MODBUS RTU COMMUNICATION FOR VONSCH PRODUCTS

Version 1.2

UNIFREM, QUATROFREM, FOTO CONTROL 3F, FOTO CONTROL 1F, FOTO CHARGER

Obsah

1 Serial interface

Physical layer of the communication is based on RS485.

Baud rate is configurable in the converter, values 9600, 19200, 38400, 57600, 115200, 128000 can be selected.

Transfer consists of: 1start bit, 8 data bits, 1 parity bit (even), 1 stop bit.

CANNON 9-pin connector PINOUT.

Pin number	Name/Purpose
3	R+/T+
8	R-/T-
5	GND

2 Frame

VONSCH implementation of Modbus protocol is compliant with the MODBUS RTU specification. Modbus frame is described in Fig 1. Inverter is always in the role of a slave and responds to the requests send by master. Inverter accepts frames with its address, or the global address 0. Inverter does not respond to global frames.

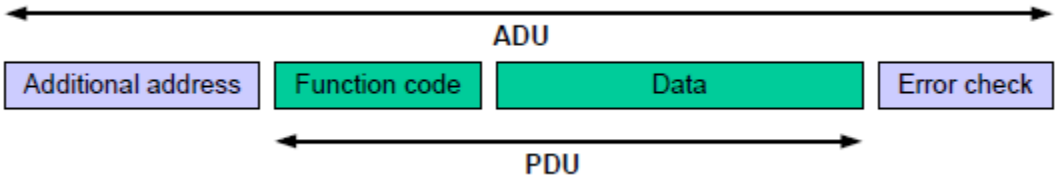


Fig 1 : MODBUS RTU protocol frame

Address (Additional address) is the address of the device (inverter). It is configurable by a parameter, within allowed range of 1-99 dec.

CRC (Error check) is the checksum for checking the integrity of the frame.

2.1. Supported functions

0x03 register read
0x10 register write
0x17 register read and write
0x02 discrete register read
0x04 input register read

2.2. Description legend

Orange – master request (control system) to the slave device (inverter, charger)
Green – „good“ response of the slave (inverter, charger) to the master
Red – response to the master at fault

3 Registers – access to the parameters

Access by the registers allows access to individual parameters of the device – change its configuration or monitor its conditions. Description of individual parameters is described in the corresponding manual of the inverter (device).

3.1. Register map

Register address	Nr. of registers	Data meaning	Block meaning
0x0000	2	Parameter ID = 0	Set 1
0x0002	2	Parameter ID = 1	
0x0004	2	Parameter ID = 2	
		...	
0x2000	2	Parameter ID = 0	Set 2
0x2002	2	Parameter ID = 1	
0x2004	2	Parameter ID = 2	
		...	
0x4000	2	Parameter ID = 0	Set 3
0x4002	2	Parameter ID = 1	
0x4004	2	Parameter ID = 2	
		...	
0x6000	2	Parameter ID = 0	Set 4
0x6002	2	Parameter ID = 1	
0x6004	2	Parameter ID = 2	
		...	
0x8000	x		Unused
0xE000	2	Password	Cyclic data exchange
0xE002	2	ID0	
0xE004	2	Value0	
0xE006	1	CW	
0xE007	1	REF	
0xE008	1	ID1	
0xE009	1	ID2	
		...	
0xE027	1	ID32	
0xE028	x		Unused
0xE100	2	Access	Cyclic data exchange
0xE102	2	ID0	
0xE104	2	Value0	
0xE106	1	SW	
0xE107	1	ACT	
0xE108	2	Value1	
0xE10A	2	Value2	
		...	
0xE146	2	Value32	
0xE147	1	CW	
0xE148	1	REF	
0xE148	x		Unused

Data meaning:

Data	Description
Parameter ID	*Access to individual parameters* *Register address = (set – 1) * 0x2000 + ID * 2* *ID of the parameter is the unique number of the parameter according to the documentation of the device.*
Password	*Entering the password for protected parameter write (read is not protected).* *Password is set as 4 ASCII characters.* *Zx = ASCII value of the character* *Z4 * 0x1000000 + Z3 * 0x10000 + Z2 * 0x100 + Z1* *e.g. password "AB12" i sused as 0x32314241*
Access	*Actual level of access to the parameter* *0 – read-only, 1 – user access, 2 – service access*
IDx	*ID of the selected parameter for the access by ValueX* *This serves for accessing the group of selected parameters.* *FOTO CONTROL 1f and FOTO CHARGER keep the value of ID1-ID8 only after turning off the device.*
ValueX	*Access to the value of selected parameter by the IDx.*
CW	*control word, write of the control word, see description of the control word*
SW	*status word, read of the inverter state, see description of the status word*
REF	*setpoint/reference write, integer +/- XXX.X [%]* *98.7% is written as 987*
ACT	*Actual (main) value read, integer* *-UNIFREM – Actual frequency, +/- XXXX [rpm]* *-QUATROFREM, FOTOCONTROL 3f – Produced power (ID 593), XXXXX [W]* *-FOTOCONTROL 1f, FOTOCHARGER – Produced power (ID 278) XXXXX [W]*

Basic parameters of the device are 32 bit data. Therefore, by accessing to the parameters it is necessary to access two registers. Since the parameters are of different types, also 32 bit data interpretation is different. Possible interpretation of data can be seen in the following table.

