Valid for the following models:
EMOTRON Modbus RTU

SERIAL COMMUNICATION OPTION

INSTRUCTION MANUAL · ENGLISH

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SAFETY INSTRUCTIONS

Instruction manual

It is important to be familiar with the main product (softstarter/ inverter) to fully understand this instruction manual.

Technically qualified personnel

Installation, commissioning, demounting, making measurements, etc. of or on the Emotron products may only be carried out by personnel technically qualified for the task.

Installation

The installation must be made by authorised personnel and must be made according to the local standards.

Opening the frequency inverter or softstarter

DANGER! ALWAYS SWITCH OFF THE MAINS VOLTAGE BEFORE OPENING THE UNIT AND WAIT AT LEAST 5 MINUTES TO ALLOW THE BUFFER CAPACITORS TO DISCHARGE.

Always take adequate precautions before opening the frequency inverter or softstarter. Although the connections for the control signals and the jumpers are isolated from the main voltage. Always take adequate precautions before opening the inverter or softstarter.

EMC Regulations

EMC regulations must be followed to fulfill the EMC standards.

CONTENT

List of tables

List of figures

1. GENERAL INFORMATION

1.1 Introduction

The MODBUS RTU optional card is an asynchronous serial interface for the frequency inverters of the VFB/VFX series and the softstarters of the MSF series to exchange data asynchronously with external equipment.

The protocol used for data exchange is based on the Modbus RTU protocol, originally developed by Modicon.

Physical connection can be either RS232 or RS485.
It acts as a slave with address 1 - 247 in a master-slave configuration. The communication is half duplex. It has a standard non return to zero (NRZ) format.
Baudrates are possible from 2400 up to 38400 bits per sec.
The character frame format (always 11 bits) has:

- one start bit
- eight data bits
- one or two stop bits
- even or no parity bit

(The frequency inverters VFB/VFX have no parity).
A Cyclic Redundancy Check is included.

1.2 Description.

This instruction manual describes the installation and operation of the MODBUS RTU option card, which can be built into the following products.:

- VFB/VFX Frequency inverters:
  - VFB40-004 to VFB40-046
  - VFB40-018 to VFX40-1k2
  - VFX50-018 to VFX50-1k2

specific information about the frequency inverters is in chapter 4. page 53.

-MSF softstarters:

- MSF-017 - MSF-1400

specific information about the sofstarters is in chapter 3. page 29.

1.3 Users

This instruction manual is intended for:
- installation engineers
- designers
- maintenance engineers
- service engineers

1.4 Safety

Because this option is a supplementary part of the frequency inverter or sofstarter, the user must be aquainted with the original instruction manual of the VFB/VFX frequency inverter and the MSF sofstarter. All safety instructions, warnings etc. as mentioned in these instruction manuals are to be known to the user.
The following indications can appear in this manual. Always read these first and be aware of their content before continuing.

NOTE! Additional information as an aid to avoiding problems.

CAUTION **Failure to follow these instructions can result in malfunction or damage to the softstarter or the frequency inverter.**

WARNING  **Failure to follow these instructions can result in serious injury to the user in addition to serious damage to the softstarter or the frequency inverter.**

DANGER  **The life of the user is in danger.**

1.5 Delivery and unpacking.

Check for any visible signs of damage. Inform your supplier immediately of any damage found. Do not install the option card if damage is found.

If the option card is moved from a cold storage room to the room where it is to be installed, condensation can form on it. Allow the option card to become fully acclimatised and wait until any visible condensation has evaporated before installing it in the inverter or softstarter.

2. MODBUS RTU

2.1 General

Devices communicate using a master-slave technique, in which only one device (the master) can initiate transactions (called 'queries'). The other devices (the slaves) respond by supplying the requested data to the master, or by taking the action requested in the query. Typical master devices include host processors and programming panels. Typical slaves include programmable controllers, motor controllers, load monitors etc, see Fig. 1.

