AMR-RTV20/DM

Heat source controller

Operation manual

Version 1.01

AMiT

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Contents

History of revisions

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Revision	Date	Changes
100	25. 9. 2013	New document.
101	26. 5. 2014	Chapters 1, 2, 4, 5.1, 7 and 9 correction. Figure corrections.

Related documentation

1. DetStudio development environment help

2. Application Note AP0016 – Principles of RS485 interface usage
   file: ap0016_en_xx.pdf

3. Application Note AP0025 – ARION Network Communication – definition by table
   file: ap0025_en_xx.pdf

4. Application Note AP0050 – Project documentation for AMiT company products
   file: ap0050_en_xx.pdf

1 Introduction

AMR-RTV20/DM is a small compact programmable controller in a plastic box. It is possible to operate four outputs manually and read outputs state retrospectively.

This controller is supplied with Loader only. Required software must be loaded into controller before first use.

Basic features
- 4 relay outputs
- 4 relay outputs with AUT / 0 / 1 settings
- Retrospective reading of automatic / manual switch state
- 2 universal inputs Ni1000 / Pt1000 / contact / 0 mA to 20 mA
- 6 universal inputs Ni1000 / Pt1000 / contact
- RS485 interface with galvanic isolation
- DIN 35 mm rail mounting

2 Technical parameters

CPU		
	CPU	ST32F103
	FLASH	512 KB
	RAM	64 KB
	EEPROM	2 KB

Universal inputs		
	Number of inputs	8
	Inputs type *)	2 × analogue 0 mA to 20 mA / / Ni1000 / Pt1000 / dry contact 6 × Ni1000 / Pt1000 / dry contact
	Inputs distribution	1 × 8
	Input accuracy	0 mA to 20 mA < 1 % Ni1000/6180 ppm ±0.5 °C Ni1000/5000 ppm ±0.6 °C Pt1000 ±0.8 °C
	Temperature dependence	70 ppm/°C
	Input overvoltage protection	Diodes
	R_{Max} for log. 1	< 1000 Ω
	R_{Min} for log. 0	> 1300 Ω
	Galvanic isolation	No
	Connection point	WAGO 231-309/102-000
	Wire cross section	0.08 mm^2 to 2.5 mm^2

Note *) Ni1000 is with sensitivity 6180 ppm / 5000 ppm.

Warning Terminal AGND (6) is internally connected with terminal GND (4).

Relay outputs A / 0 / 1		
	Number of outputs	4
	Output type	4 × closing contact
	Output groups	4 Each relay separately
	Output mode	AUT / normally opened / normally closed *)
	Operation mode selection	Lever switch on the cover
	Retrospective switch state reading	Yes
	Contacts protection	Varistor
	Galvanic isolation	Yes
	Insulation strength GI	4000 V AC
	Rated voltage (resistive load)	230 V AC / 24 V DC
	Rated current (resistive load)	6 A max.
	Rated power force (resistive load)	1500 VA AC / 144 W DC
	Operate time	10 ms
	Release time	5 ms
	Contact lifetime Without load Nominal load	2×10^7 switches 1×10^5 switches
	Switch state indication	LED on cover
	Connection points	WAGO 231-302/102-000
	Wire cross section	0.08 mm^2 to 2.5 mm^2

Note *) Power supply voltage +24 V must be connected to the controller for correct function of Normally closed mode.

Relay outputs

Number of outputs	4
Output type	4 × closing contact
Output groups	2 2 outputs share same terminal
Contacts protection	Varistor
Galvanic isolation	Yes
GI insulation strength	4000 V AC
Rated voltage (resistive load)	230 V AC / 24 V DC
Rated current (resistive load)	2 A max.
Rated power force (resistive load)	500 VA AC / 50 W DC
Common terminal maximum current	8 A
Operate time Release time	10 ms 5 ms

Contact lifetime
   Without load
   Nominal load
	
	2×10^7 switches
	1×10^5 switches

Switch state indication	LED on cover
Connection points	WAGO 231-303/102-000
Wire cross section	0.08 mm^2 to 2.5 mm^2

RS485

Overvoltage protection	Transil 600 W
Galvanic isolation	Yes
Insulation strength	500 V AC / 1 minute *)
Terminating resistor	120 Ω on the controller **)

Idle state definition **)
   up to +5 V
   up to 0 V
	
	1 kΩ on the controller
	1 kΩ on the controller

Maximum wire length	1200 m / 19200 bps
Max. number of stations on segment	63
Operation indication	LED on cover
Connection point	WAGO 231-303/102-000
Wire cross section	0.08 mm^2 to 2.5 mm^2

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

Power supply

Nominal power supply voltage	24 V DC
Power supply voltage range	19.2 V DC to 28.8 V DC
Power consumption	Max. 140 mA at 24 V DC
Connection point	WAGO 231-303/102-000
Wire cross section	0.08 mm^2 to 2.5 mm^2

Mechanics

Mechanical design	Plastic box
Mounting	DIN 35 mm rail mounting
Equipment protection class	II
Ingress protection rate	IP20
Signal connection	Connectors WAGO 231
Maximum wire cross section	2.5 mm^2
Weight – netto – brutto	0.29 kg ±5 % 0.33 kg ±5 %
Dimensions (w × h × d)	(106 × 90 × 75) mm

