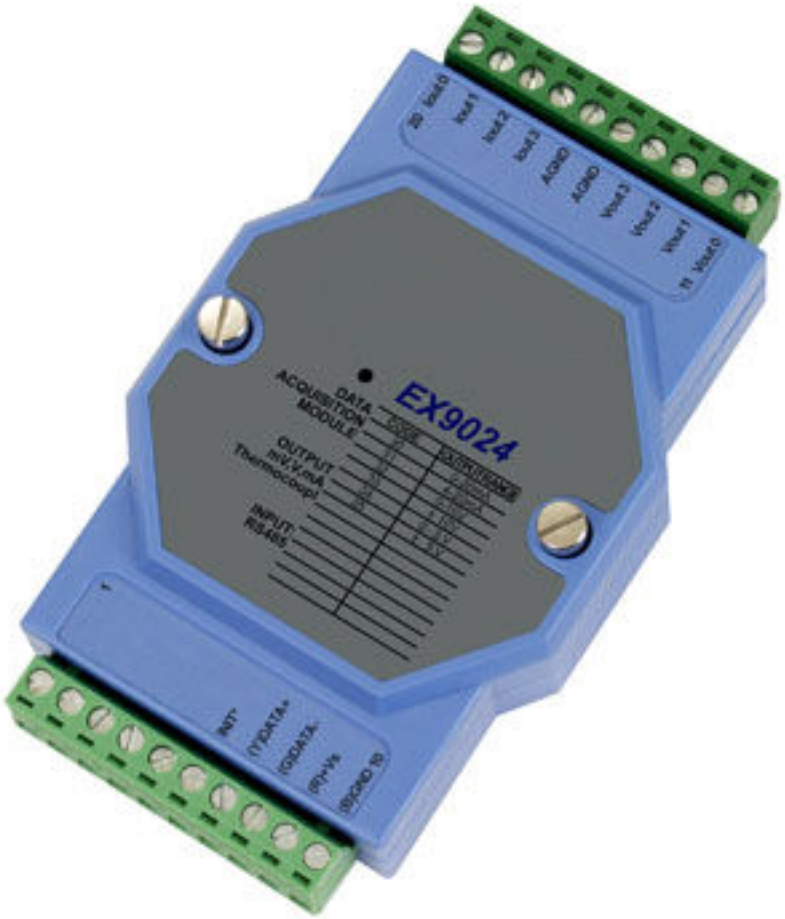
Technical Manual for
RT-EX-9024

Version 2.02



4 x Analog Output (14 bit)

Introduction

The EX9024 MODBUS I/O Expansion module is a high-quality and low-cost data acquisition device that allows expanding the on-board analog output capabilities on X32-based RTCU units almost indefinitely and completely transparent using MODBUS communication protocol.

The EX9024 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 EX9024 can expand the RTCU with additional 4 analog outputs.

The EX9024 can be configured to output 6 different ranges, these are:

- -10V → 10V
- 0V → 10V
- -5V → 5V
- 0V → 5V
- 0mA → 20mA
- 4mA → 20mA

The EX9024 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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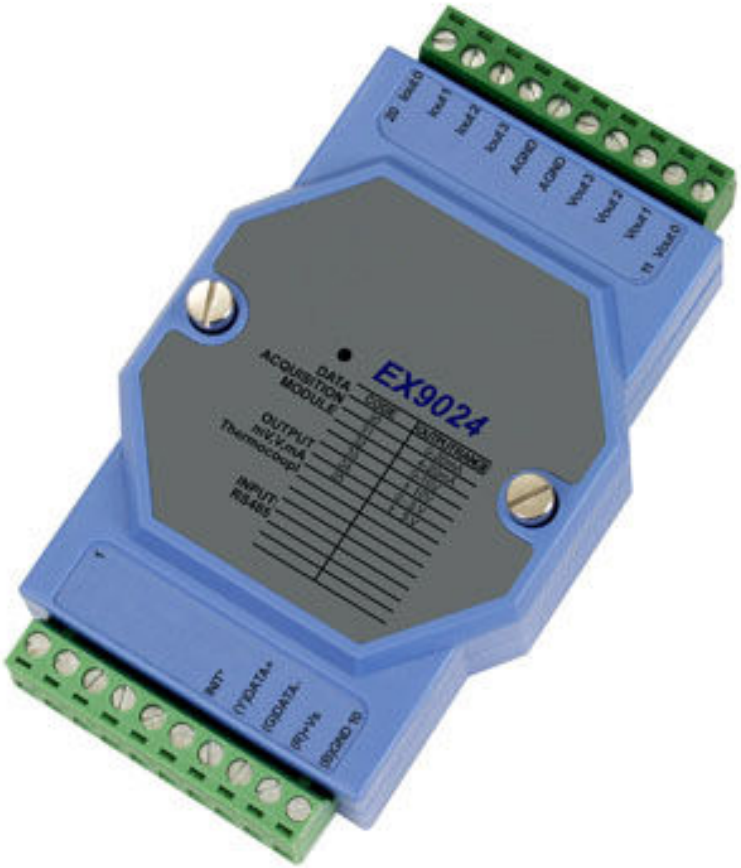
Graphical view