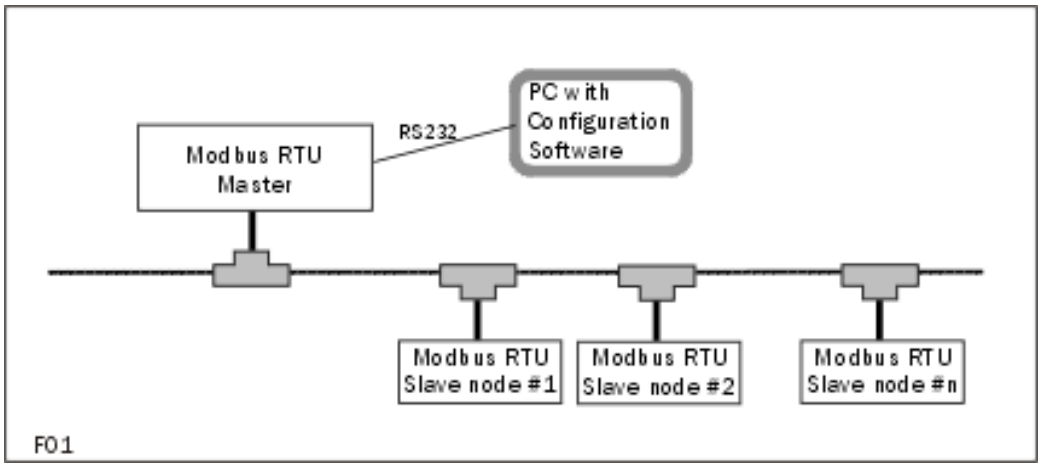


Fig. 1 Network configuration.

The master can address individual slaves. Slaves return a message (called a 'response') to queries that are addressed to them individually.

The Modbus protocol establishes the format for the master's query by placing into it the device address, a function code defining the requested action, any data to be sent, and an error checking field. The slave's response message is also constructed using Modbus protocol. It contains fields confirming the action taken, any data to be returned and an error-checking field. If an error occurred in receiving the message, or if the slave is unable to perform the requested action, the slave will construct an error message and send this as its response, see Fig. 2.

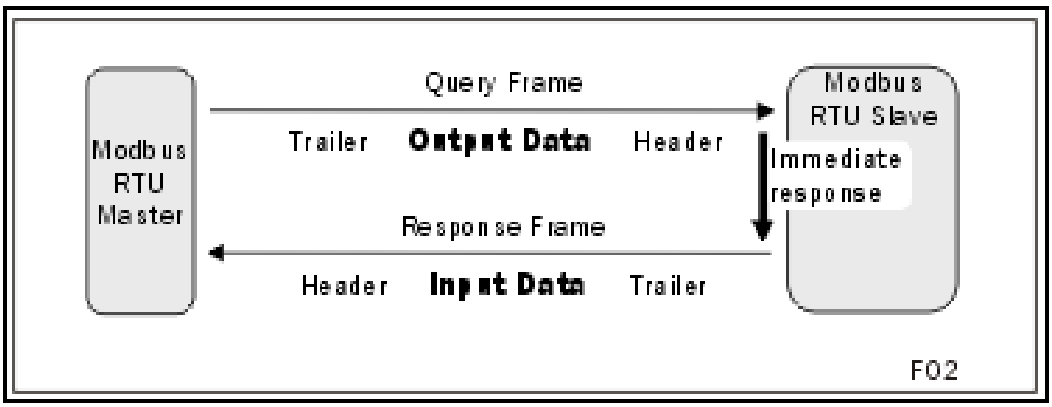


Fig. 2 Shows the MODBUS RTU data exchange.

Modbus RTU uses a binary transmission protocol.

If even parity is used, each character (8 bit data) is sent as:

Table 22 Character frame with no parity.