Data	Description
SETVALUE	*Parameter is a 32bit floating point number according to IEEE 754 standard.*
ENUM	*Parameter is stored as Integer. This number represents the selected choice in the range. The choices are zero-based numbered.*
BITENUM	*Bit parameter. Each bit represents some information (flag). Meaning of the individual bits are described in the documentation for the parameter. There is a bit number in the name of the parameter.*
SHORTCUT	*Parameter is stored as Integer. This number represents the ID of selected parameter.*
DATE	*Date in BCD code (day = [0-3bit] + 10*[4-7bit], month = [8-11bit] + 10*[12-15bit], year = [16-19bit] + 10*[20-23bit], century =[24bit] (0 – 20th century, 1 – 21st century), day of the week = [28-31bit])*
TIME	*Time in the BCD code (second = [0-3bit] + 10*[4-7bit], minute = [8-11bit] + 10*[12-15bit], hour = [16-19bit] + 10*[20-23bit])*
SETVALUE_DPAR	*This parameter is configuration dependent and can yield any type of the parameters above.*

3.2. Register read 0x03

Request

Function code	1 Byte	**0x03**
Starting address	2 Bytes	0x0000 – 0xFFFF
Nr. of registers = **N**	2 Bytes	0x0001 – 0x007D

Response

Function code	1 Byte	**0x03**
Nr. of bytes	1 Bytes	2 x **N**
Values of registers	**N** x 2 Bytes	Values

Response at fault

Error code	1 Byte	**0x83**
Exception code	1 Byte	01, 02, 03, 04

Example of reading actual frequency ID 47, for UNIFREM frequency converter (address 1).
*Register = 0x2000 * (set – 1) + 2 * ID = 94 = 0x5E*

Address	Function	Register		Nr. of registers		CRC	
0x01	0x03	0x00	0x5E	0x00	0x02	0xA5	0xD9

Address	Function	Length (Nr. of bytes).	Data				CRC	
0x01	0x03	0x04	0x41	0xEA	0x7B	0x6B	0xAC	0xE4

The conversion of 0x41EA7B6B according to IEEE 754 is 29.31 Hz.

It is possible to read more parameters in one cycle, e.g. reading of Voltage DC (46) and Frequency (47) can be done by reading 4 registers starting at the address 0x5E.

3.3. Register write 0x10

Request

Function code	1 Byte	**0x10**
Starting address	2 Bytes	0x0000 – 0xFFFF
Nr. of registers = **N**	2 Bytes	0x0001 – 0x007B
Nr. of bytes	1 Byte	2 x **N**
Values of registers	**N** x 2 Bytes	Values

Response

Function code	1 Byte	**0x10**
Starting address	2 Bytes	0x0000 – 0xFFFF
Values of registers	2 Bytes	0x0001 – 0x007D

Response at fault

Error code	1 Byte	**0x90**
Exception code	1 Byte	01, 02, 03, 04

Write can be refused if it is a diagnostic parameter, parameter inaccessible (disabled) or if the appropriate permissions (service parameters, user passwords) are not set. The parameter must be written as a whole 32 bits (always 2 registers). It is possible to write more parameters at once.

Example of writing the parameter Setpoint frequency (ID 344) to 13 Hz (0x41500000 according to IEEE 754) for the UNIFREM converter (address = 1).
*Register = 0x2000 * (set – 1) + 2 * ID = 0x2B0*

Address	Function	Register		Nr. of registers		Nr. of bytes.	Data				CRC	
0x01	0x10	0x02	0xB0	0x00	0x02	0x45	0x41	0x50	0x00	0x00	0xF5	0x96

Address	Function	Register		Nr. of registers		CRC	
0x01	0x10	0x02	0xB0	0x00	0x02	0x41	0x97

3.4. Register read and write 0x17

Request

Function code	1 Byte	**0x17**
Starting read address	2 Bytes	0x0000 – 0xFFFF
Nr. of read values = **M**	2 Bytes	0x0001 – 0x007D
Starting write address	2 Bytes	0x0000 – 0xFFFF
Nr. of write values = **N**	2 Bytes	0x0001 – 0x0079
Nr. of bytes	1 Byte	2 x **N**
Values of registers to write	**N** x 2 Bytes	Values

Response

Function code	1 Byte	**0x17**
Nr. of bytes	1 Bytes	2 x **M**
Values of read registers	**M** x 2 Bytes	Values…

Response at fault

Error code	1 Byte	**0x97**
Exception code	1 Byte	01, 02, 03, 04

The meaning of data is similar to the one when reading registers 0x03 and writing registers 0x10. This function is mostly used for cyclic data exchange.

