interference and/or with longer cabling, shielded cables should be used. Connect the cable shielding to the PE terminal on switchboard inlet.

If the wires are led outside the building, it is necessary to use proper surge protection on the inputs and outputs.

Analogue inputs Use the shielded signal cables for wiring.
Shielding should be connected to the PE right on the switchboard inlet.

If the wires are led outside the building, it is necessary to use proper surge protection on the inputs.

RS485 channel Use shielded signal cables for wiring. Cable shielding should be connected to the RS485 line connector shielding and only at single point of line segment is connected to PE terminal (direct earthing), at another points through line arrester (indirect earthing).

It is possible to use the **DM-485TO485** repeater manufactured by AMiT for mutual separations of line segments.

RS232 channel When used only for service or utilized within the switchboard frame, only unshielded flat communication cable can be used.

When permanently used outside the switchboard, use shielded wiring. Connect the cable shielding to the PE terminal just on switchboard inlet.

Note All PE connections must be executed with as low impedance as possible. Technical parameters of unit are guaranteed only when these wiring rules are applied.

Caution! **Clamps ≅V and ≅V (1 and 2) must not be connected with neither GND, nor AGND of control system!**

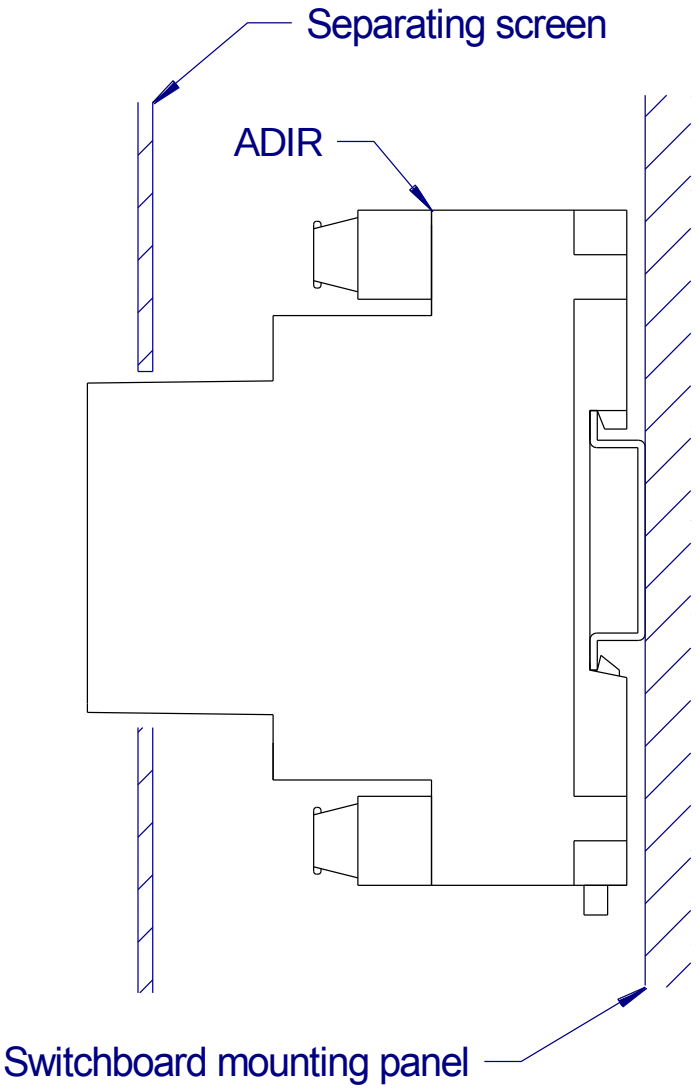

Fig. 26 - Example of the installation of the control systém

9. Ordering information and completion

Control system

ADIR	Control system with RS485 interface, complete WAGO connector set, operating manual, warranty list

Warning: Since 1. 3. 2008 ADIR control system is delivered only with mounted RS485 line.

Connection to PC

KABEL 232RP	Connection cable RS232 PC-**ADIR**

This cable is used for uploading programs to the control system and for debugging.

Transformer

TRF01	Power transformer for the **ADIR** control system – 230 V AC / 5 VA, on DIN rail 35 mm

If any other transformer than **TRF01** is used, **ADIR** control system might not work properly, or even be damaged.

9.1. Factory settings

RS485 configuration Both jumpers for line termination and idle state definition are fitted.

10. Maintenance

The control system does not require any regular inspection or maintenance except for the control voltage of the backup battery.

Backup battery Backup battery is used for backing up programs and parameters into the RAM memory. Its nominal voltage is 3.0 V DC; nominal capacity is 1 Ah. If the voltage drops below 2.7 V, battery is considered to be discharged. If this occurs, it must be replaced.

Inspection must be carried out once every five years. With reference to manufacturer, the assumed battery lifetime is 10 years.

Cleaning Time after time, depending on the device usage, it is necessary to remove dust from control system. The control system is to be cleaned off by dry brush, soft brush or a vacuum cleaner.

Note **The maintenance mentioned above can be performed by manufacturer or authorized service only!**

11. Waste disposal

Electronics disposal Control system electronics disposal is governed by Waste Electrical and Electronic Equipment directives. The equipment must not be disposed together with common public waste. It must be delivered to places specified for that purpose and recycled.

Battery disposal Control system contains a lithium battery. The battery is a hazardous waste. Therefore, it must be delivered to places specified for that purpose. Disposal of worn-out batteries and accumulators must not be in contrary to valid regulations.