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

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

2.1   Dimensions
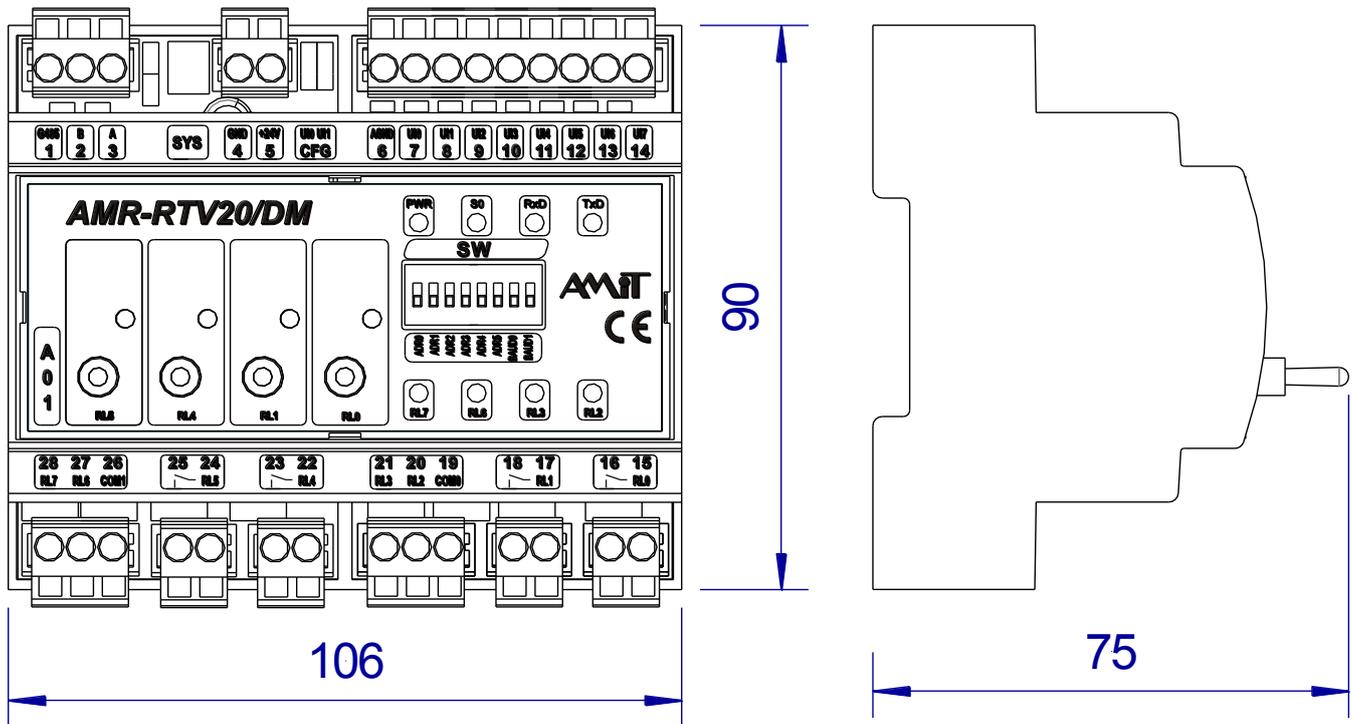
Fig. 1 – **AMR-RTV20/DM** dimensions

2.2   Recommended drawing symbol

Following drawing symbol is recommended for the controller **AMR-RTV20/DM**. Only part of it will be visible in following examples.
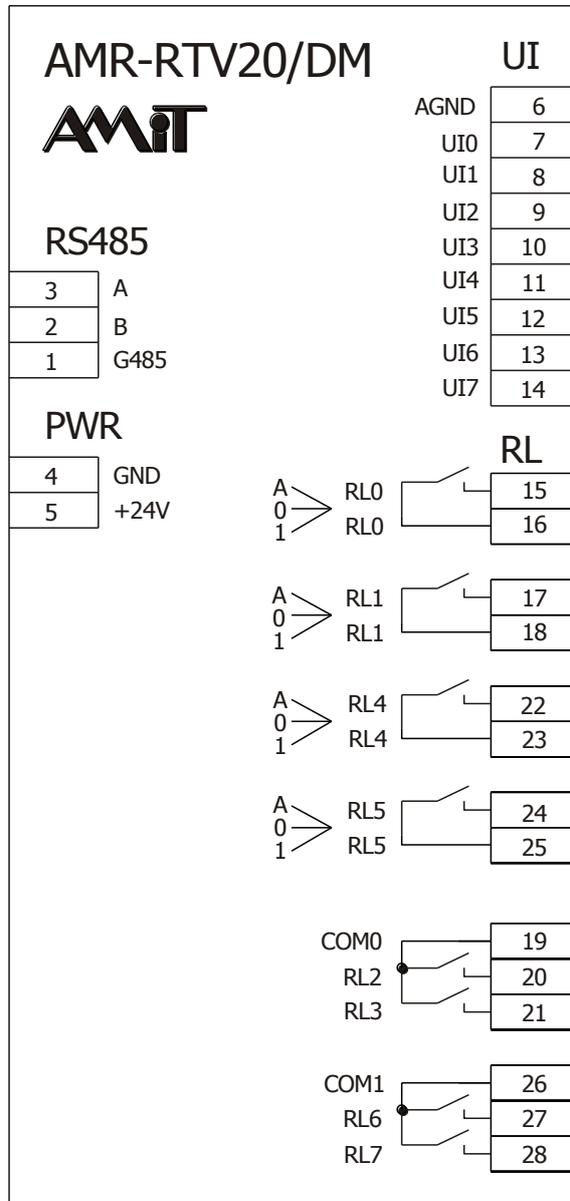
Fig. 2 – Recommended drawing symbol for **AMR-RTV20/DM**

3   Conformity assessment

This equipment meets the requirements of NV616/2006 and NV17/2003 Czech Government Decree. 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	Classification
EN 55011:2009	Industrial, scientific and medical equipment – Radio-frequency disturbance characteristics – Limits and methods of measurement	Class A *)
EN 61000-4-2:2009	Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test	Complies
EN 61000-4-3:2006	Electromagnetic compatibility (EMC) – Part 4-3: Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test, 80 MHz to 1000 MHz	10 V/m
EN 61000-4-3:2006	Electromagnetic compatibility (EMC) – Part 4-3: Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test, 1000 MHz to 2000 MHz	3 V/m
EN 61000-4-3:2006	Electromagnetic compatibility (EMC) – Part 4-3: Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test, 2000 MHz to 2700 MHz	1 V/m
EN 61000-4-4:2012	Electromagnetic compatibility (EMC) – Part 4-4: Testing and measurement techniques – Electrical fast transient/burst immunity test, power supply	±2 kV
EN 61000-4-5:2006	Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement techniques – Surge immunity test	±2 kV
EN 61000-4-6:2009	Electromagnetic compatibility (EMC) – Part 4-6: Testing and measurement techniques – Immunity to conducted disturbances, induced by radio-frequency fields	3 V
EN 61010-1:2010	Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 1: General requirements	Complies

*)   This is device of Class A. In the internal environment this product can cause some radio disturbances. In such case the user can be requested to take the appropriate measures.

3.1 Other tests

Tested in accordance with standard	Type of test	Classification
EN 61000-4-29:2000	Electromagnetic compatibility (EMC) – Part 4-29: Electromagnetic compatibility (EMC) – Part 4-29: Testing and measurement techniques – Voltage dips, short interruptions and voltage variations on d.c. input power port immunity tests	Complies
EN 60068-2-1:2007	Environmental testing – Part 2-1: Tests – Test A: Cold	Complies
EN 60068-2-2:2007	Environmental testing – Part 2-2: Tests – Test B: Dry heat	Complies

4   Power supply

The controller **AMR-RTV20/DM** can be power supplied according to conditions in chapter "2 Technical parameters" by DC power supply.
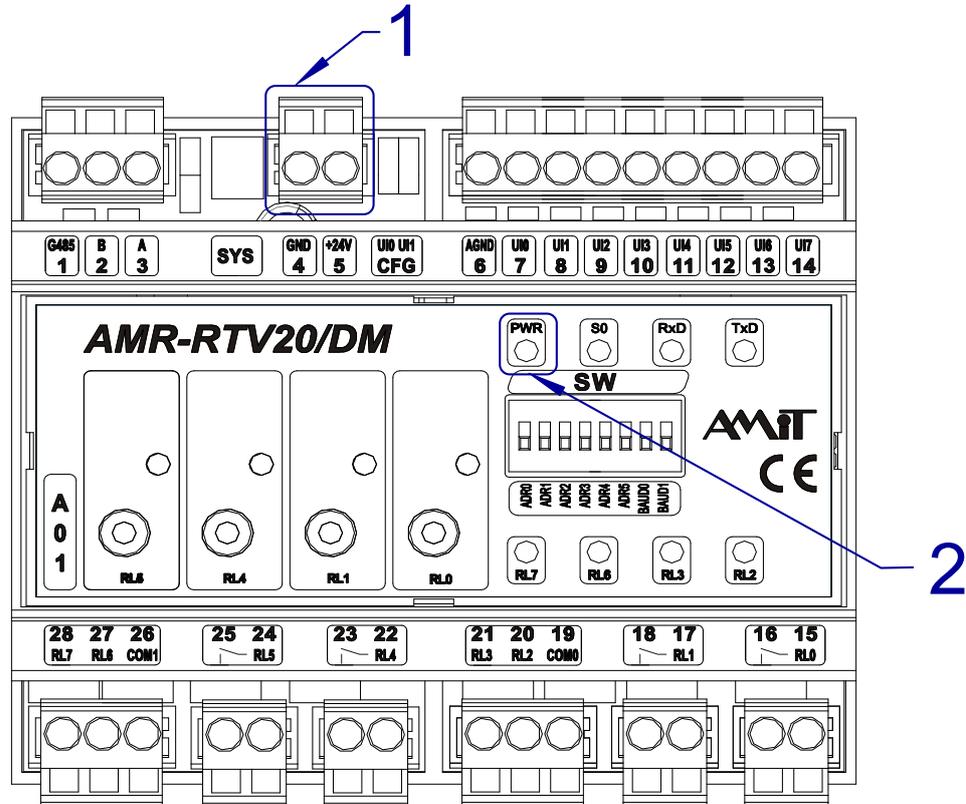
Fig. 3 – Power supply connector location

Legend

Number	Description
1	Power supply connector
2	LED, indicating connected power supply

Terminals marking

Terminal	Signal	Description
4	GND	Power supply Ground
5	+24V	Power supply +24 V DC

A presence of connector power supply voltage is indicated by LED PWR.

LED states description

LED	Description
ON	Power supply is connected.
OFF	Power supply is not connected.

