EWIO$_2$
Modbus Server

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Description of Modbus Server v1.0 for the EWIO$_2$

General

The Modbus server uses the network protocol Modbus/TCP, which is based on TCP/IP. Some general information on starting and operating the Modbus server follows.

IP address

On a local network, the individual devices are uniquely addressed with their IP address. If this has not yet been done, it is configured in the EWIO with the web interface. There you can either set a constant IP address or have it assigned automatically via DHCP if a DHCP server is in the network.

TCP port number

The port number is used to address individual TCP connections to application programs in a device. The Modbus server is addressed when establishing a connection with a particular port number. The default for Modbus/TCP is port number 502.
This port number is passed to the Modbus server as a command line argument. If a different port number is needed, it can be changed in the shell script that starts the Modbus server.

Unit Identifier

A device with Modbus/TCP interface can contain a gateway to a Modbus/RTU interface. The Unit Identifier for Modbus/TCP corresponds to the slave address with Modbus/RTU. Then this field is used for addressing the Modbus/RTU slaves.

The Modbus server in the EWIO has no Modbus/RTU interface and therefore does not evaluate the Unit Identifier. The Unit Identifier (slave address) in Modbus commands can therefore have any values.

Start / Stop

The Modbus server can be started or stopped in the web interface.

Cooperation with other programs

These programs in the EWIO can be the BACnet server, the web interface or a script. To prevent confusion, each output should only be controlled by one program. For the Modbus server, this means that it only controls an output when writing to the relevant register. With the BACnet-server, however, the object must be specifically deactivated for this output. Reading from inputs and outputs from other programs is possible any time. Operating modes behave like outputs in this regard. When operating modes, e.g., are changed by analogue inputs from a different program in the EWIO, this will be recognized by the Modbus server and signaled in the register.

Modbus functions

The following functions for communication are realized in the Modbus server:

Read Holding Registers	Read Input Registers
Write Single Register	Write Multiple Registers
Write and Read Registers	
Read Coils	Read Discrete Inputs
Write Single Coil	Write Multiple Coils

Modbus registers

In the Modbus server, Holding Registers and Input Registers are located at the same addresses. The Modbus functions Read Holding Registers and Read Input Registers thus have the same value..

Each register has 16 bits, which are optionally addressable as coils or discrete inputs. Bit 0 has the lowest bit address. Bit address = 16 * register address + bit number.

Registers at addresses that are not listed in the tables below exist, but have no function. Read/write access therefore can be used without errors, but it also does not do anything.

The register addresses are thus roughly divided into blocks:

Holding Registers, Input Registers	
Address	Description
0 – 99	Data for inputs/outputs in the EWIO
100 – 199	Data for inputs/outputs in extension module with address 1
…	…
600 – 699	Data for inputs/outputs in extension module with address 6
700 – 799 800 – 899	Other data in the EWIO

The data for inputs/outputs is generally broken down in the block as follows:

Holding Registers, Input Registers	
Address	Description
0 – 9	Status
10 – 19	Digital inputs/outputs
20 – 29	Analogue inputs/outputs
30 – 39	Analogue outputs default settings
40 – 59	Analogue inputs measured values
60 – 69	Analogue inputs measuring ranges
70 – 89	Analogue inputs raw measured values
90 – 99	Analogue inputs raw measuring ranges

EWIO and extension modules always occupy just part of these reserved registers. This is described below individually for all device types.

Registers for inputs/outputs in the EWIO

Holding Registers, Input Registers	
Address	Description
0	Code for IO subassembly type 0 = unequipped 1 = subassembly with 4 digital inputs for switches 4 digital inputs with optocoupler 4 PNP transistor outputs 3 analogue outputs 0-10 V 3 analogue inputs 0-10 V, 0-20 mA, 40-4M Ohm
1	Code for relay subassembly type 0 = unequipped 2 = subassembly with 6 relay outputs 2 triac outputs 3 = subassembly with 4 relay outputs 1 M-Bus Master interface
2	Version of the Modbus server 1 = Version 1

