Technical Manual for
RT-EX-9017

Version 2.01

8 x Analog Input (16 bit)

Introduction

The EX9017 MODBUS I/O Expansion module is a high-quality and low-cost add-on data acquisition device that allows expanding the on-board analog input capabilities on X32-based RTCU units almost indefinitely and completely transparent using MODBUS communication protocol.

The EX9017 uses EIA RS-485 - the industry's most widely used bi-directional, balanced transmission line standard. It lets the module transmit and receive data at high data rates over long distances.

The EX9017 can be used to expand the RTCU with additional 8 analog inputs.

The EX9017 can be configured to measure 6 different ranges, these are:
- $-10V \rightarrow 10V$
- $-5V \rightarrow 5V$
- $-1V \rightarrow 1V$
- $-500mV \rightarrow 500mV$
- $-150mV \rightarrow 150mV$
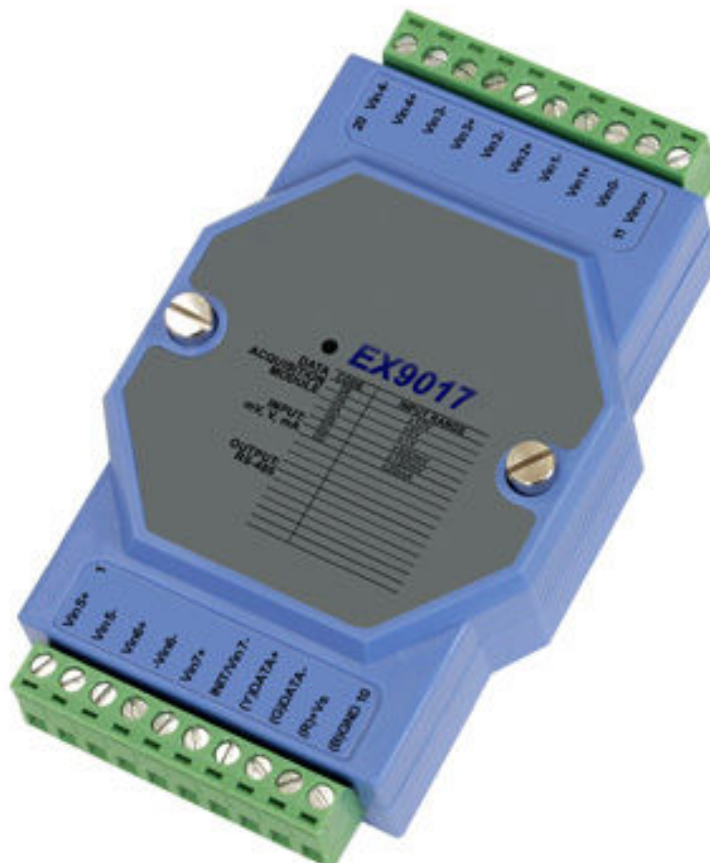- $-20mA \rightarrow 20mA$

The EX9017 works in a variety of environments and applications, including:
- Factory automation and control
- SCADA applications
- HVAC applications
- Remote measuring, monitoring and control
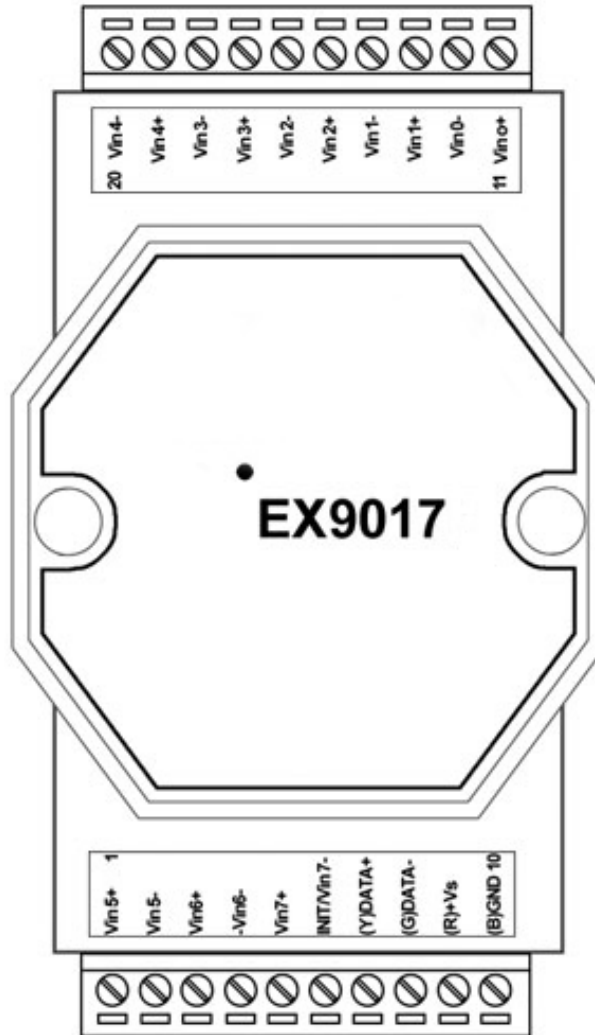- Security and alarm systems, etc.