Wiring example

AMR-RTV20/DM

PWR

| 5 | +24V |
| 4 | GND |

RS485

3	A
2	B
1	G485

+24V
GND

1
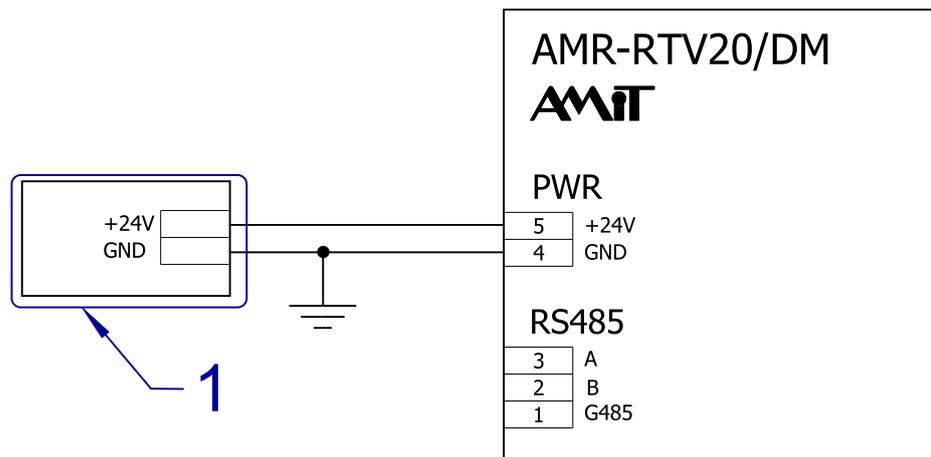
Fig. 4 – Power supply wiring example

Legend

Number	Description
1	External power supply 24 V DC

Note It is recommended to connect the terminals AGND (inputs ground) and GND with switchboard's PE terminal during the installation.

5 Inputs / outputs

5.1 Universal inputs

AMR-RTV20/DM contains 8 universal inputs. All inputs can be used as analogue inputs for sensors connection:

- Ni1000 with 6180 ppm or 5000 ppm sensitivity,
- Pt1000,

or as dry digital inputs.

Inputs UI0 and UI1 also can be independently configured also for range 0 mA to 20 mA through configuration jumpers.
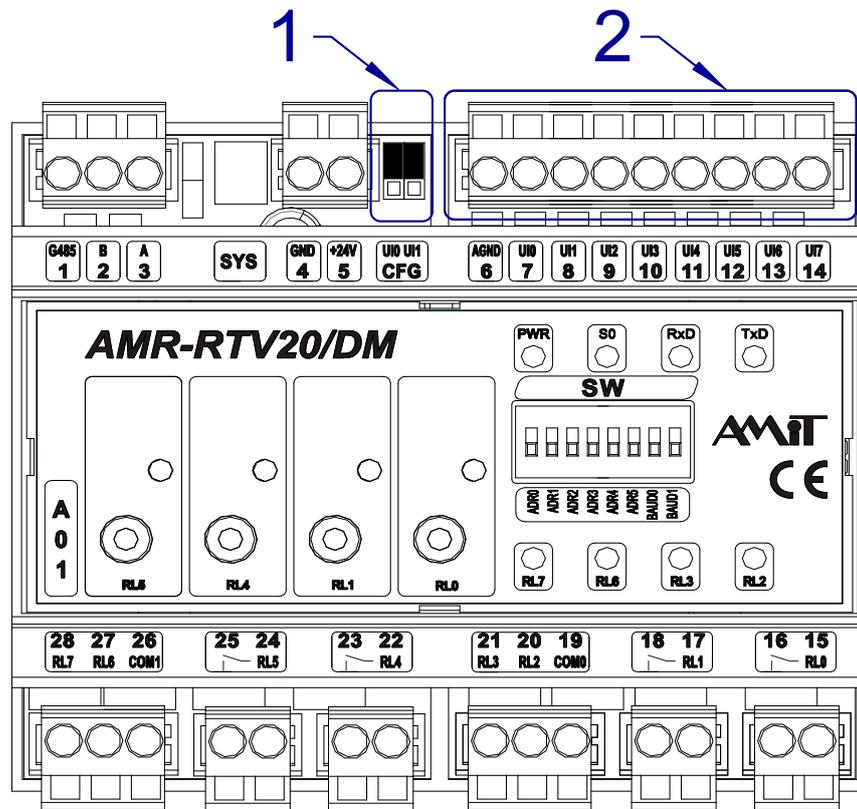
Fig. 5 – Universal inputs connector location

	Number	Description
Legend	1	Configuration jumpers
	2	Universal inputs
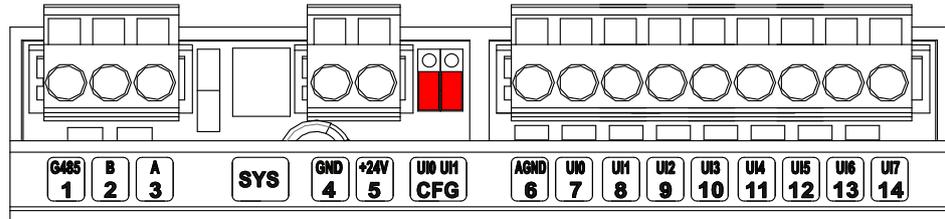
Fig. 6 – Configuration jumpers setting for mode Ni1000 / Pt1000
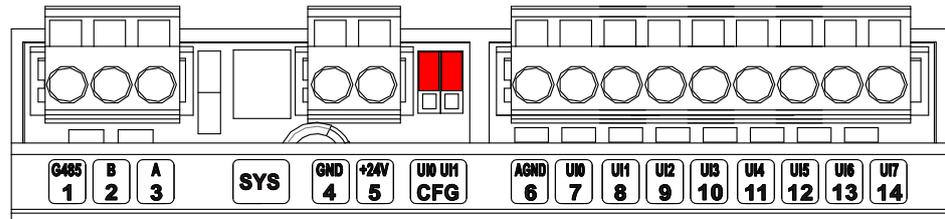
Fig. 7 – Configuration jumpers setting for range 0 mA to 20 mA

Connector marking

Terminal	Signal	Description
6	AGND	Universal inputs ground
7	UI0	Universal input 0
8	UI1	Universal input 1
9	UI2	Universal input 2
10	UI3	Universal input 3
11	UI4	Universal input 4
12	UI5	Universal input 5
13	UI6	Universal input 6
14	UI7	Universal input 7