Holding Registers, Input Registers	
Address	Description
3 Bit 48…	Status flags for internal communication Bit 0 = No communication with the IO subassembly Bit 1 = No communication with the relay subassembly Bit 2 = No communication from IO subassembly Bit 3 = No communication from relay subassembly Bit 4 = Error counter for IO subassembly changed Bit 5 = Error counter for relay subassembly changed Bit 6 = Interface to IO driver does not work
4	Command register 0 = Command register is empty or command was executed 301 = Cold boot, Reboot EWIO after 1-2 seconds 302 = Warm boot, reboot Modbus server after 1-2 seconds 400 = Search extension modules 401…406 = Delete extension module 1…6
10 Bit 160…	Message for manual operation of digital outputs EWIO2: Bit 0…7: Relay DO1…3, Triac TR1…TR2, relay DO4…6 Bit 8…11: Transistor 1…4 EWIO2-M: Bit 0…3: Relay DO1…4 Bit 8…11: Transistor 1…4
11 Bit 176…	Switching status of digital outputs EWIO2: Bit 0…7: Relay DO1…3, Triac TR1…TR2, relay DO4…6 Bit 8…11: Transistor 1…4 EWIO2-M: Bit 0…3: Relay DO1…4 Bit 8…11: Transistor 1…4
12 Bit 192…	Short circuit of digital outputs EWIO2 / EWIO2-M: Bit 8…11: Transistor 1…4
15 Bit 240…	Switching status of digital inputs Bit 0…7: Input 1…8

Holding Registers, Input Registers	
Address	Description
20 – 22	Output values of voltage outputs O1 – O3 Data type: Signed Integer16 Value range: Value 0 = 0 Volt … value 32767 = 10.24 Volt Resolution: 15 Bit (0.3125 mV)
28 Bit 448…	Message for manual operation of analogue outputs Bit 0…2: Output O1…O3
29 Bit 464…	Message for short circuit of analogue outputs Bit 0…2: Output O1…O3
30 – 32	Default settings of voltage outputs O1 – O3 Data type: Signed Integer16 Value range: Value 0 = 0 Volt … value 32767 = 10,24 Volt Resolution: 15 Bit (0.3125 mV)
40 – 41 42 – 43 44 – 45	Measured values of analogue input E1 – E3 Data type: Float Unit: Depending on operating mode V, mA, Ohm, %, °C
60 – 62	Measuring ranges for analogue input E1 – E3 (read-write) Value Description 1 0-10V % 2 0-5V % Pullup 3 0-10 Volt 4 0-5 Volt Pullup 5 Ohm 6 User Defined Range 7 PT100 8 PT500 9 PT1000 10 NI1000-TC5000 11 NI1000-TC6180 12 BALCO500 13 KTY81_110 14 KTY81_210 15 NTC1k8 Thermokon 16 NTC5k Thermokon 17 NTC10k Thermokon 18 NTC20k Thermokon 19 LM235Z 20 NTC10k Carel

Holding Registers, Input Registers	
Address	Description
	21 NTC5k Schneider 22 NTC30k Schneider 23 KP250 24 Poti 10k % 25 Inactive 26 0-20mA % 27 0-20mA 28 4-20mA % 29 4-20mA 30 3-wire sensing (input E2) 31 4-wire sensing (input E2) 32 Test 40 Ohm - 14 kOhm 33 Test 12 kOhm - 4 MOhm 34 Test 40 Ohm - 650 Ohm 35 Test 500 Ohm - 14 kOhm 36 Test 12 kOhm - 180 kOhm 37 Test 140 kOhm - 4 MOhm
70 – 71 72 – 73 74 – 75	Raw measured values of analogue input E1 – E3 Data type: Float Unit: Depending on operating mode V, mA, Ohm
90 – 92	Raw measuring ranges for analogue input E1 – E3 (read-only) Value Description 0 Inactive 1 0-10V 2 0-5V Pullup 3 Ohm two-conductor measurement 4 Test 40 Ohm - 14 kOhm 5 Test 12 kOhm - 4 MOhm 6 Test 40 Ohm - 650 Ohm 7 Test 500 Ohm - 14 kOhm 8 Test 12 kOhm - 180 kOhm 9 Test 140 kOhm - 4 MOhm 10 0-20mA 11 Three-conductor measurement (input E2) 12 Four-conductor measurement (input E2)

Holding Registers, Input Registers	
Address	Description
700 – 701 702 – 703 704 – 705 706 – 707 708 – 709 710 – 711 712 – 713 714 – 715	Frequency of digital inputs 1 - 8 Data type: Float Unit: Hz Measuring range: 0.1 – 2000 Hz
720 – 723 724 – 727 728 – 731 732 – 735 736 – 739 740 – 743 744 – 747 748 – 751	Pulse counter of digital inputs 1 - 8 Data type: Unsigned Integer 64
760 – 767	Debouncing time constant of digital inputs 1 - 8 Values: 0…255 Unit: ms
780-783	Modbus interface 0 (extension modules):
780	Baudrate Values: 1 2 3 4 5 6 7 8 Baud: 1200 2400 4800 9600 19200 38400 57600 115200