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Graphical view

Pin Assignment

The 2 x 10-pins plug-terminals as seen in the following figure allow connecting supply, communication lines and analog inputs. The table below shows pin names and their function.

Pin	Name	Description
1	Vin5+	Positive differential input 5
2	Vin5-	Negative differential input 5
3	Vin6+	Positive differential input 6
4	Vin6-	Negative differential input 6
5	Vin7+	Positive differential input 7
6	INIT*/Vin7-	Shared for INIT* and negative differential input Vin7[1]
7	(Y)DATA+	RS485+ data signal
8	(G)DATA-	RS485- data signal
9	(R)+VS	(+) Supply. Please refer to the specification for correct voltage level

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[1] By default the pin is assigned to INIT*, but can be changed with jumper 1, see "Appendix B – Changing jumper 1".

Pin	Name	Description
10	(B)GND	Supply ground.
11	Vin0+	Positive differential input 0
12	Vin0-	Negative differential input 0
13	Vin1+	Positive differential input 1
14	Vin1-	Negative differential input 1
15	Vin2+	Positive differential input 2
16	Vin2-	Negative differential input 2
17	Vin3+	Positive differential input 3
18	Vin3-	Negative differential input 3
19	Vin4+	Positive differential input 4
20	Vin4-	Negative differential input 4

Please refer to the section "Wire Connections" for correct wiring to the external device/sensor.

Default Settings

Name	Description
Baud rate	9600
Data bits	8
Parity	None
Stop bit	1
Device address	1
Analog Input Type	-10 to +10 V
JP1 setting	INIT* mode (see "Appendix B – Changing jumper 1" on how to change)

These settings can easily be changed in RTCU IDE. Please refer to "Appendix A – Using the module as I/O extension in the RTCU IDE" for details.

LED Indicator

The EX9017 is provided with a system LED to indicate power status. In the following table description of the different states of the LED can be found:

Name	Pattern	Description
System	ON	Power on
	OFF	Power off

INIT* Pin Operation (Configuration mode)

The module has a build-in EEPROM to store configuration information such as address, type, baud rate and other information. Sometimes a user may forget the configuration of the module, or simply need to change it. Therefore, the module has a special mode named **"INIT mode"** to allow the system to change the configuration. To enable INIT mode, please follow these steps:

1. Power off the module.
2. Check the jumper 1[2], and make sure that pin 6 is set to **INIT***.
3. Connect the INIT* pin to the GND pin.
4. Power on the module.

The module is now ready to be configured, afterward remove the power and change jumper 1, if needed.

When using the RTCU IDE to change the setting, select "setup module" from the right-click menu of the node in "I/O – Extension" tree, and a guide will go through each step of the configuration process. Please refer to the RTCU IDE on-line help for further information.

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[2] To change see "Appendix B – Changing jumper 1"

Implementation

The minimum and maximum ranges in the six configurations are shown in the table below.

Range	Min. (INT)	Max.(INT)	Min.(DINT)	Max. (DINT)
-10V to 10V	-32768	32767	0	65535
-5V to 5V	-32768	32767	0	65535
-1V to 1V	-32768	32767	0	65535
-500mV to 500mV	-32768	32767	0	65535
-150mV to 150mV	-32768	32767	0	65535
-20mA to 20mA	-32768	32767	0	65535

It's recommended to assign the analog inputs to an INT for ease-of-use. Then the received result will be correct signed.

The analog input module has the same 16 bit resolution in each of the configurations, so for increased accuracy select the range which fits the application best.

Following tables illustrates which values are expected to be read, when a test value is applied to the inputs.