3.5. Cyclic data exchange

It serves to control the inverter by the control system. The control system sends the inverter the references (CW, setpoint frequency, IDs of parameter to read, ...) and the inverter responds with its state and the values of the required parameters. The exchange is optimized, so that all the required information can be exchanged within a single communication cycle (request-response).Function 0x17 read registers and write registers is used for this. It is possible to use two modes of data exchange.

Mode 1

Master sends CW, REF, IDs of parameters that wants to read, the password and it can write a single parameter. The inverter responds with SW, ACT and the values of requested parameters. Example 1, 2; 3.

CW	REF	ID 1	ID2	...	IDx
SW	ACT	Value read 1	Value read 2	...	Value read X

Mode 2

Master sends CW, REF and can write more selected parameters at once. The inverter responds with SW, ACT and values of selected parameters. In this case, the master does not send the IDs of the selected parameters, they are set directly in the converter. (Caution: different products have different numbers of parameter selection, see the register map.) See Example 4.

Value write 1	Value write 2	...	Value write X	CW	REF
SW	ACT	Value read 1	Value read 2	...	Value read X

Example 1

Writing the UNIFREM converter (address 1) start command, Frequency setpoint to 25 Hz (50%), maximum current (ID 5) to 10 A (0x41200000). Reading the actual state, RPM value, DC voltage (ID 46), Cooler temperature (ID 74), Motor current (ID 42) and state of Binary inputs (ID 184).

Address	Function	Read register		Nr. of registers		Address of write		Nr. of registers		Nr. of	Data										CRC	
										12 Bytes	CW		REF = 50.0% = 500 = 0x1F4		ID1 = 46 = 0x2E		ID2 = 74 = 0x4A		ID3 = 42 = 0x2A		ID4 = 184 = 0xB8		
0x01	0x17	0xE1	0x06	0x00	0x0A	0xE0	0x06	0x00	0x06	0x0C	0x04	0x7F	0x01	0xF4	0x00	0x2E	0x00	0x4A	0x00	0x2A	0x00	0xB8	0x4A	0x7C

Address	Function	Nr. of	Data																		CRC	
		20	SW		ACT = 0x2EE = 750 rpm		Value1 = 465.45V				Value2 = 63.67°C				Value3 = 1.56A				Value4 = BIN3					
0x01	0x17	0x14	0x07	0x37	0x02	0xEE	0x43	0xE8	0xB9	0xE3	0x42	0x7E	0xB5	0x5C	0x3F	0xC8	0x1E	0xF4	0x00	0x00	0x00	0x04	0x0F	0x02

Example 2

Start and frequency ref. command of UNIFREM converter (address 1, reading only state.

Request: 0x01, 0x17, 0xE1, 0x06, 0x00, 0x02, 0xE0, 0x06, 0x00, 0x02, 0x04, 0x04, 0x7F, 0x01, 0xF4, 0x3A, 0xB6

Response: 0x01, 0x17, 0x02, 0x07, 0x37, 0xFE, 0x52

Example 3

Writing the Max. frequency parameter (ID 111 = 0x6F) to the value 50 Hz (0x42480000), user password is „AB12“, device is UNIFREM converter (address = 1).

Request: 0x01, 0x17, 0xE1, 0x02, 0x00, 0x04, 0xE0, 0x00, 0x00, 0x06, 0x0C, 0x32, 0x31, 0x42, 0x41, 0x00, 0x00, 0x00, 0x6F, 0x42, 0x48, 0x00, 0x00, 0xBD, 0x8D

Response: 0x01, 0x17, 0x08, 0x00, 0x00, 0x00, 0x6F, 0x42, 0x48, 0x00, 0x00, 0x95, 0xF0

By this reading, we have verified that ID0 remained unchanged and Value0 is set to the correct value.

Example 4

Writing the UNIFREM converter (address 1) start command, Frequency setpoint to 25 Hz (50%), maximum current (ID 5) to 10 A (0x41200000). Reading the actual state, RPM value, DC voltage (ID 46), Cooler temperature (ID 74), Motor current (ID 42) and state of Binary inputs (ID 184). The selected quantities are preset in the converter, their IDs are not sent over the communication.

Address	Function	Read register		Nr. of registers		Address of write		Nr. of registers		Nr. of	Data								CRC	
										8 Bytes	Max. I = 10A = 0x41200000				CW		REF = 50.0% = 500 = 0x1F4			
0x01	0x17	0xE1	0x06	0x00	0x0A	0xE1	0x46	0x00	0x04	0x08	0x41	0x20	0x00	0x00	0x04	0x7F	0x01	0xF4	0xBA	0xA5

Address	Function	Nr. of	Data																CRC	
		20	SW		ACT = 0x2EE = 750 rpm		Value1 = 465.45V				Value2 = 63.67°C				Value3 = 1.56A				Value4 = BIN3					
0x01	0x17	0x14	0x07	0x37	0x02	0xEE	0x43	0xE8	0xB9	0xE3	0x42	0x7E	0xB5	0x5C	0x3F	0xC8	0x1E	0xF4	0x00	0x00	0x00	0x04	0x0F	0x02

4 Description of Control Word and Status Word

4.1. Control Word – CW

The Control Word (CW) serves for control of the inverter/charger (ready, start, stop…).

