ANNEXE 3 FONCTIONS D'OPEN MODBUS

6 Common MODBUS functions

MODBUS functions from the *OPEN MODBUS / TCP SPECIFICATION* are found in the application layer of the WAGO ETHERNET fieldbus coupler/controller.

More information
More information on the *OPEN MODBUS / TCP SPECIFICATION* you can find in the Internet:
http://www.modicon.com/openmbus/standards/openmbus.htm

These functions allow digital or analog input and output data to be set or directly read out of the fieldbus node.

Function code	hexadecimal	Function	Description
FC1:	0x01	read coils	Reading of several input bits
FC2:	0x02	read input discretes	Reading of several input bits
FC3:	0x03	read multiple registers	Reading of several input registers
FC4:	0x04	read input registers	Reading of several input registers
FC5:	0x05	write coil	Writing of an individual output bit
FC6:	0x06	write single register	Writing of an individual output register
FC7:	0x07	read exception status	Reading of the first 8 input bits
FC11:	0x0B	get comm event counters	Communication event counter
FC15:	0x0F	force multiple coils	Writing of several output bits
FC16:	0x0010	write multiple registers	Writing of several output registers
FC23	0x0017	read/write multiple registers	Reading and writing of several output registers

Tab. 6-1: List of the MODBUS functions in the fieldbus coupler and controller

To execute a desired function, specify the respective function code and the address of the selected input or output channel.

Attention
The examples listed use the hexadecimal system (i.e.: 0x000) as their numerical format. Addressing begins with 0.
The format and beginning of the addressing may vary according to the software and the control system. All addresses then need to be converted accordingly.

6.1 Use of the MODBUS functions

The graphical overview uses a fieldbus node as an example to show which MODBUS functions can be used to access data of the process image.

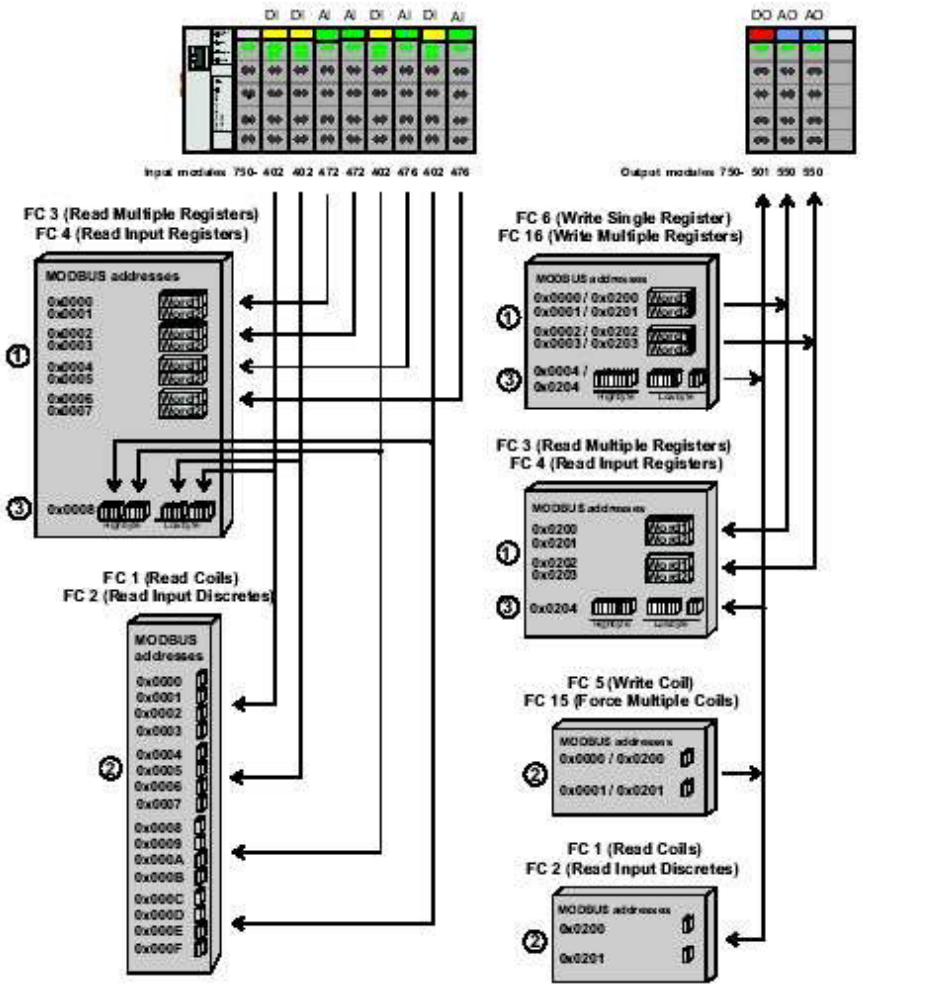

Fig. 6-1: Use of the MODBUS functions G012918e

Attention
It is recommended that analog data be accessed with register functions ① and digital data with coil functions ②.

6.2 Description of the MODBUS functions

All MODBUS functions in the WAGO ETHERNET fieldbus coupler and controller are executed as follows:

When a function code is entered, the MODBUS master (i.e. PC) makes a request to the coupler/controller of the fieldbus node.
Subsequently, the coupler/controller sends a datagram to the master as a response.

If the coupler receives an incorrect request, it sends an error datagram (Exception) to the master.

The exception code contained in the exception has the following meaning:

Exception Code	Meaning
0x01	Illegal Function
0x02	Illegal Data Address
0x03	Illegal Data Value
0x04	Slave Device Failure

The following chapters describe the datagram architecture of request, response and exception with examples for each function code.