In the table below are the value when -100mV and 100mV is applied to the input in each of the voltage configurations.

-100mV and 100mV

| Range	-100mV (INT)	100mV (INT)	-100mV (DINT)	100mV (DINT)
-10V to 10V	-328	328	33096	328
-5V to 5V	-655	655	33423	655
-1V to 1V	-3277	3277	36045	3277
-500mV to 500mV	-6557	6557	39325	6557
-150mV to 150mV	-21845	21845	54613	21845

Configuring to read ±20mA and applying -1mA and 1mA results in the following

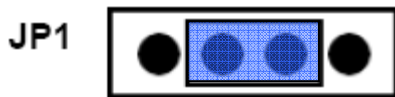| Range	-1mA (INT)	1mA (INT)	-1mA (DINT)	1mA (DINT)
-20mA to 20mA	-1638	1638	34406	1638

Please note, that the values are expressed as 2's complement, which means, that the negative values, when using DINT type, should be converted correctly. As an example, -1V in ±10V range returns a value of 62258, while -10V returns a value of 32768. The same is the case for the current input.
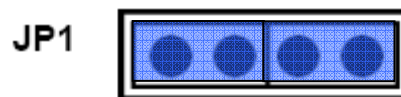
Wire Connections

When connecting devices to the input channels 0 to 5 please follow the wiring schemes below.
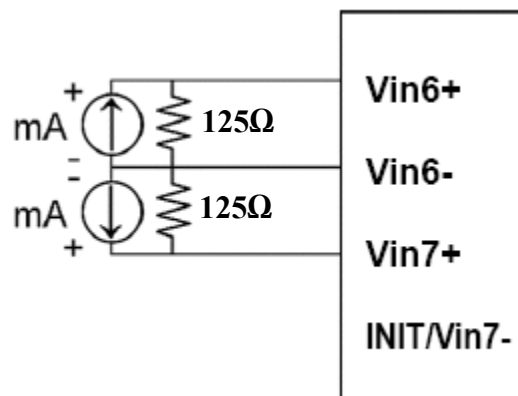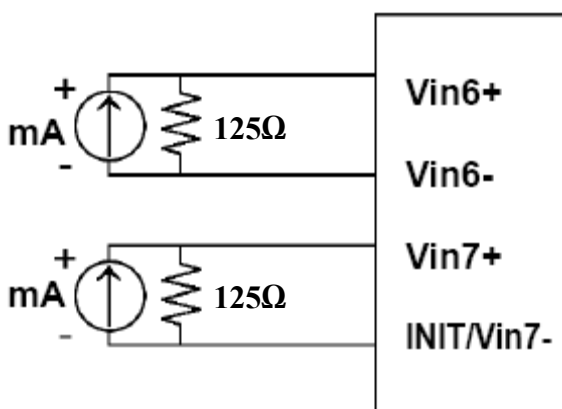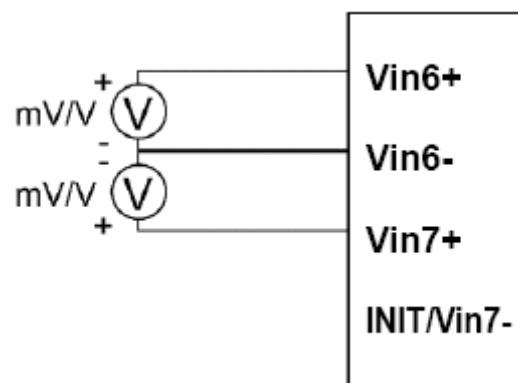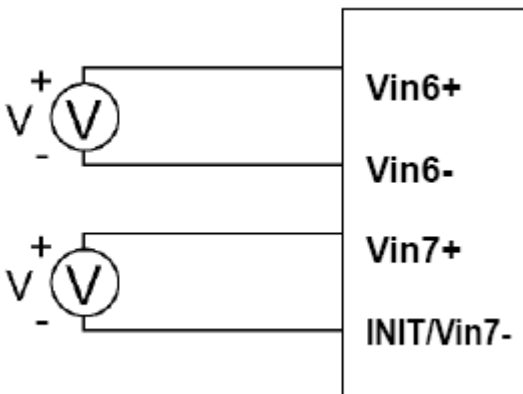Please note, that when connecting a current source, a **125 Ω** resistor should be connected as following.
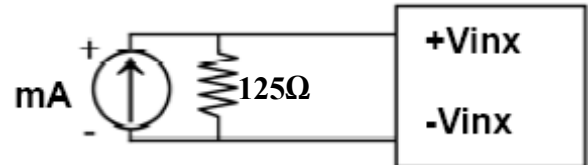
When connecting devices to the pin 5 and 6 please follow the wiring schemes below depending on the mode that has been set with jumper 1.