Wiring examples
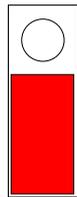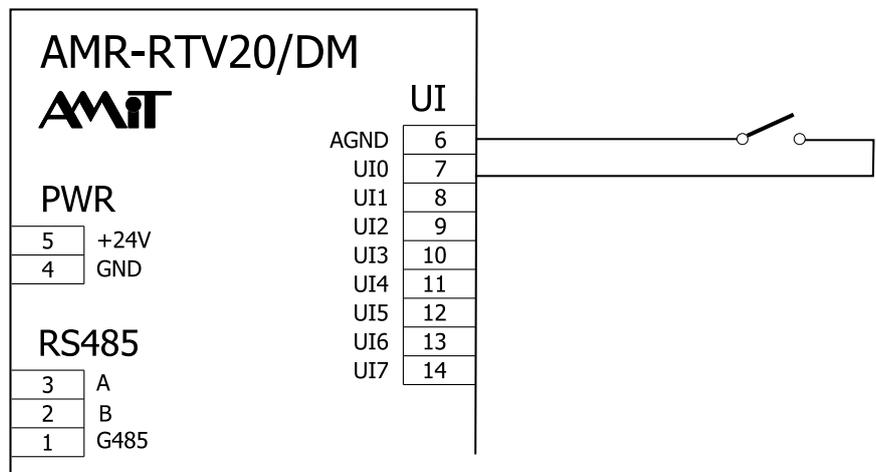
Fig. 8 – Dry contact wiring example
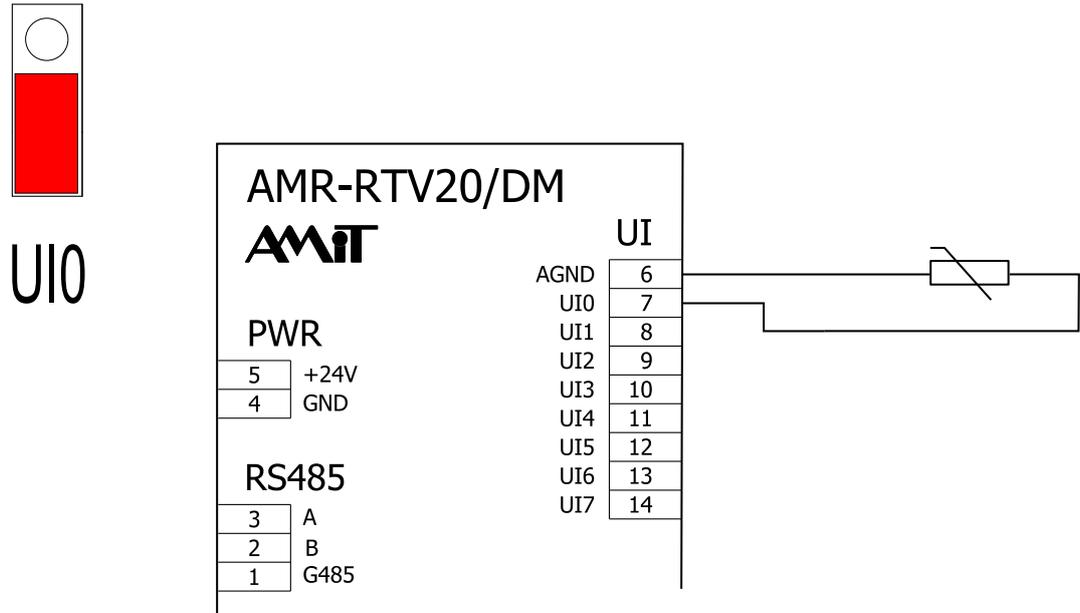
Fig. 9 – Sensors Ni1000 / Pt1000 wiring example
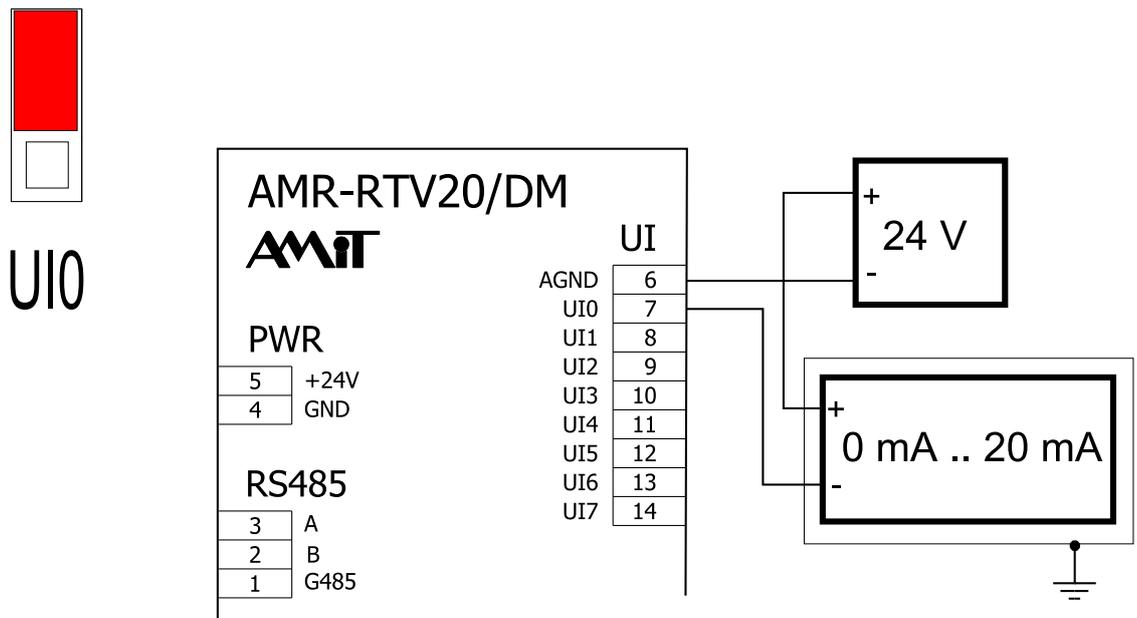
Fig. 10 – Sensor with output 0 mA to 20 mA (4 mA to 20 mA) wiring example

Note More details about shielding wiring and overvoltage protection are presented in Application Note AP0050 – Project documentation for AMiT company products.

5.2 Relay outputs

The controller **AMR-RTV20/DM** contains 2 × 2 relay outputs with common inlet and 4 independent relay outputs with mode selection possibility using a front panel switch.

Various phases of the mains voltage can be switched using single relays or groups of relays (one group can switch only one phase).
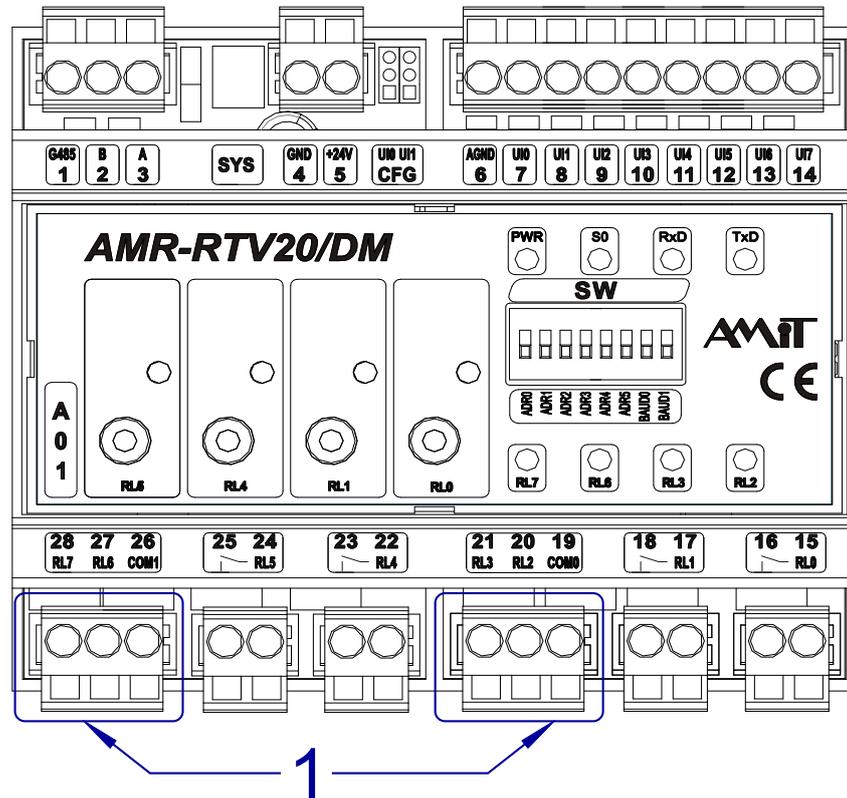
Fig. 11 – Location of relay outputs terminals with common contact