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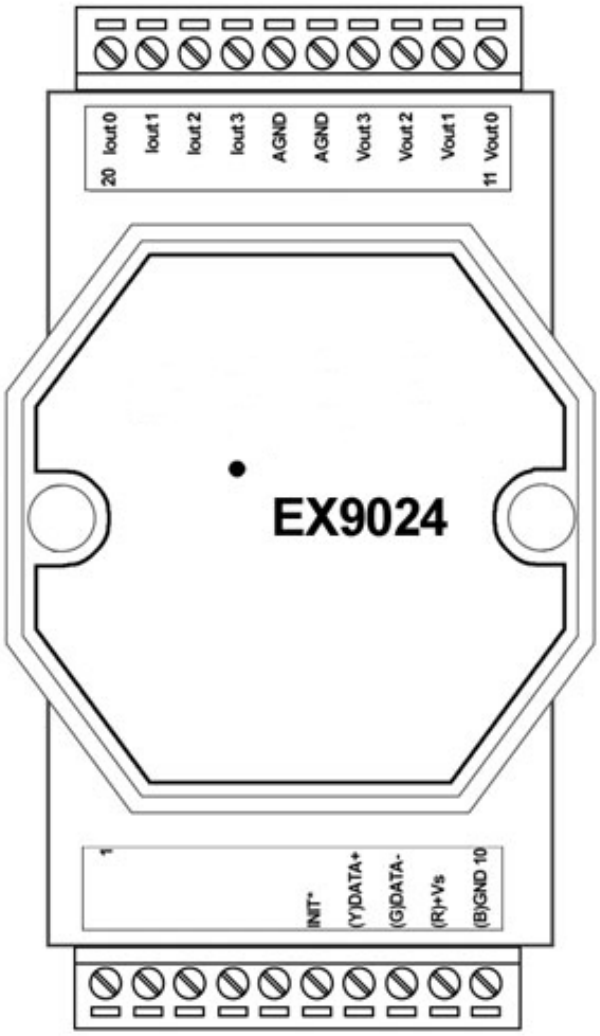
Pin Assignment

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



Pin	Name	Description
1	NC	
2	NC	
3	NC	
4	NC	
5	NC	
6	INIT*	Pin for initialization of the configuration routine
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
10	(B)GND	Supply ground.

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Pin	Name	Description
11	VOUT0	Analog voltage output 0
12	VOUT1	Analog voltage output 1
13	VOUT2	Analog voltage output 2
14	VOUT3	Analog voltage output 3
15	AGND	Analog Ground
16	AGND	Analog Ground
17	IOUT3	Analog current output 3
18	IOUT2	Analog current output 2
19	IOUT1	Analog current output 1
20	IOUT0	Analog current output 0

*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 Output Type	0 to +10 V

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 EX9024 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

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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. Connect the INIT* pin to the GND pin.
3. Power on the module.

The module is now ready to be configured, afterward remove the power.

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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Implementation

The digital-to-analog converter has a resolution of 14 bits in voltage output configuration. In current output configuration only a 13 bit resolution are used.

The minimum and maximum values are shown in the table below.

Range	Min.	Max.
-10V to 10V	0	16383
0V to 10V	8192	16383
-5V to 5V	4096	12287
0V to 5V	8192	12287
0mA to 20mA	8192	16383
4mA to 20mA	9829	16383

It's recommended to use the -10V to 10V or 0mA to 20mA configuration and thereby avoid additional code to handle minimum and maximum allowable value. Writing an out-of-range value to the analog output will cause an exception from the module.

By using -10V to 10V or 0mA to 20mA configuration, the other configurations ranges are covered. It's important to notice that the accuracy of the output will not be improved by choosing another configuration.

It's important that all outputs are defined and has at least an initial writing even though they are not used. Otherwise the analog output module may generates an exception, as it will get a default value of zero which is out of range in most modes.

The table below shows value to write to produce a -2.5V / 2.5V output.

Range	-2.5V	2.5V
-10V to 10V	6144	10240
0V to 10V	N.A	10240
-5V to 5V	6144	10240
0V to 5V	N.A	10240

Below the value for producing a 10mA current output are shown.