Vin7- mode

INIT* mode

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Technical Specifications

Resolution	16 bit
Input Channel	8 diff.
Sampling Rate	10 Hz
Voltage Input	+/- 150 mV +/- 500 mV +/- 1 V +/- 5 V +/- 10 V
Current Input	+/- 20 mA
Isolation	3000 V
Power Input	+10 V to + 30 V
Power Consumption	1,3 W
Operating Temperature	-25 ~ 75°C
Dual Watchdog Timer	√

Appendix A – Using the module as I/O extension in the RTCU IDE

To be able to use the MODBUS I/O Expansion module as an I/O extension, the RTCU IDE project needs to be configured correctly, by entering the correct parameters for the expansion module into the "I/O Extension device" dialog[3].

The following figure shows the correct setting for an EX9017 connected to the RS485_1 port on a RTCU DX4 with default settings:
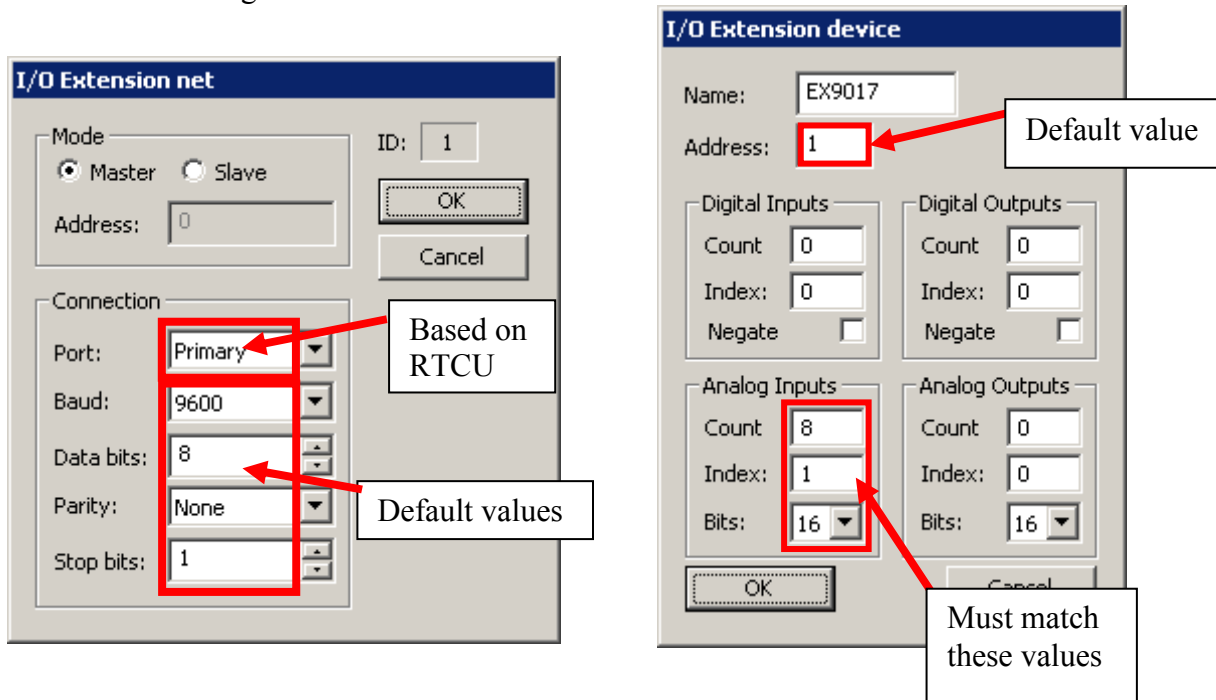
To change the above mentioned default values, new values must be entered and transferred to the module[4].

Values in the "I/O Extension net" must be set according to communication between the module and the RTCU unit, the port numeration follows the principles of the serOpen function, which is described in the IDE online help. When changing baud, data bit(s), parity or stop bit(s) all units on the net must be reconfigured[5].