1	Start bit.
8	Data bits, hexadecimal 0-9,A-F, least significant bit sent first.
1	Even parity bit.
1	Stop bit.

If no parity is used each character (8 bit data) is sent as:

Table 23 Character frame with parity.

1	Start bit.
8	Data bits, hexadecimal 0-9,A-F, least significant bit sent first.
2	Stop bit.

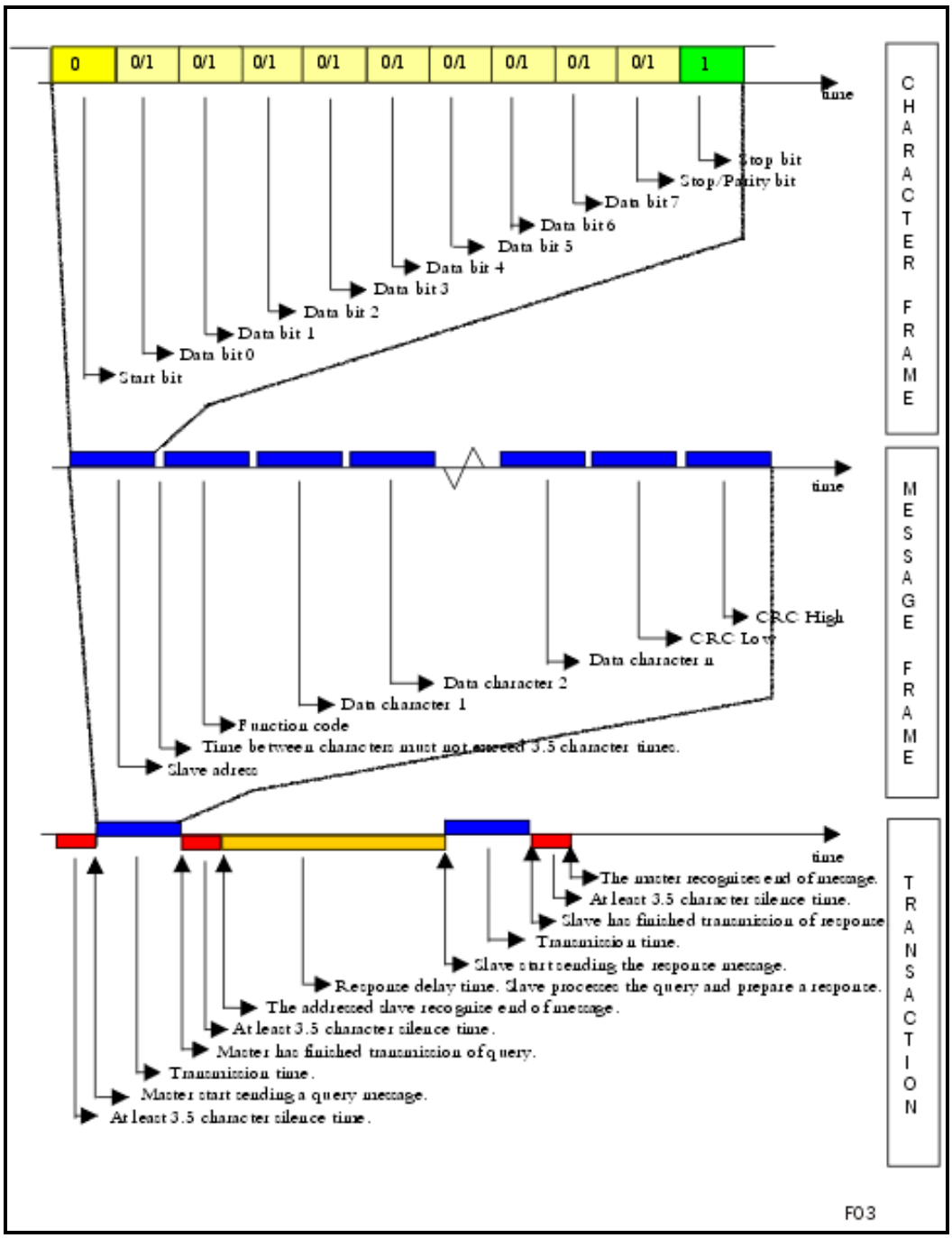


Fig. 3 Timing diagram for a transaction (query and response messages) (bottom in figure), a message frame (middle in figure) and a character frame (top in figure).