Bit	Name	Comment
0	ON	Negated OFF1
1	No OFF 2	Negated OFF2 – No Coast Stop
2	No OFF 3	Negated OFF3 – No Quick Stop
3	Enable Operation	
4	Enable Ramp Generator	UNIFREM only
5	Unfreeze Ramp	UNIFREM only
6	Enable Setpoint	UNIFREM only
7	Fault Acknowledge	
8-9	-	Reserved
10	Control by PLC	
11-15	-	Reserved

Bit	=	State
0	0→1	Inverter enters the **"Switched On"** state, when Coast Stop or Quick stop are inactive.
	1→0	Emergency stop, inverter stops by following the preset ramp. After reaching zero frequency, inverter stops feeding the motor and enters the **"Switching Off"** state and continues to enter **"Ready For Switching On"** state, when Coast Stop or Quick stop are inactive.
	0	Exits the **"Switching On Inhibited"** state and enters "Ready For Switching On" state.
1	1	Continue operation (Coast Stop – inactive).
	0	Emergency stop, inverter stops feeding the motor immediately. It enters the **"Switching On Inhibited"** state.
2	1	Continue operation (Quick Stop – inactive).
	0	Emergency stop, inverter stops by following the preset ramp of Quick stop. Inverter is in **"Switching Off"** state. After reaching zero frequency, inverter stops feeding the motor and enters the **"Switching On Inhibited"** state.
3	1	START. Inverter starts feeding the motor and smoothly increases frequency up to the setpoint.
	0	STOP. Inverter stops by following the preset ramp and stops feeding the motor
4	1	Normal operation of ramp block.
	0	Force the zero frequency on the ramp block output.
5	1	Unfreeze the ramp output. (Normal operation)
	0	Freeze the ramp output.
6	1	Normal ramp operation.
	0	Ramp input is set to zero.
7	0→1	Fault acknowledge.
	0	Normal operation.
10	1	Inverter accepts the commands sent by master (accepts CW).
	0	Inverter ignores the commands sent by master (ignores CW).

4.2. Status Word – SW

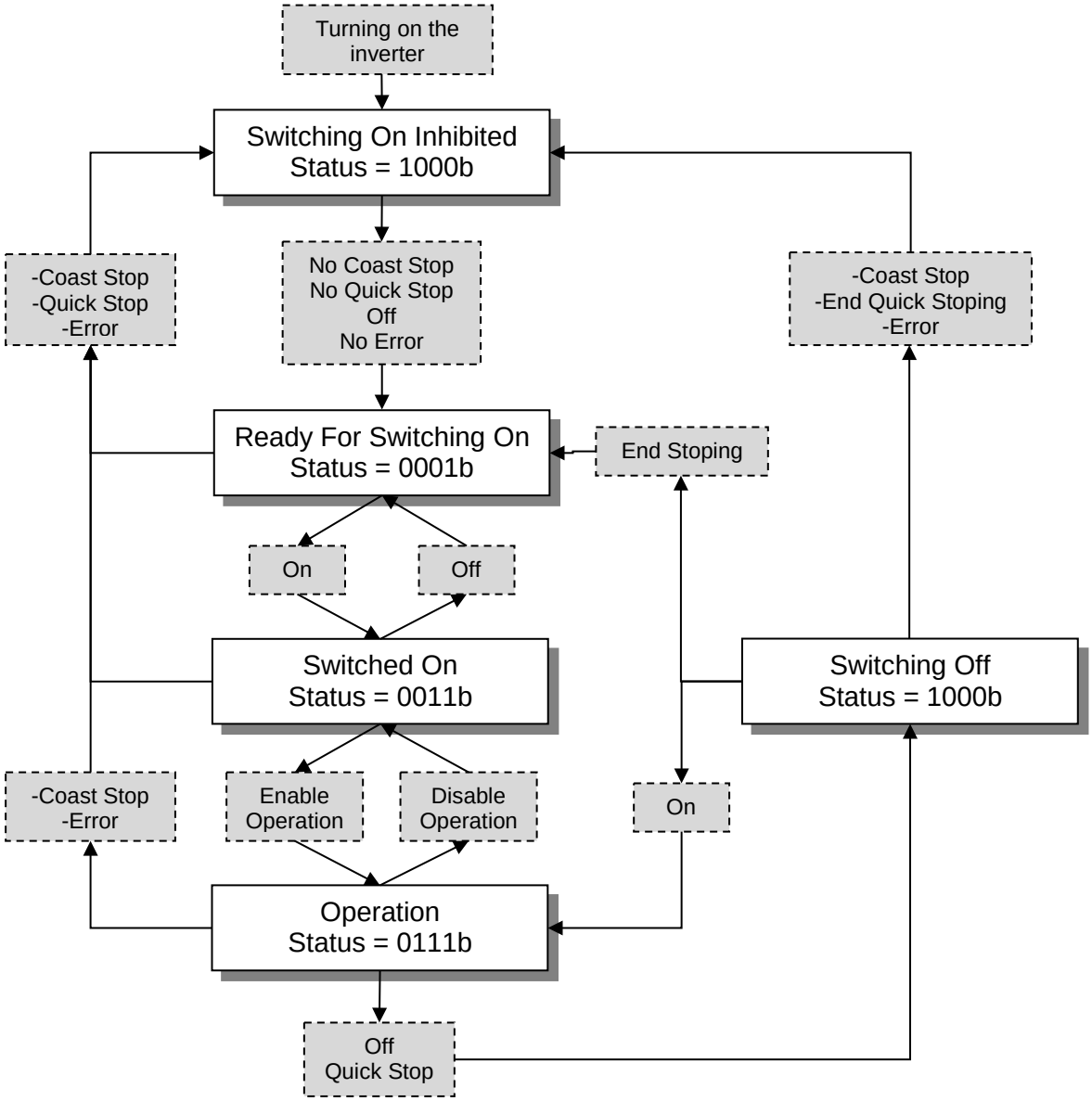
Status Word “SW” shows the actual state of the inverter/charger (Ready, Run, Start …).