The address field is per default "1"; if more modules are connected to same net each must have a unique address. Changing the address of a module is done by selecting the new value and then reconfigure the module.

A close attention must be paid to the Count, Index and Bits fields in the "Analog Inputs" section, which must be 8, 1 and 16 respectively, else will communication with the module fail.

[3] Please refer to the RTCU IDE online help for creating and editing I/O extension
[4] Please see "Project Control - I/O Extension" in the IDE online help.
[5] To reconfigure: right click the device in the IDE and select "setup module", and then follow the guide.
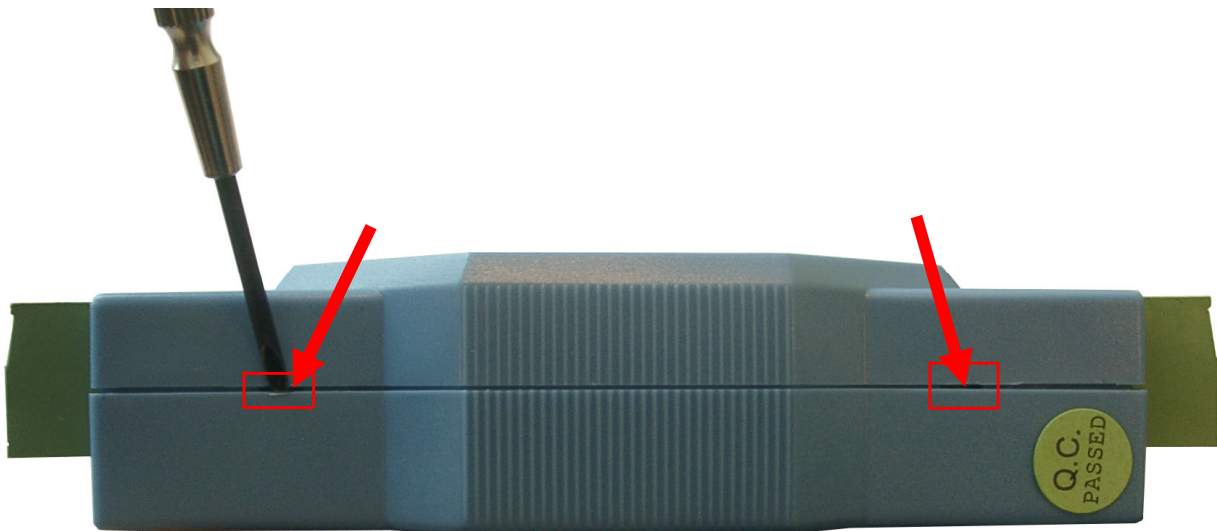
Appendix B – Changing jumper 1