Note
In the case of the read functions (FC1 – FC 4) the outputs can be additionally written and read back by adding an offset of 200_{hex} (0x0200) to the MODBUS address.

6.2.1 Function code FC1 (Read Coils)

The function reads the status of the input and output bits (coils) in slave.

Request

The request determines the starting address and the number of bits to be read.
Example: An inquiry, with which the bits 0 to 7 are to be read.

Byte	Field name	Example
Byte 0, 1	Transaction identifier	0x0000
Byte 2, 3	protocol identifier	0x0000
Byte 4, 5	length field	0x0006
Byte 6	unit identifier	0x01 not used
Byte 7	MODBUS function code	0x01
Byte 8, 9	reference number	0x0000
Byte 10, 11	Bit count	0x0008

Response

The current values of the inquired bits are packed in the data field. A 1 corresponds to the ON status and a 0 to the OFF status. The lowest value bit of the first data byte contains the first bit of the inquiry. The others follow in ascending order. If the number of inputs is not a multiple of 8, the remaining bits of the last data byte are filled with zeroes (truncated).

Byte	Field name	Example
.....		
Byte 7	MODBUS function code	0x01
Byte 8	Byte count	0x01
Byte 9	Bit values	0x12

The status of the inputs 7 to 0 is shown as byte value 0x12 or binary 0001 0010.
Input 7 is the bit having the highest significance of this byte and input 0 the lowest value.
The assignment is thus made from 7 to 0 with OFF-OFF-OFF-ON-OFF-OFF-ON-OFF.

Bit:	0	0	0	1	0	0	1	0
Coil:	7	6	5	4	3	2	1	0

Exception

Byte	Field name	Example
.....		
Byte 7	MODBUS function code	0x81
Byte 8	Exception code	0x01 or 0x02

6.2.2 Function code FC2 (Read Discrete Inputs)

This function reads the input bits in the slave.

Requests

The request determines the starting address and the number of bits to be read.
Example: An inquiry with which the bits 0 to 7 are to be read:

Byte	Field name	Example
Byte 0, 1	Transaction identifier	0x0000
Byte 2, 3	protocol identifier	0x0000
Byte 4, 5	Length field	0x0006
Byte 6	unit identifier	0x01 not used
Byte 7	MODBUS function code	0x02
Byte 8, 9	reference number	0x0000
Byte 10, 11	Bit count	0x0008

Response

The current value of the inquired bit is packed into the data field. A 1 corresponds to the ON status and a 0 the OFF status. The lowest value bit of the first data byte contains the first bit of the inquiry. The others follow in an ascending order. If the number of inputs is not a multiple of 8, the remaining bits of the last data byte are filled with zeroes (truncated).

Byte	Field name	Example
.....		
Byte 7	MODBUS function code	0x02
Byte 8	Byte count	0x01
Byte 9	Bit values	0x12

The status of the inputs 7 to 0 is shown as a byte value 0x12 or binary 0001 0010.
Input 7 is the bit having the highest significance of this byte and input 0 the lowest value.
The assignment is thus made from 7 to 0 with OFF-OFF-OFF-ON-OFF-OFF-ON-OFF.

Bit:	0	0	0	1	0	0	1	0
Coil:	7	6	5	4	3	2	1	0

Exception

Byte	Field name	Example
.....		
Byte 7	MODBUS function code	0x82
Byte 8	Exception code	0x01 or 0x02

6.2.5 Function code FC5 (Write Coil)

With the aid of this function a single output bit is written.

Request

The request determines the address of the output bit. Addressing starts with 0.

Example: The second output bit is set (address 1):

Byte	Field name	Example
Byte 0, 1	Transaction identifier	0x0000
Byte 2, 3	protocol identifier	0x0000
Byte 4, 5	length field	0x0006
Byte 6	unit identifier	0x01 not used
Byte 7	MODBUS function code	0x05
Byte 8, 9	reference number	0x0001
Byte 10	ON/OFF	0xFF
Byte 11		0x00

Response

Byte	Field name	Example
.....		
Byte 7	MODBUS function code	0x05
Byte 8, 9	Reference number	0x0001
Byte 10	Value	0xFF
Byte 11		0x00

Exception

Byte	Field name	Example
.....		
Byte 7	MODBUS function code	0x85
Byte 8	Exception code	0x01, 0x02 or 0x03

6.2.8 Function code FC15 (Force Multiple Coils)

Using this function a number of output bits are set to 1 or 0. The maximum number is 256 bits.

Request

The first point is addressed with 0.
The inquiry message specifies the bits to be set. The requested 1 or 0 states are determined by the contents of the inquiry data field.

In this example 16 bits are set, starting with the address 0. The inquiry contains 2 bytes with the value 0xA5F0 or 1010 0101 1111 0000 in binary format.

The first byte transmits the 0xA5 to the addresses 7 to 0, whereby 0 is the lowest value bit. The next byte transmits 0xF0 to the addresses 15 to 8, whereby the lowest value bit is 8.

Byte	Field name	Example
Byte 0, 1	Transaction identifier	0x0000
Byte 2, 3	protocol identifier	0x0000
Byte 4, 5	Length field	0x0009
Byte 6	unit identifier	0x01 not used
Byte 7	MODBUS function code	0x0F
Byte 8, 9	reference number	0x0000
Byte 10, 11	Bit Count	0x0010
Byte 12	Byte Count	0x02
Byte 13	Data Byte1	0xA5
Byte 14	Data Byte2	0xF0

Response

Byte	Field name	Example
.....		
Byte 7	MODBUS function code	0x0F
Byte 8, 9	Reference number	0x0000
Byte 10, 11	Bit Count	0x0010

Exception

Byte	Field name	Example
.....		
Byte 7	MODBUS function code	0x8F
Byte 8	Exception code	0x01 or 0x02