	Number	Description
Legend	1	Relay connectors with common inlet
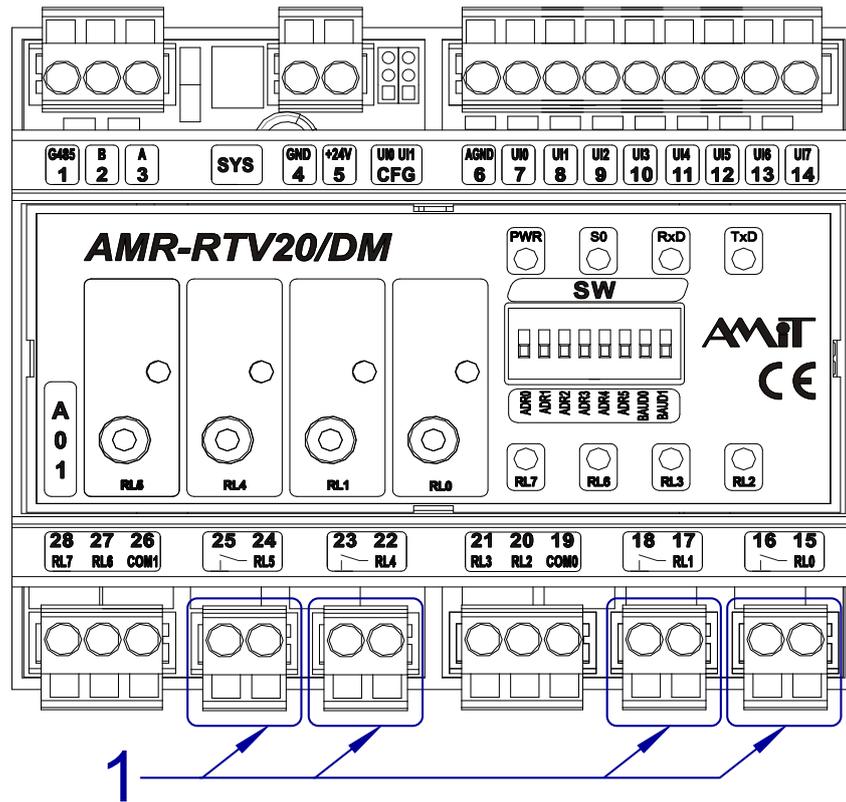
Fig. 12 – Location of relay outputs with mode selection

Legend

Number	Description
1	Relay connectors with mode selection

Connectors marking

Terminal	Signal	Description
15	RL0	Relay 0 terminals
16		
17	RL1	Relay 1 terminals
18		
19	COM0	Common terminal for relay 2 and relay 3
20	RL2	Relay 2 output
21	RL3	Relay 3 output
22	RL4	Relay 4 terminals
23		
24	RL5	Relay 5 terminals
25		
26	COM1	Common terminal for relay 6 and relay 7
27	RL6	Relay 6 output
28	RL7	Relay 7 output

5.2.1   Operation mode selection

Each relay with mode selection possibility can be switched to one of three modes using a lever switch located on the top cover:

- Relay is controlled automatically (AUT) by **AMR-RTV20/DM** software
- Relay is permanently opened (0)
- Relay is permanently closed (1)

Power supply voltage must be brought to the controller for correct operation of modes AUT and 1.
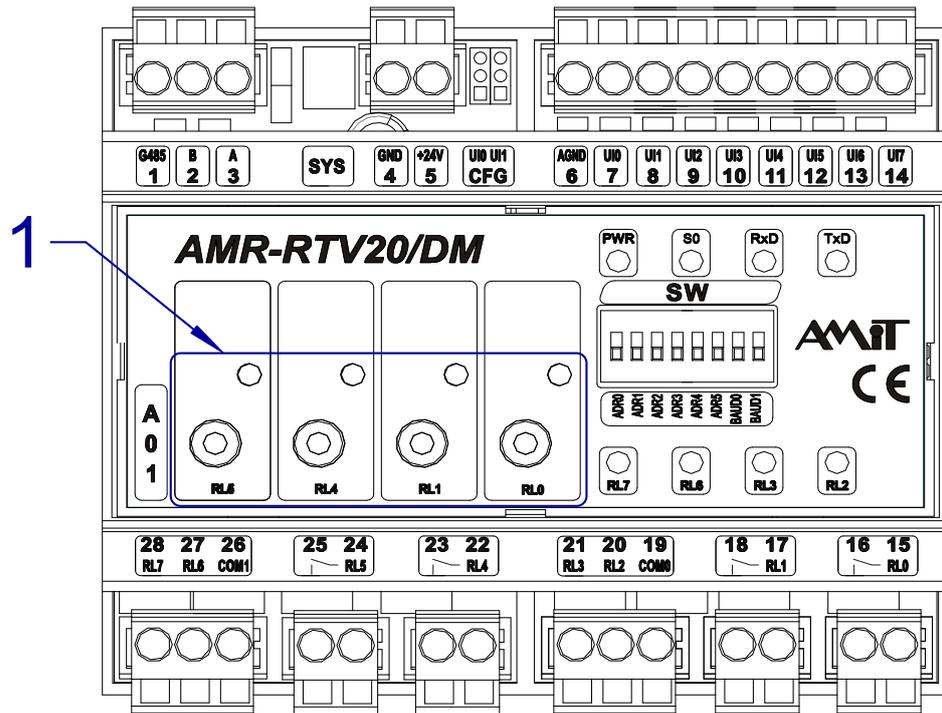
Fig. 13 – Switches location

Legend

Number	Description
1	Switches

Switches position description

Position	Label	Description
Up	A	Relay is controlled automatically by the program (AUT)
Middle	0	Relay is permanently opened (0)
Down	1	Relay is permanently closed (1)

5.2.2 Normally closed contact indication

Normally closed relay contacts are indicated by a relevant LEDs (they have the same number as the relay) located on the controller cover.
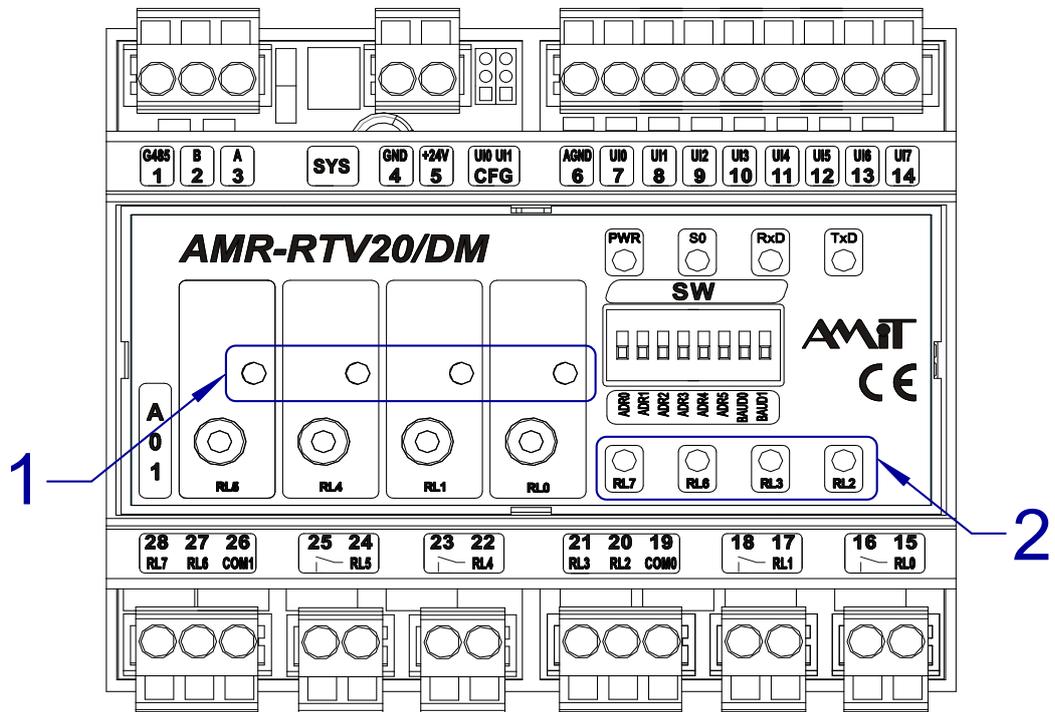
Fig. 14 – LED locations on **AMR-RTV20/DM** cover

Legend

Number	Description
1	LEDs for relays with mode selection
2	LEDs for relays with shared inlet

LED description

LED	Description
ON	Relay is normally closed
OFF	Relay is normally opened

6   RS485

The controller **AMR-RTV20/DM** is equipped with one RS485 communication interface that is galvanically isolated.

RS485 is used for multiple stations connection to the network. It is necessary to follow the rules mentioned in Application Note AP0016 – Principles of RS485 interface usage for correct working of RS485.