2.2 Framing

Messages start with a silent interval of at least 3.5 character times. This is easily implemented as a multiple of character times at the baud rate used on the network (shown as T1-T2-T3-T4 in the table below). The first field then transmitted is the device address.

The allowed characters transmitted for all fields are hexadecimal 0-9,A-F. Network devices monitor the network bus continuously, including during the 'silent' intervals. When the first field (the address field) is received, each device decodes it to find out if it is the addressed device.

Following the last transmitted character, a similar interval of at least 3.5 character times marks the end of the message. A new message can begin after this interval.

The entire message frame must be transmitted as a continuous stream. If a silent interval of more than 3.5 character times occurs before completion of the frame, the receiving device flushes the incomplete message and assumes that the next byte will be the address field of a new message.

Similarly, if a new message begins earlier than 3.5 character times following a previous message, the receiving device will consider it a continuation of the previous message. This will set an error, as the value in the final CRC field will not be valid for the combined messages. A typical message frame is shown below.

Header	**START**	T1-T2-T3-T4
	ADDRESS	8 bits
	FUNCTION	8 bits
Data	**DATA**	n x 8 bits
Trailer	**CRC CHECK**	16 bits
	END	T1-T2-T3-T4

2.2.1 Address field

The address field of a message frame contains eight bits. The individual slave devices are assigned addresses in the range of 1 - 247. A master addresses a slave by placing the slave address in the address field of the message.

When the slave sends its response, it places its own address in this address field of the response to let the master know which slave is responding.

2.2.2 Function field

The function code field of a message frame contains eight bits. Valid codes are in the range of 1 - 6, 15, 16 and 23. See 2.2, page 13.

When a message is sent from a master to a slave device, the function code field tells the slave what kind of action to perform.

Examples are:

- to read the ON/OFF states of a group of inputs;
- to read the data contents of a group of parameters;
- to read the diagnostic status of the slave;
- to write to designated coils or registers within the slave.

When the slave responds to the master, it uses the function code field to indicate either a normal (error-free) response or that some kind of error occurred (called an exception response). For a normal response, the slave simply echoes the original function code. For an exception response, the slave returns a code that is equivalent to the original function code with its most significant bit set to a logic 1.

In addition to its modification of the function code for an exception response, the slave places an unique code into the data field of the response message. This tells the master what kind of error occurred, or the reason for the exception, see 2.4.2, page 28.

The master device's application program has the responsibility of handling exception responses. Typical processes are to post subsequent retries of the message, to try diagnostic messages to the slave and to notify operators.

Additional information about function codes and exceptions comes later in this chapter.

2.2.3 Data field

The data field is constructed using sets of two hexadecimal digits (8 bits), in the range of 00 to FF hexadecimal.

The data field of messages sent from a master to slave devices contains additional information which the slave must use to take the action defined by the function code. This can include items like discrete and register addresses, the quantity of items to be handled and the count of actual data bytes in the field.

For example, if the master requests a slave to read a group of holding registers (function code 03), the data field specifies the starting register and how many registers are to be read. If the master writes to a group of registers in the slave (function code 10 hexadecimal), the data field specifies the starting register, how many registers to write, the count of data bytes to follow in the data field, and the data to be written into the registers.

If no error occurs, the data field of a response from a slave to a master contains the data requested. If an error occurs, the field contains an exception code that the master application can use to determine the next action to be taken.