Holding Registers, Input Registers	
Address	Description
781	Parity and stop bits Values: 1 2 3 4 Mode: 8e1 8o1 8n2 8n1
782	Number of second attempts after transmission errors Default setting is 2
783	Minimum timeout in ms to complete reception Default setting is 100
785-788	Modbus interface 1 (general use)
785	Baudrate Values: 1 2 3 4 5 6 7 8 Baud: 1200 2400 4800 9600 19200 38400 57600 115200
786	Parity and stop bits Values: 1 2 3 4 Mode: 8e1 8o1 8n2 8n1
787	Number of second attempts after transmission errors Default setting is 2
788	Minimum timeout in ms to complete reception Default setting is 100

Holding Registers, Input Registers	
Address	Description
800 – 839	Interpolation table with up to 10 interpolation points for the sensor characteristic curve with User Defined Range X0, Y0 … X9, Y9 Node X (e.g. temperature) and interpolation value Y (e.g. resistance) alternate. The values of X and Y must be sorted in ascending or descending value. The table is filled starting from the beginning. It ends either after a fixed set number of interpolation points or if Xn = Yn = 0, see below. Data type: Float [20]
840	Measuring range & and interpolation with User Defined Range Value Description 1 Volt linear 2 Volt Pullup linear 3 Ohm linear 4 mA linear 5 Volt exponential 6 Volt Pullup exponential 7 Ohm NTC exponential 8 mA exponential
841	BACnet measuring unit of nodes Xn with User Defined Range Values: 0…236 Examples: 2 = mA, 4 = Ohm, 5 = V, 62 = °C
842	Number of interpolation points in the interpolation table with User Defined Range Normal values are 1…10. When another number is set, the table is previously Xn = Yn = 0, the number of then recounted and signaled again in this register.

Registers for inputs/outputs in extension modules

For each extension module, there is a unique block with 100 registers
For module address 1 the register starting at 100, module address 2 register starting at 200, ...

The registers of the individual module types are descried in the following tables.
The register addresses there for example apply for module address 1.

Holding Registers, Input Registers (all extension modules)	
Address	Description
100	Code for the type of extension module 0 = no extension module or unknown device 1 = MR-DO4 2 = MR-TO4 3 = MR-DI4 4 = MR-DI10 5 = MR-SI4 6 = MR-DIO4/2 7 = MR-AO4 8 = MR-AOP4 9 = MR-AI8 10 = MR-CI4
101	Software version of the extension module, point count before
102	Software version of the extension module, point count after
103	Status flags for internal communication Only status bits 4 and 8 are relevant in the application. Bit 4 = Modbus device switched off/missing, RS485 connection interrupted Bit 8 = The Modbus device has a different type than the one configured The remaining status bits signal program errors. Bit 0 = The Modbus device signals Illegal Function Code Bit 1 = The Modbus device signals Illegal Data Address Bit 2 = The Modbus device signals Illegal Data Value Bit 3 = The Modbus Router signals Gateway Path Unavailable Bit 5 = The ExtMod driver does not understand the response from the Modbus device Bit 6 = The ExtMod driver has no TCP connection to the Modbus router Bit 7 = The Modbus frames from the Modbus router were no longer synchronized Bit 9 = The ExtMod-API has no connection to the ExtMod driver

Holding Registers, Input Registers (digital extension modules)	
Address	Description
110	Message for manual operation of digital outputs Bit 0…3: Output 1…4 (with MR-DO4, MR-TO4) Bit 0…1: Output 1…2 (with MR-DIO4/2)
111	Switching status of digital outputs Bit 0…3: Output 1…4 (with MR-DO4, MR-TO4) Bit 0…1: Output 1…2 (with MR-DIO4/2)
115	Switching status of digital inputs Bit 0…3: Input 1…4 (with MR-DI4, MR-DIO4/2, MR-SI4) Bit 0…9: Input 1…10 (with MR-DI10)

Holding Registers, Input Registers (modules with analogue output)	
Address	Description
120 – 123	Output values of voltage outputs 1 – 4 (MR-AO4, MR-AOP4) Data type: Signed Integer16 Value range: Value 0 = 0 Volt … value 32767 = 10.24 Volt Resolution: 14 Bit (0,625 mV)
128	Signal for manual operation of voltage outputs (only MR-AOP4) Bit 0…3: Output 1…3
130 – 133	Default settings of voltage outputs 1 – 4 (MR-AO4, MR-AOP4) Data type: Signed Integer16 Value range: Value 0 = 0 Volt … value 32767 = 10.24 Volt Resolution: 14 Bit (0,625 mV)