Bit	Name	Comment
0	Ready To Switch On	
1	Ready To Operate	
2	Operation Enabled	
3	Fault Present	
4	No OFF2	No Coast Stop
5	No OFF3	No Quick Stop
6	Switching On Inhibited	
7	Warning Present	
8	Speed Error within tolerance	UNIFREM only, others 0
9	Control Requested	
10	f Or n Reached	UNIFREM only, others 0
11	Run	
12	Set b0	**Active set**
13	Set b1	
14	Fref < 0	UNIFREM only, others 0
15	-	Reserved

Bit	=	Stav
6,2,1,0	1000	**“Switching On Inhibited“** state. It means that Coast Stop or Quick Stop are active (motor is not fed, quick stop finished successfully), inverter is in the initialization phase or a fault is present.
	0001	**“Ready For Switching On“** state. Coast Stop and Quick Stop are inactive, no fault is present.
	0011	**“Switched On“** state. Inverter is ready to accept the Start command.
	0111	**“Switched Off“** state. Inverter can be stopped by Quick stop or emergency stop, deactivation of ON.
3	1	A fault occurred.
	0	No fault occurred.
4	1	Coast Stop inactive.
	0	Coast Stop active
5	1	Quick Stop inactive.
	0	Quick Stop active.
7	1	A warning occurred.
	0	No warning occurred.
8	1	Inverter frequency equal to setpoint frequency.
	0	Inverter frequency is different from setpoint frequency.
9	1	Inverter will accept the Control Word, received from MODBUS master..
	0	Inverter will ignore the Control Word.
10	1	Inverter frequency equal to setpoint frequency.
	0	Inverter frequency is different from setpoint frequency.
11	1	Inverter is in operation (generates voltage on its output).
	0	Inverter is stopped (does not generate voltage on its output).
12,13	00	First parameter set active.
	01	Second parameter set active.
	10	Third parameter set active.
	11	Fourth parameter set active.
14	1	Frequency setpoint is negative (lower than zero).
	0	Frequency setpoint is positive.

4.3. State machine

Individual states of the slave are shown by white rectangles. Shown state corresponds to the bits 6,2,1,0 of the Status Word. Grey rectangles represent the events which cause the transition to other state.