2.2.4 CRC Error checking field

The error checking field contains a 16 bit value implemented as 2 bytes. The error check value is the result of a Cyclical Redundancy Check (CRC) calculation performed on the message contents.

The CRC field is appended to the message as the last field in the message. When this is done, the low-order byte of the field is appended first, followed by the high-order byte. The CRC high-order byte is the last byte to be sent in the message.

Additional information about CRC calculation, see chapter 5. page 78.

2.3 Functions

Emotron supports the following MODBUS function codes.

Function name	Function code
Read Coil Status	1 (01h)
Read Input Status	2 (02h)
Read Holding Registers	3 (03h)
Read Input Registers	4 (04h)
Force Single Coil	5 (05h)
Force Single Register	6 (06h)
Force Multiple Coils	15 (0Fh)
Force Multiple Registers	16 (10h)
Force/Read Multiple Holding Registers	23 (17h)

2.3.1 Read Coil Status

Read the status of digital changeable parameters.

EXAMPLE

Requesting the motor PTC input ON/OFF-state. It is ON.

PTC input: Modbus no = 29 (1Dh)
On: Yes = 1 coil = 0001
1 byte of data: Byte count=01

Request message.

Field name	Hex value
Slave address	01
Function	01
Start address HI	00
Start address LO	1D
Number of Coils HI	00
Number of Coils LO	01
CRC LO	6D
CRC HI	CC

Response message.

Field name	Hex value
Slave address	01
Function	01
Byte count	01
Coil no.29 (1Dh) status	01
CRC LO	90
CRC HI	48

See 3.8, page 40 and 4.8, page 61 for all parameters readable with this function code.

2.3.2 Read Input Status

Read the status of digital read-only information.

EXAMPLE

Request the Pre-alarm status. It is no Pre-alarm. Pre-alarm status: Modbus no= 2.

Request message.

Field name	Hex value
Slave address	01
Function	02
Start address HI	00
Start address LO	02
Number of Inputs HI	00
Number of Inputs LO	01
CRC LO	18
CRC HI	0A

Response message.

Field name	Hex value
Slave address	01
Function	02
Byte count	01
Input no.2 (02h)status	00
CRC LO	A1
CRC HI	88

See 3.9, page 41 for all digital status readable with this function code.

2.3.3 Read Holding Registers

Read the value of analogue changeable information.
Example, requesting the Nominal Motor Voltage, Nominal Motor Frequency and the Nominal Motor Current. Their values are 400.0 V, 60 Hz and 15.5 A.

400.0V, unit 0.1V - 4000 (0FA0h)
60Hz unit 1Hz - 60 (003Ch)
15.5A, unit 0.1A - 155 (009Bh)

Request message.

Field name	Hex value
Slave address	01
Function	03
Start address HI	00
Start address LO	00
Number of Registers HI	00
Number of Registers LO	03
CRC LO	05
CRC HI	CB

Response message.

Field name	Hex value
Slave address	01
Function	03
Byte count	06
Reg no. 0, (0h) data HI	0F
Reg no. 0, (0h) data LO	A0
Reg no. 1, (1h) data HI	00
Reg no. 1, (1h) data LO	3C
Reg no. 2, (2h) data HI	00
Reg no. 2, (2h) data LO	9B
CRC LO	20
CRC HI	34

See 3.11, page 45 and 4.10, page 65 for all analogue changeable parameters readable with this function code.

2.3.4 Read Input Registers

Read the contents of analogue read-only information.

EXAMPLE

Request the Shaft Torque. It is 452.0 Nm. It has a long representation, 2 registers are used.

452.0 Nm, unit 0.1 Nm - 4520 (000011A8h).

Request message.

Field name	Hex value
Slave address	01
Function	04
Start address HI	00
Start address LO	0A
Number of Registers HI	00
Number of Registers LO	02
CRC LO	51
CRC HI	C9

Response message.