New software application can be uploaded into the controller through RS485.
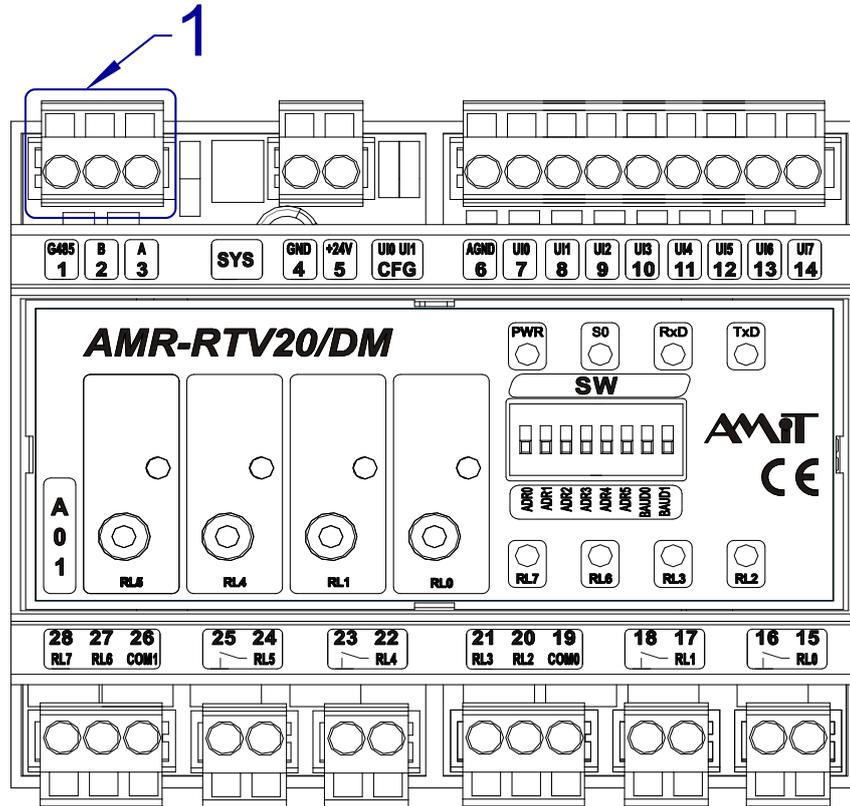
Fig. 15 – RS485 interface connectors location

	Number	Description
Legend	1	RS485 interface connector

Software operation   RS485 is labelled as COM0 in programming.

	Terminal	Signal	Description
Connectors marking	1	G485	RS485 interface, ground (shielding)
	2	B	RS485 interface, signal B
	3	A	RS485 interface, signal A

Configuration jumpers Each station on RS485 network must have wires terminating resistors and idle state definition properly set. Configuration jumpers located near the RS485 connector are used for termination setting.
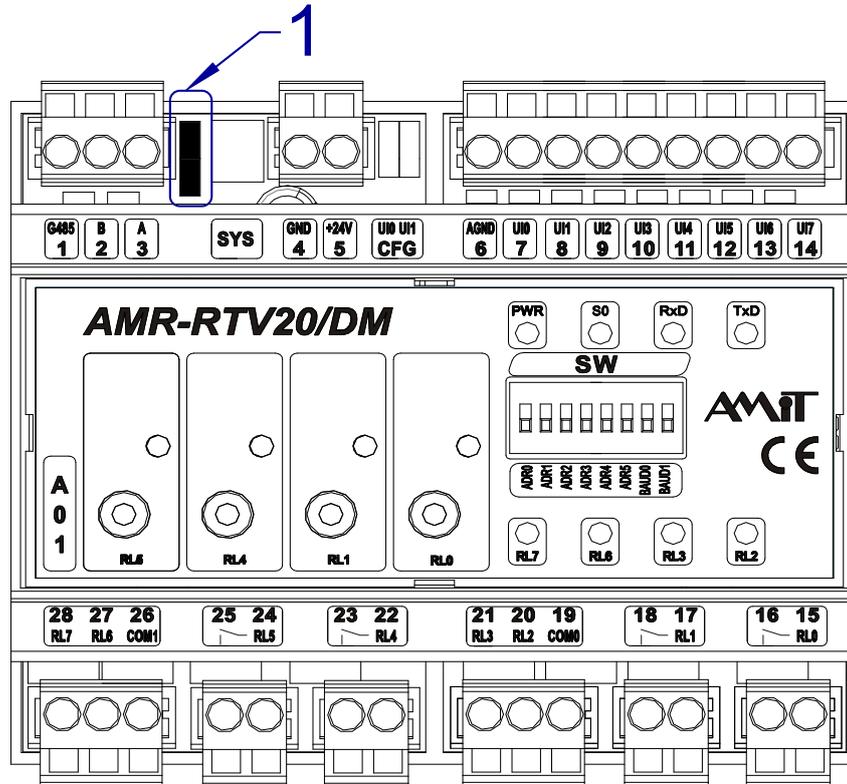
Fig. 16 – RS485 interface configuration jumpers

Legend

Number	Description
1	Configuration jumpers

Jumpers description

Jumper	Description
J10	Idle state + signal A termination
J11	Idle state + signal B termination

Jumpers	Description
Are set	End station, terminator is connected
Are not set	Intermediate station, idle state and wires termination is inactive

RS485 status LED RS485 interface activity is indicated by LEDs located on the controller cover.
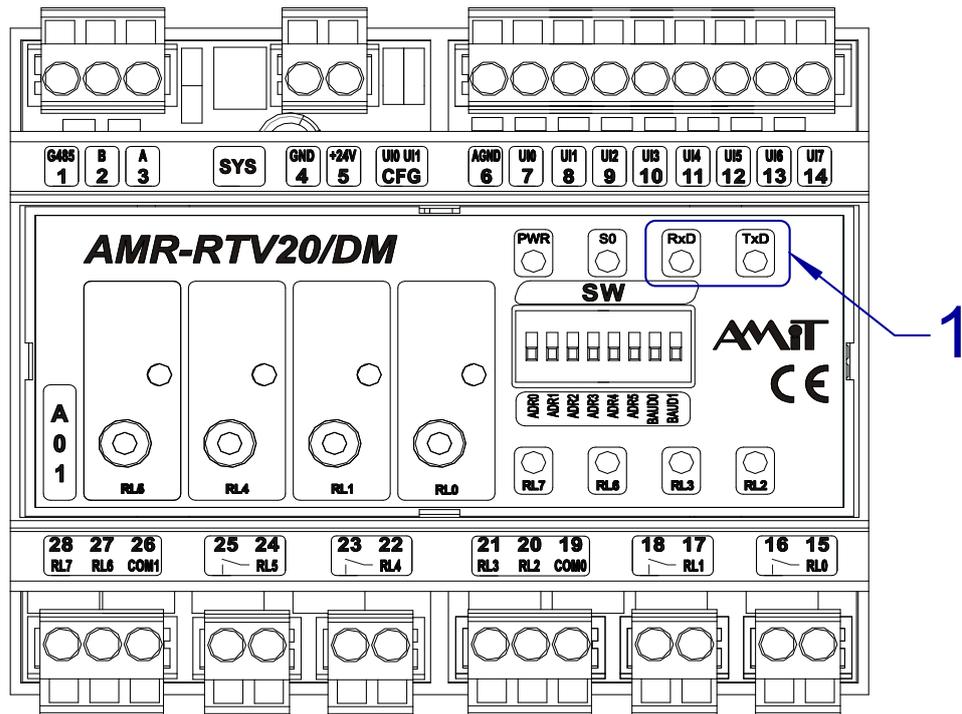
Fig. 17 – RS485 LED locations

Legend

Number	Description
1	LEDs for RS485

LEDs description

LED	Description
RxD	Controller is receiving data
TxD	Controller is transmitting data

7 Mounting

The controller **AMR-RTV20/DM** must be mounted into the switchboard. It is intended to be mounted on a 35 mm DIN rail in vertical or horizontal position. DIN rail position is fixed by lock on the bottom part of the controller.

If maximum ambient temperature is not exceeded, controller is cooled by natural air circulation.

If the module is used in other way than it is intended for, the controller protection can be violated.