4.4. State machine handling

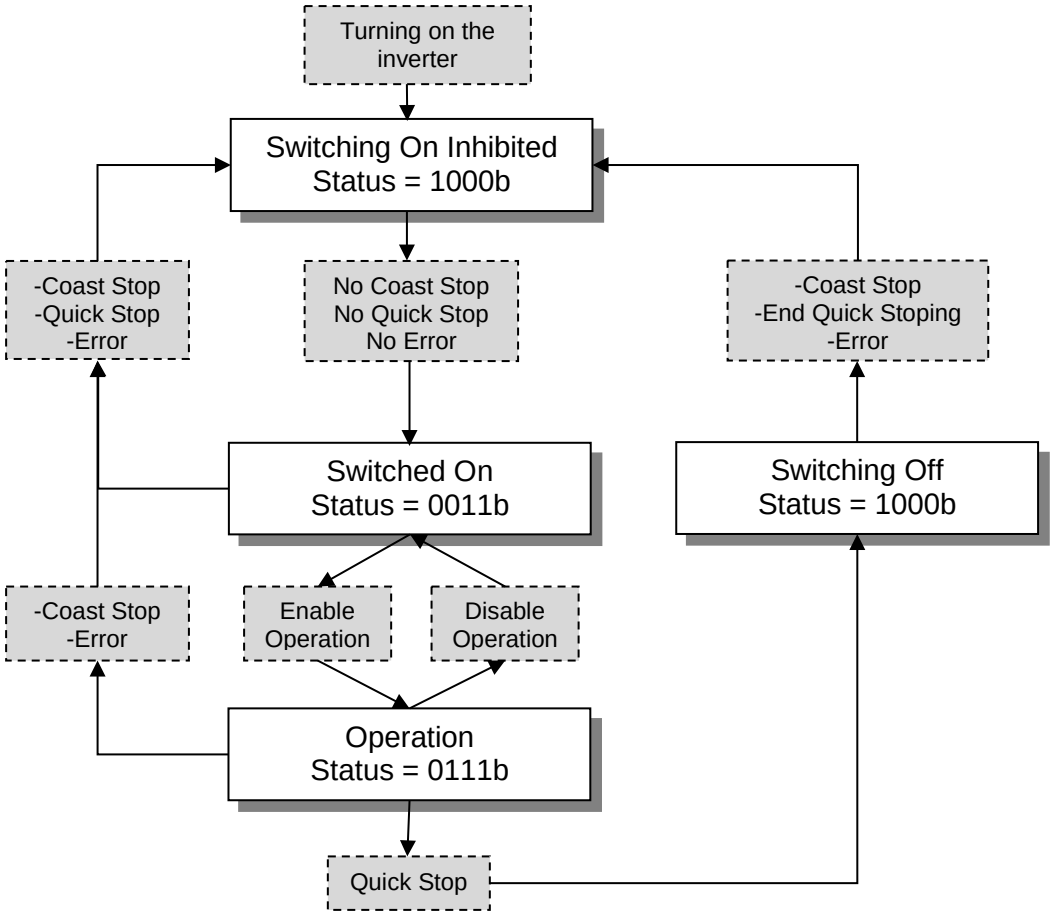
In the following example it is supposed that Coast Stop and Quick stop functions are not used. Simple fault acknowledgement and start of the device can look like following:

```
//fault to be acknowledged
if (SW.bit3 == 1 && Button_confirm)
        CW = 0x0486;
//state Switching On Inhibited
else if (SW.bit6 == 1)
        CW = 0x0406;
//state Ready for Switching On, no Start
```

```
else if (SW.bit1 == 0 && !Button_start)
        CW = 0x0407;
//START
else
        CW = 0x047F;
```

After the start command, device starts to generate the voltage on its output terminals and tries to reach the setpoint. After the stop command, the device decreases its output frequency or current to zero and stops generating voltage.

4.5. Simplified state machine



4.6. Simplified State machine handling

Same assumptions as in regular state machine are valid.

```
//fault to be confirmed
if (SW.bit3 == 1 && Button_confirm)
        CW = 0x0486;
//start
else if (Button_start)
        CW = 0x047F;
//no start
else
        CW = 0x0476;
```

5 Inverter configuration

For proper communication of the inverter with Modbus master, it is necessary to set several parameters for control and communication. Configuration procedure, function of individual parameters and diagnostics of the inverter are described in detail in the instruction manual supplied together with the inverter.

UNIFREM, QUATROFREM, FOTO CONTROL 3F

ID	Parameter	Value	Unit	Comment
\ MENU \ SETTINGS \ COMMANDS \ START STOP RESET				
194 (194)	Start source	MODBUS MODBUS2	(selection)	Inverter accepts CW from MODBUS (2 – simplified state machine)
\ MENU \ SETTINGS \ COMMANDS \ FREQUENCY SETPOINT				
706 (-)	Source of freq. setpoint	MODBUS	(selection)	Configure the inverter to accept freq. setpoint as REF received over MODBUS.
195 (-)	Freq. reverse source	According to the setpoint value	(selection)	Frequency reverse will be evaluated according to REF sign.
\ MENU \ SETTINGS \ COMMUNICATION				
234 (277)	Converter address	1 – 99		Address of the converter.
\ MENU \ SETTINGS \ COMMUNICATION \ MODBUS				
218 (218)	Baud RS485	9,6 – 115,2	kBps (selection)	Communication Baud rate setting.
961 (777)	MB Idle	Fault Warning Fault CW Warning CW	(selection)	Reaction of the inverter to communication loss. CW prefix is stricter, inverter checks the renewal of CW and REF reception.
659 (606)	MB Fault timeout	5	[s]	Timeout of communication interruption with Master. After this time, a fault is generated.
962 (833)	MB Warning timeout	2	[s]	Timeout of communication interruption with Master. After this time, a warning is shown.
963 (834)	MB Warning mode	Reset Stop Quick Stop None	(selection)	Defines what action the converter should take after Modbus warning occurs.
1156 (983)	Broadcast	Yes, No	(selection)	Turning on / off the broadcasts. Broadcast is a message with the address 0, which can be processed by all the recipients simultaneously.
660 (607)	DataFormat	No swap Byte swap Word swap Byte & word swap	(selection)	This parameter defines the order of transferring single bytes for 16 and 32 bit data.
\ MENU \ SETTINGS \ COMMUNICATION \ MODBUS \ Parameters MODBUS				
1094-1126 (940-972)	ID0-ID32	-	SHORTCUT	Preset of parameters for cyclic data exchange. It is required to set them for mode 2.
\ MENU \ DIAGNOSTICS \ Communication \ MODBUS				
MODBUS protocol diagnostics, as seen by the inverter.				
\ MENU \ DIAGNOSTICS \ Communication \ RS LINKS				
Serial lines diagnostics.				