In the following a brief description is explaining how to open the case of the module and locate the jumper 1, which is mentioned in the section "Pin Assignment".
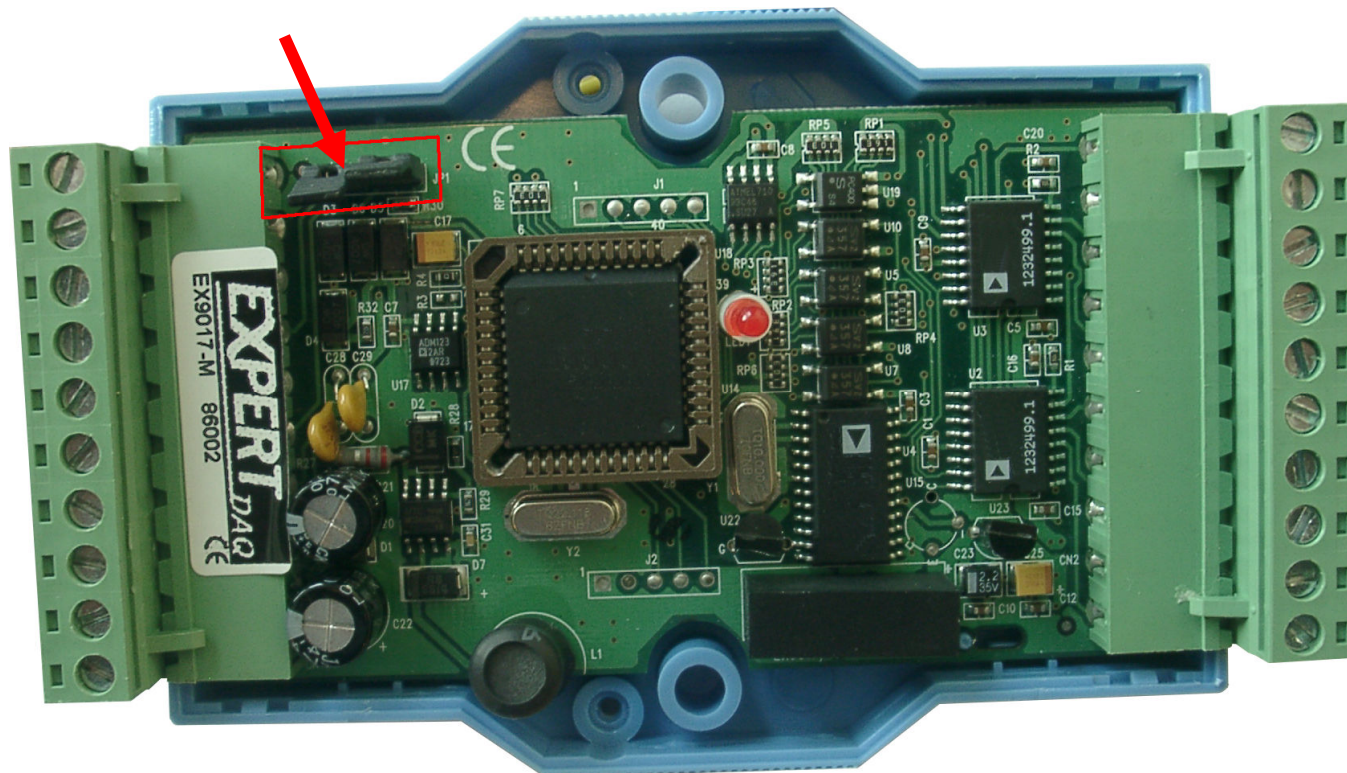
1. Unscrew the 2 screws located in the bottom side of the closure
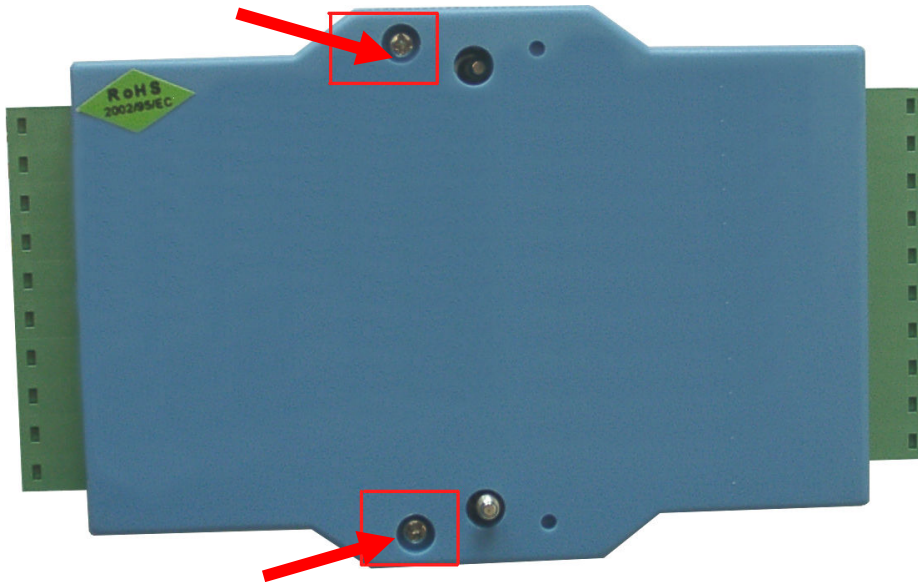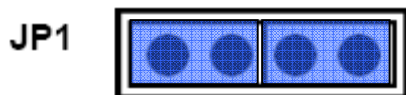

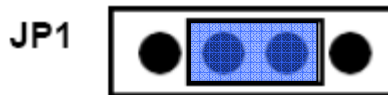2. Click the 4 clips located on both sides using a tool, i.e. a screw driver

3. Jumper 1 is located top left side as illustrated in the following figure. Please refer to the section "Pin Assignments" in order to set the jumpers for correct configuration.

4. Select jumper setting according to wanted functionality

Pin 6 is in INIT* mode

Pin 6 is in Vin7- mode