Range	10mA
0mA to 20mA	12288
4mA to 20mA	12288

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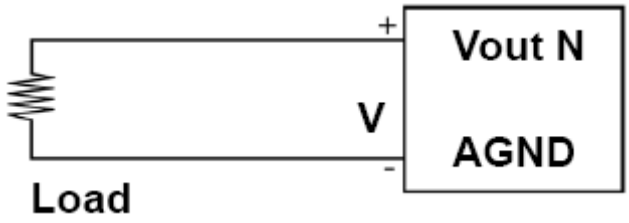
Wire Connections

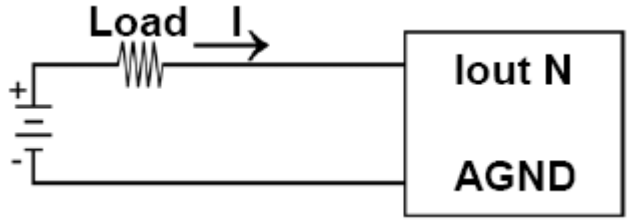
Voltage Output:

When connecting a device to the voltage output of the add-on module please follow this wiring scheme:



Current Output:

When connecting a floating load to the current output of the add-on device please follow this wiring scheme:



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Technical Specifications

Resolution	14 bit
Output Channel	4
Voltage Output	+/- 10 V 0 ~ 10 V +/- 5 V 0 ~ 5 V
Current Ouput	0 ~ 20 mA 4 ~ 20 mA
Power Input	+10 V to + 30 V
Power Consumption	2,0 W
Operating Temperature	-25 ~ 75°C
Dual Watchdog Timer	√
Power-on Value	√
Safe Value (When host fail / Comm. Fail)	√

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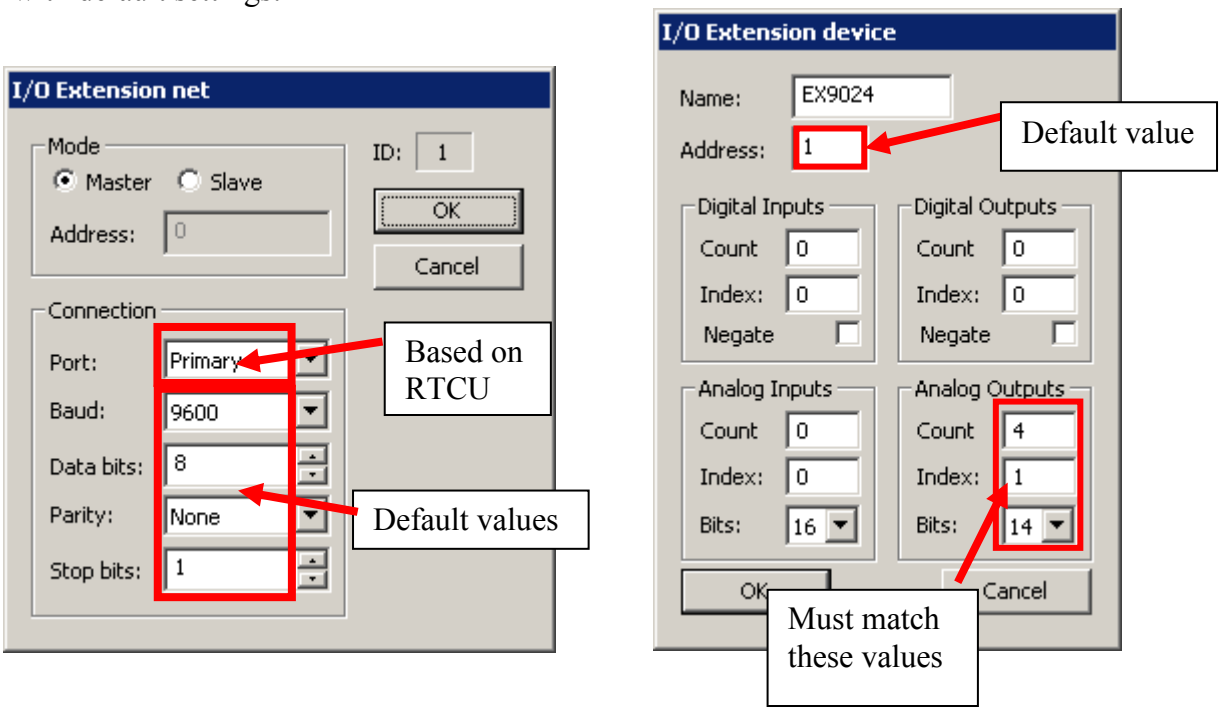
Appendix A – Using the module as I/O extension in the RTCU IDE

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[1].

The following figure shows the correct setting for an EX9024 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[2].

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[3].

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 Outputs" section, which must be 4, 1 and 14 respectively, else will communication with the module fail.

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

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