IDs in parentheses are valid for QUATROFREM a FOTO CONTROL 3F.

FOTO CONTROL 1F, FOTO CHARGER

ID	Parameter	Value	Unit	Comment
\ MENU \ SETTINGS \ COMMAND				
172	Start source	Modbus Modbus2	(selection)	Inverter accepts MODBUS CW (2 – simplified state machine)
\ MENU \ SETTINGS \ COMMUNICATION				
28	Inverter address	1 – 99		Address of the inverter.
29	BAUD	9,6 – 115,2	kBps (selection)	Communication Baud rate setting.
143	MB idle	none Warning Stop Fault	(selection)	Reaction of the inverter to communication loss.
31	MB timeout	5	[s]	Timeout of communication interruption with Master.
\ MENU \ SETTINGS \ COMMUNICATION \ Parameters MB				
33-40	ID1- ID8	-	SHORTCUT	Preset of parameters for cyclic data exchange. It is required to set them for mode 2.
\ MENU \ DIAGNOSTICS \ Communication				
MODBUS protocol diagnostics, as seen by the inverter.				

6 Discrete inputs – state of the device

It is possible to monitor the state of the inverter via the discrete inputs. They allow access directly to the selected bit states. It is also possible to access them via registers.

6.1. Map of discrete inputs

Input address	Nr. of inputs	Data meaning	Corresponding ID		
			UNIFREM	FOTO CONTROL 3F QUATROFREM	FOTO CONTROL 1F FOTOCHARGER
0x0000	32	Converter state	76	76	59
0x0020	32	Fault E1 – E32	781	687	60
0x0040	32	Fault E33 – E64	780	688	61
0x0060	32	Warning W1 – W32	250	283	51
0x0080	32	Warning W33 – W64	424	22	52
0x00A0	32	Bin. inputs + Logical blocks	184 a 8	184 a 573	6
0x00C0	x	Unused			

6.2. Read of discrete inputs 0x02

Request

Function code	1 Byte	**0x02**
Starting address	2 Bytes	0x0000 – 0xFFFF
Nr. of inputs = **N**	2 Bytes	0x0001 – 0x07D0

Response

Function code	1 Byte	**0x02**
Number of bytes	1 Bytes	**M**
Value of inputs	**M** x 1 Bytes	Values

If (N <> 0) Then M = (N / 8) + 1; Else M = 0;

Response at fault

Error code	1 Byte	**0x82**
Exception code	1 Byte	01, 02, 03, 04

Example of reading the state of UNIFREM inverter (address 1)

Address	Function	Input		Nr. of inputs		CRC	
0x01	0x02	0x00	0x02	0x00	0x01	0xA5	0xD9

Address	Function	Nr. bytes	Data	CRC	
0x01	0x02	0x01	0x00	0xA1	0x88

Inverter is stopped (no PWM – no voltage generation).

It is possible to read more inputs in one cycle.

7 Input registers – history, stats

To input registers historical entries of events and statistics are mapped. Historical entries are written sequentially and after using all available memory it is resumed from the beginning, so the old values are overwritten by new ones. Based on the time stamp (date and time) full historical sequence can be compiled. There is a service parameter History Index (UNIFREM ID = 243; QUATROFREM, FOTO CONTROL 3f ID = 285; FOTO CONTROL 1f, FOTO CHARGER ID = 53), which determines the next position for writing events to history. Value (index - 1) indicates the latest record in history.

7.1. Map of input registers

UNIFREM, QUATROFREM, FOTO CONTROL 3F

Input address	Nr. of inputs	Data meaning		Data type
0x0000	1	Entry 0	Event	Integer 0x000-0x03F Fault E1-E64 0x100-0x13F Warning W1-W64 0x200-... Specific event
0x0001	1		Reserved	
0x0002	2		Fault time	TIME
0x0004	2		Fault date	DATE
0x0006	1		ID1	SHORTCUT
0x0007	1		ID2	SHORTCUT
0x0008	1		ID3	SHORTCUT
0x0009	1		ID4	SHORTCUT
0x000A	1		ID5	SHORTCUT
0x000B	1		ID6	SHORTCUT
0x000C	2		Value1	According to the parameter type of ID1
0x000E	2		Value2	According to the parameter type of ID2
0x0010	2		Value3	According to the parameter type of ID3
0x0012	2		Value4	According to the parameter type of ID4
0x0014	2		Value5	According to the parameter type of ID5
0x0016	2		Value6	According to the parameter type of ID6
0x0018	6		Reserved	
0x001E	30	Entry 1		See Entry 0
0x003C		...		
0x77E2	30	Entry 1023		See Entry 0
0x7800		Unused		