Controller must be mounted so that terminals and bottom part of the controller are not available to operator – see the figure below. Using of residential LV switchboards is recommended.
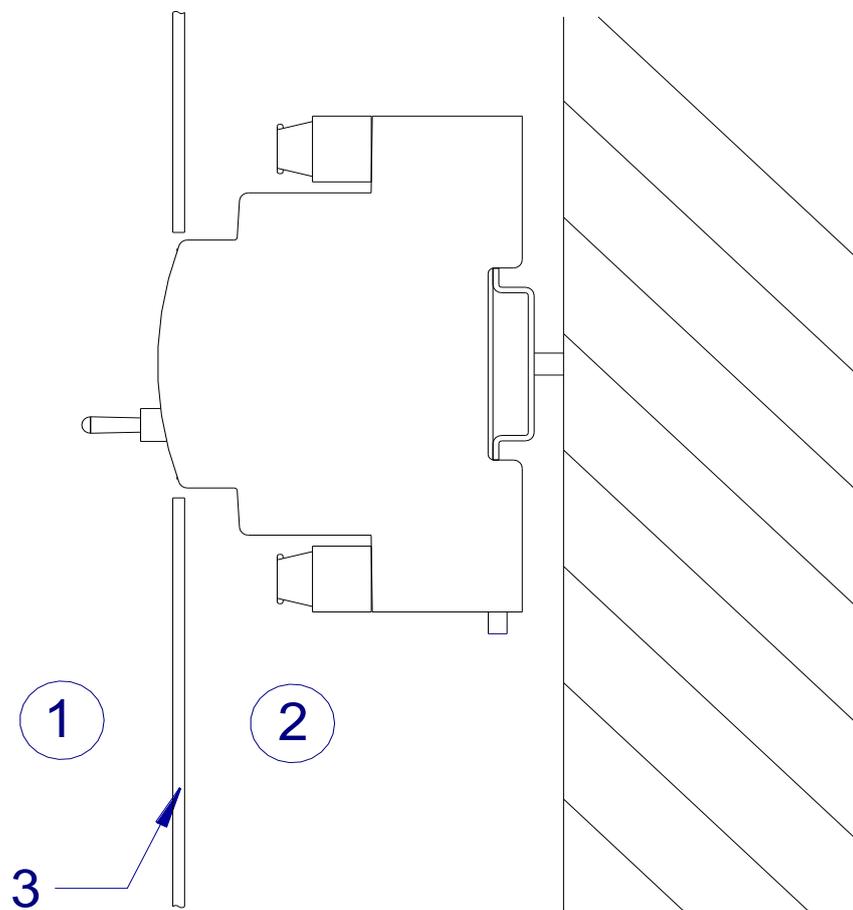
Fig. 18 – **AMR-RTV20/DM** mounting on a DIN 35 mm rail

	Number	Description
Legend	1	Accessible area by operator
	2	Inaccessible area by operator
	3	Separating barrier

7.1   Installation rules

Connect the controller's terminal GND (4) to the switchboard's PE terminal.

Universal
inputs   Connect the universal inputs terminal AGND (6) to the switchboard's PE terminal.

Realize the connection with PE on the switchboard input.

Use shielded wires for a digital input mode in environments with higher levels of interference and for longer cablings. Connect the shielding to the switchboard's PE terminal just on the input.

Use shielded cables for analogue input mode. Connect the cable shielding to the switchboard's PE terminal immediately on the input.

If the inlets are kept outside the building, the appropriate inputs need to be overvoltage protected.

Relay outputs   Cabling must be installed so that accidental release of any single wire does not bring main voltage on safe part and vice versa.

Maximum current in the bulb is higher than its nominal current. Even the short-time value of switched current must not overcome its maximum allowed value.

If the inlets are led outside the building, the appropriate outputs need to be overvoltage protected.

RS485
interface   It is necessary to perform RS485 interface connection according to recommendations in Application Note AP0016 – Principles of RS485 interface usage.

Note   All PE terminal connections must be realized with the lowest impedance as possible. Technical parameters of device are guaranteed only when these wiring rules are applied.

8   Programming and configuration

The controller **AMR-RTV20/DM** is factory-programmed with Loader only. The appropriate application software must be loaded into the controller before first use.

The controller is equipped with configuration switch (DIP). Individual switches description depends on used software application, i.e. different programs can use DIP switch in different ways.

A new application program can be created by using:
- DetStudio / EsiDet   development tool

An application can be uploaded into the controller using:
- DetStudio   development tool
- AMRconfig   service and programming utility
- AMR multidownload   multi-programming utility
- AppLoader   tool for uploading application

Programs can be downloaded from www.amitomation.com, Download section.

8.1   Loader

Loader running state is indicated by controller's LED S0 and can be used in cases the user application is causing any troubles, e.g. repeated restarts, controller connection inability, etc. The controller can be switched by service button to the Loader state.

8.2   Status LEDs and service button

LED S0 serves for module program status indication.
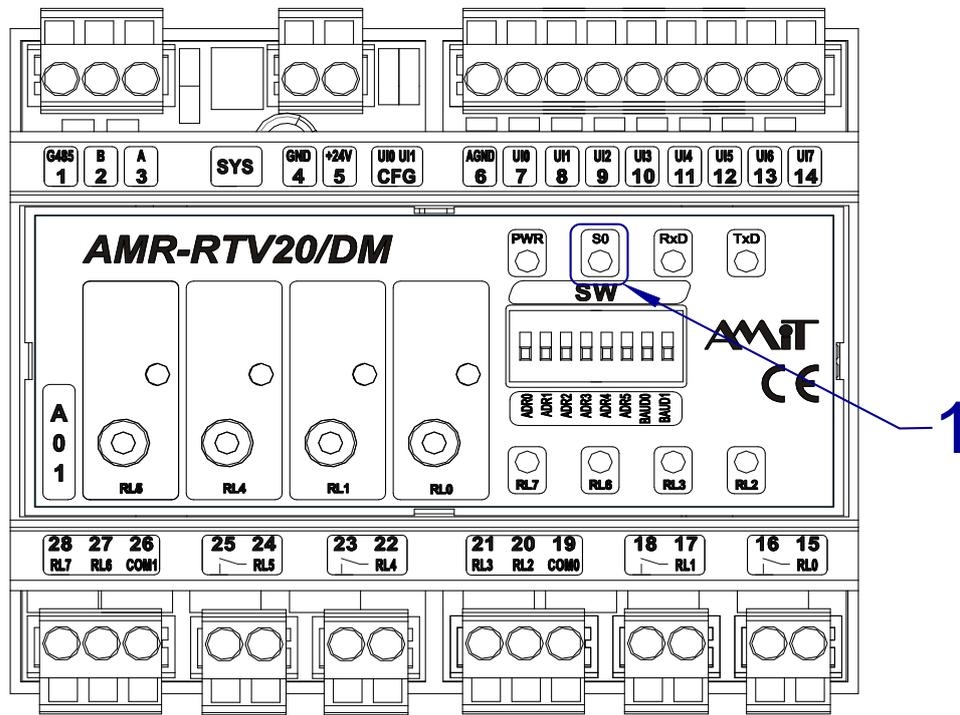
Fig. 19 – Status LED location