Holding Registers, Input Registers (modules with analogue input, MR-AI8)	
Address	Description
140 – 141 142 – 143 144 – 145 146 – 147 148 – 149 150 – 151 152 – 153 154 – 155	Measured values of analogue input 1 – 8 Data type: Float Unit: Depending on operating mode V, Ohm, %, °C
160 – 167	Measuring ranges for analogue input 1 – 8 (read-write) Value Description 1 0-10V % 2 0-5V % Pullup 3 0-10 Volt 4 0-5 Volt Pullup 5 Ohm 6 User Defined Range 7 PT100 8 PT500 9 PT1000 10 NI1000-TC5000 11 NI1000-TC6180 12 BALCO500 13 KTY81_110 14 KTY81_210 15 NTC1k8 Thermokon 16 NTC5k Thermokon 17 NTC10k Thermokon 18 NTC20k Thermokon 19 LM235Z 20 NTC10k Carel 21 NTC5k Schneider 22 NTC30k Schneider

Holding Registers, Input Registers (modules with analogue input, MR-AI8)	
Address	Description
	23 KP250 24 Poti 10k % 25 Inactive
170 – 171 172 – 173 174 – 175 176 – 177 178 – 179 180 – 181 182 – 183 184 – 185	Raw measured values of analogue input 1 – 8 Data type: Float Unit: Depending on operating mode V, Ohm
190 – 197	Raw measuring ranges for analogue input 1 – 8 (read-only) Value Description 0 Inactive 1 0-10V 2 0-5V Pullup 3 Ohm

Holding Registers, Input Registers (modules with analogue input, MR-CI4)	
Address	Description
140 – 141 142 – 143 144 – 145 146 – 147	Measured values of analogue input 1 – 4 Data type: Float Unit: Depending on operating mode V, mA, %
160 – 163	Measuring ranges for analogue input 1 – 4 (read-write) Value Description

Holding Registers, Input Registers (modules with analogue input, MR-CI4)	
Address	Description
	1 0-10V % 3 0-10 Volt 26 0-20mA % 27 0-20mA 28 4-20mA % 29 4-20mA
170 – 171 172 – 173 174 – 175 176 – 177	Raw measured values of analogue input 1 – 4 Data type: Float Unit: Depending on operating mode V, mA
190 – 193	Raw measuring ranges for analogue input 1 – 4 (read-only) Value Description 1 0-10V 10 0-20mA

Registers for measured values in the data base

The most recently saved measured values in the data base can be queried.
The measured values can originate from devices on the M-Bus or Modbus or from the EWIO.

Holding Registers, Input Registers	
Address	Description
1000	Number of the data point for selection (Read / Write) Value 1…400 for configured data points The number is also used for BACnet-Trend Logs.
1001	Number of the data point as status (Read) Value 1…400: The data point exists, current data can be queried Value 0: The selected data point does not exist
1002 – 1003	Current measured value (Read) Data type float General data type, also with integer or binary data.
1050 – 1099	Data point name (Read) Data type string The name is used for identification of the data point. Query in the web interface: Data point / description

Data type string

With this data type, texts are coded with 2 bytes (UTF8) for each register.
Unused characters at the end of the string are filled with null bytes.

Example: text "abc" in 3 registers:

Register addresses	Register + 0		Register + 1		Register + 2	
Bytes in order of transmission	Byte 1 High	Byte 2 Low	Byte 3 High	Byte 4 Low	Byte 5 High	Byte 6 Low
Character	'a'	'b'	'c'	0	0	0

Data type float with analogue values

For the data type float, 2 registers are needed, i.e. 4 bytes.
The problem is that with Modbus there is no norming to the data type float and the market standard is 4 different sequences of bytes in the registers.

But with Modbus the principle applies that with data of multiple bytes in length, the highest value is transmitted first and the lowest is transmitted last (big-endian). Using this as a basis, float is coded for our devices as follows.

Register addresses	Register A+0		Register A+1	
Bytes in order of transmission	Byte 1 High	Byte 2 Low	Byte 3 High	Byte 4 Low
Bit numbers	Bit 31-24	Bit 23-16	Bit 15-8	Bit 7-0
Bits of float values	Sign, Exp 7-1	Exp 0, Mant 22-16	Mant 15-8	Mant 7-0

When multiple registers are used for a data type, all of them are read or written together in one command so that the data is consistent.

The registers can also be read individually, but in that case the user must ensure that the data is consistent, e.g. with multiple queries.

Data type integer-16 with analogue output

Values in the Modbus register are interpreted as signed int16.

Bit 15 must be 0 (positive), negative values are replaced with 0.
Bit 14...0 contain the output value with 15 bits.

This type of coding is extendible for negative output voltage and remains compatible when lower resolution is used.

Data type integer-64 with pulse counter

Counter states are interpreted as unsigned int64. For this, 4 registers are required.

But with Modbus, in case of data with multiple bytes length the highest value is transmitted first and the lowest is transmitted last (big-endian). The highest value register therefore has the lowest address and the lowest value register has the highest address.