FOTO CONTROL 1F, FOTOCHARGER

Input address	Nr. of inputs	Data meaning		Data type
0x0000	1	Entry 0	Event	Integer 0x000-0x03F Fault E1-E64 0x100-0x13F Warning W1-W64 0x200-... Specific event
0x0001	1		Reserved	
0x0002	2		Fault time	TIME
0x0004	2		Fault date	DATE
0x0006	2		Reserved	
0x0008	1		ID1	SHORTCUT
0x0009	1		ID1 Master	SHORTCUT
0x000A	1		ID2	SHORTCUT
0x000B	1		ID2 Master	SHORTCUT
0x000C	1		ID3	SHORTCUT
0x000D	1		ID3 Master	SHORTCUT
0x000E	1		ID4	SHORTCUT
0x000F	1		ID4 Master	SHORTCUT
0x0010	1		ID5	SHORTCUT
0x0011	1		ID5 Master	SHORTCUT
0x0012	1		ID6	SHORTCUT
0x0013	1		ID6 Master	SHORTCUT
0x0014	2		Value1	According to the parameter type of ID1
0x0016	2		Value2	According to the parameter type of ID2
0x0018	2		Value3	According to the parameter type of ID3
0x001A	2		Value4	According to the parameter type of ID4
0x001C	2		Value5	According to the parameter type of ID5
0x001E	2		Value6	According to the parameter type of ID6
0x0020	32	Entry 1		See Entry 0
0x0040		...		
0x1FE0	32	Entry 255		See Entry 0
0x2000		Unused		
0xA000	1	Day 0	Date	Integer RR*512+(M-1)*31+(D-1) RR – last two digits of the year, M – month, D – day
0xA001	1		Production	Integer Produced energy during the day XXX.XX [kWh]
0xA002	2	Day 1		See day 0
0xA004		...		
0xA2FE	2	Day 383		See day 0
0xA300		Unused		
0xB000	1	Hour 0	Date	Integer RR*512+(M-1)*31+(D-1) RR – last two digits of the year, M – month, D – day
0xB001	1		Half an hour	Integer Index of half an hour, numbered from zero (0-47). Produced energy is related to this half an hour.
0xB002	1		Production 1	Integer Produced energy during 1st ¼ hour XXXX [Wh]
0xB003	1		Production 2	Integer Produced energy during 2nd ¼ hourd XXXX [Wh]
0xB004	4	Hour 1		See hour 0
0xB008		...		
0xB2FC	4	Hour 191		See hour 0
0xB300		Unused		

7.2. Input registers read 0x04

Request

Function code	1 Byte	**0x04**
Starting address	2 Bytes	0x0000 – 0xFFFF
Nr. of registers = **N**	2 Bytes	0x0001 – 0x007D

Response

Function code	1 Byte	**0x04**
Number of bytes	1 Byty	2 x **N**
Value of registers	**N** x 2 Bytes	Values

Response at fault

Error code	1 Byte	**0x84**
Exception code	1 Byte	01, 02, 03, 04

Example of entry read of the last fault of the UNIFREM inverter (address 1).
Register of entry index is: 243 * 2 = 486 = 0x1E6
Request: 0x01, 0x03, 0x01, 0xE6, 0x00, 0x02, 0x24, 0x00
Response: 0x01, 0x03, 0x04, 0x42, 0x90, 0x00, 0x00, 0xEE, 0x66
Index of the entry is 0x42900000 = 72
Input register about the entry is: 0x18 * (72 – 1) = 0x852
Request: 0x01, 0x04, 0x08, 0x52, 0x00, 0x18, 0x53, 0xB1
Response: 0x01, 0x04, 0x30, 0x00, 0x06, 0x7E, 0x90, 0x34, 0x53, 0x00, 0x04, 0x01, 0x18, 0x21, 0x11, 0x00, 0x2E, 0x00, 0x2A, 0x00, 0x2F, 0xFF, 0xFF, 0xFF, 0xFF, 0xFF, 0xFF, 0xA6, 0xD0, 0x44, 0x08, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0xEA, 0xA4, 0xA5, 0x92, 0xF5, 0x66, 0x37, 0x8E, 0xE8 0x9A, 0x39, 0x6B, 0x72, 0x05

We can extract following information from the response:
Fault 0x0006 = E7 External fault
Time = 0x00043453 = 4:34:53
Date = 0x21110118 = 18 January 2011
ID1 = 0x002E = 46 = Voltage DC
ID2 = 0x002A = 42 = Motor current (Current MT)
ID3 = 0x002F = 47 = Inverter frequency (Freq. INV)
ID4 = ID5 = ID6 = 0xFFFF – no parameters selected
Value1 = 0x4408A6D0 = 546,6V
Value2 = 0x00000000 = 0A
Value3 = 0x00000000 = 0Hz

8 Error codes

Error code is always 0x80 + requested function

Exception code	Description
0x01	Function not supported. Function is not recognized by the slave device.
0x02	Register address is out of range. Some address between begin and end address is not supported.
0x03	Request does not contain all the data, or they are out of range (number of possible registers in one request is too high).
0x04	Access to the register (parameter) is not possible. The register can be read-only, access rights are not set properly, and the value is out of range.