Legend

Number	Description
1	LED S0

Status LEDs

Light	Description
0.1 s flashing for 1 s period	Restart passage indication
Regular flashing with 0.2 s period	Loader is launched
Regular flashing with 1 s period	Application is launched
Irregular flashing with 0.5 s period	Running application is indicating error / warning. Irregular flashing means that 2 s pause follows after a particular number of flashes. Number of flashes between two pauses indicates numeric error code: 2 – error during reading from EEPROM 3 – suspiciously frequent writing to EEPROM 15 – unknown error
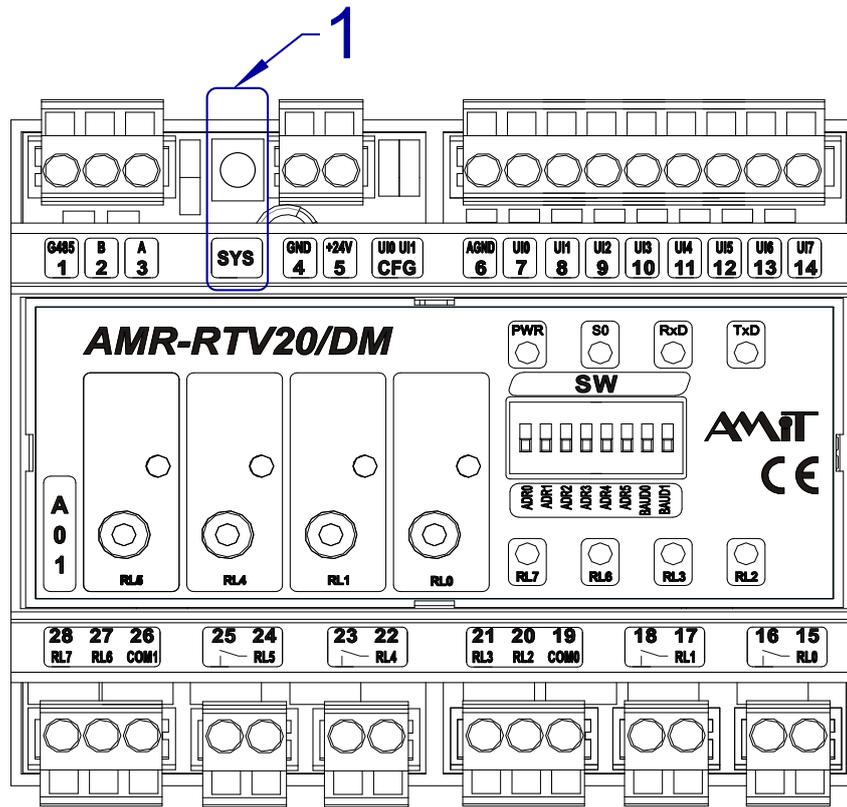
Fig. 20 – Service button SW3 location

	Number	Description
Legend	1	Service button SW3

	Button pressing	Action
Service button	> 1 s	The Loader with communication parameters set on a DIP switches is launched.

If any new application is loaded after the Loader is initiated, the original application can be started by switching the unit off and on again.

8.3 Communication parameters setting

DIP switches description for Loader and typical AMiT applications is described in this chapter. Each controller must have the address and communication speed set (**parity is always even**). Each controller on the network must have a unique address. Communication speed must be identical for all controllers. Configuration DIP switches with SW label are used for the address setting and communication speed setting. Communication parameter settings are identical for all protocols that can be operated on controller's RS485 interface.
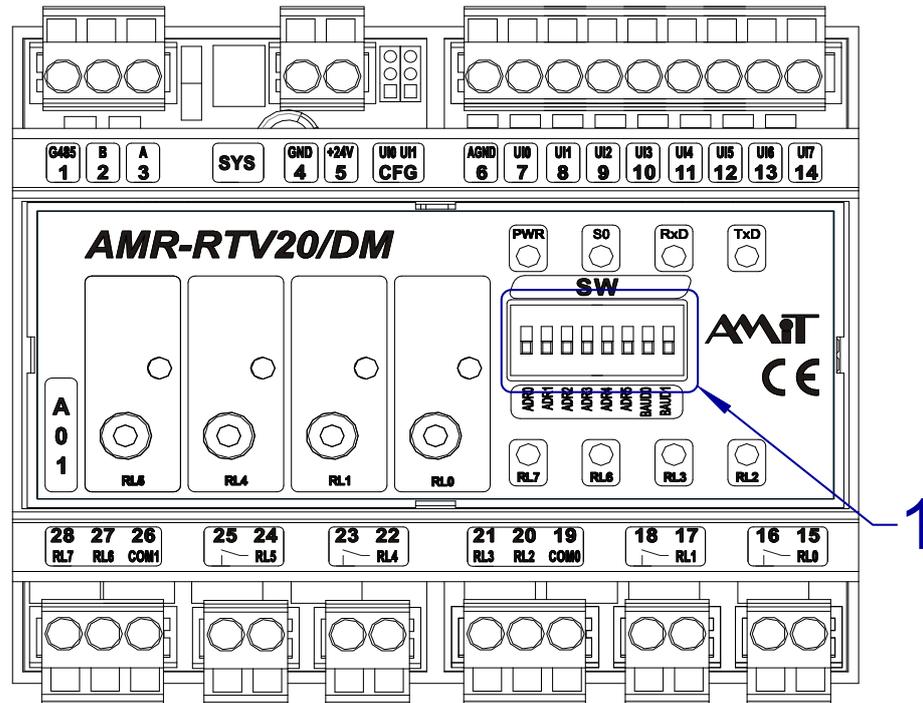
Fig. 21 – Location of configuration DIP switches

Legend

Number	Description
1	Configuration DIP switches

Switches description

Switch	Description
1, 2, 3, 4, 5, 6	Module address
7, 8	Communication speed

Individual switch values for setting the address and communication speed are described below.

Switches bit values

ADR0	Value of 1
ADR1	Value of 2
ADR2	Value of 4
ADR3	Value of 8
ADR4	Value of 16
ADR5	Value of 32

BAUD0	BAUD1	Communication speed
OFF	OFF	9600 bps
ON	OFF	19200 bps
OFF	ON	38400 bps
ON	ON	57600 bps

Module address setting

ADR0	ADR1	ADR2								
		ADR5	OFF	OFF	OFF	OFF	ON	ON	ON	ON
		ADR4	OFF	OFF	ON	ON	OFF	OFF	ON	ON
		ADR3	OFF	ON	OFF	ON	OFF	ON	OFF	ON
ADR0	**ADR1**	**ADR2**	**Module address in MODBUS network**							
OFF	OFF	OFF	X	8	16	24	32	40	48	56
ON	OFF	OFF	1	9	17	25	33	41	49	57
OFF	ON	OFF	2	10	18	26	34	42	50	58
ON	ON	OFF	3	11	19	27	35	43	51	59
OFF	OFF	ON	4	12	20	28	36	44	52	60
ON	OFF	ON	5	13	21	29	37	45	53	61
OFF	ON	ON	6	14	22	30	38	46	54	62
ON	ON	ON	7	15	23	31	39	47	55	63

X – Address 0 is not allowed (reserved for MASTER). Available address values are 1 to 63.

Settings example
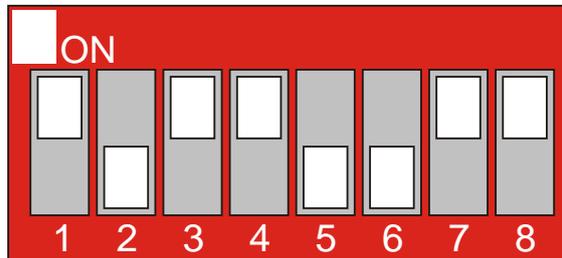
Fig. 22 – Address 13 is set, communication speed 57600 bps

Note *All position changes of individual switches take their effect only after restarting of extension module (i.e. power supply disconnecting and connecting).*

8.4 Factory setting, jumpers

RS485 configuration The RS485 interface is fitted with jumpers that activate the wires termination and idle state definition.

Universal inputs Configurable inputs (UI0 and UI1) are fitted with jumpers in position that sets these inputs into Ni1000 / Pt1000 mode.

9 Ordering information and completion

Heat source controller	**AMR-RTV20/DM**	Complete, see chapter 9.1 Completion

Others	**SB485S**	USB<->RS485 converter

A converter is used for debugging and uploading the application software into the controller **AMR-RTV20/DM**.

9.1 Completion

AMR-RTV20/DM

Part	Quantity
Heat source controller	1
WAGO 231-309/102-000	1
WAGO 231-303/102-000	3
WAGO 231-302/102-000	5
Operation manual	1

10 Maintenance

The device does not require any regular checking or service.

Cleaning Time after time with regard to a way of device usage, it is necessary to remove dust from inside electronics. The device can be cleaned by dry soft brush or vacuum cleaner, only when turned-off and disassembled.

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

11 Waste disposal

Electronics disposal The disposal of electronic equipment is subject to the regulations on handling electrical waste. The equipment must not be disposed in a common public waste. It must be delivered to places specified for that purpose and recycled.