Field name	Hex value
Slave address	01
Function	04
Byte count	04
Reg no. 10 (0Ah) data HI	00
Reg no. 10 (0Ah) data LO	00
Reg no. 11 (0Bh) data HI	11
Reg no. 11 (0Bh) data LO	A8
CRC LO	F6
CRC HI	6A

See 3.10, page 42 and 4.9, page 62 for all analogue read-only information readable with this function code.

2.3.5 Force Single Coil

Set the status of one changeable digital parameter.

EXAMPLE

Set the Start Command to ON. This will cause the motor to start.

Modbus no = 1 - adress LO 1 (01h)
Run = 1 - 0 Data HI 255 (0FFh), Data LO 00 (00h)

Request message.

Field name	Hex value
Slave address	01
Function	05
Start address HI	00
Start address LO	01
Data HI	FF
Data LO	00
CRC LO	DD
CRC HI	FA

Response message.

Field name	Hex value
Slave address	01
Function	05
Start address HI	00
Start address LO	01
Data HI	FF
Data LO	00
CRC LO	DD
CRC HI	FA

See 3.8, page 40 and 4.8, page 61 for all parameters changeable with this function code.

2.3.6 Force Single Register

Set the value of one analogue changeable parameter.

EXAMPLE

Set the Response Delay Max Alarm to 12.5 sec.

Modbus no 13 -> address LO (0Dh)
12.5s, unit 0.1s - 125 (7Dh)

Request message.

Field name	Hex value
Slave address	01
Function	06
Start address HI	00
Start address LO	0D
Data HI	00
Data LO	7D
CRC LO	D8
CRC HI	28

Response message.

Field name	Hex value
Slave address	01
Function	06
Start address HI	00
Start address LO	0D
Data HI	00
Data LO	7D
CRC LO	D8
CRC HI	28

See 3.11, page 45 and 4.10, page 65 for all parameters changeable with this function code.

2.3.7 Force Multiple Coil

Set the status of multiple digital changeable parameters.

EXAMPLE

Set the Alarm Reset ON and Start Command to ON. This will cause an alarm reset before the motor starts.

Coil no. = 0-1 Reset -> 1
Run = 1
->- 00000011 (03h)

Request message.

Field name	Hex value
Slave address	01
Function	0F
Start address HI	00
Start address LO	00
Number of Coils HI	00
Number of Coils LO	02
Byte count	01
Coil no. 0-1 status (0000 0011B)	03
CRC LO	9E
CRC HI	96

Response message.

Field name	Hex value
Slave address	01
Function	0F
Start address HI	00
Start address LO	00
Number of Coils HI	00
Number of Coils LO	02
CRC LO	D4
CRC HI	0A

See 3.8, page 40 and 4.8, page 61 for all parameters changeable with this function code.

2.3.8 Force Multiple Register

Set the contents of multiple changeable analogue parameters.

EXAMPLE

Set the Response Delay Min Alarm to 25.0 sec and the Min Alarm Level to 55%.

25.0 sec, unit 0.1 sec -> - 250 (00FAh)
55%, unit 1% -> 55 (0037h)

Request message.

Field name	Hex value
Slave address	01
Function	10
Start address HI	00
Start address LO	11
Number of Registers HI	00
Number of Registers LO	02
Byte count	04
Data HI reg 17 (11h)	00
Data LO reg 17 (11h)	FA
Data HI reg 18 (12h)	00
Data LO reg 18 (12h)	37
CRC LO	52
CRC HI	88

Response message.

Field name	Hex value
Slave address	01
Function	10
Start address HI	00
Start address LO	11
Number of Registers HI	00
Number of Registers LO	02
CRC LO	11
CRC HI	CD

See 3.11, page 45 and 4.10, page 65 for all parameters changeable with this function code.

2.3.9 Force / Read Multiple Register

Set and read the contents of multiple analogue changeable parameters in the same message.

EXAMPLE

Set the Parameter Set parameter to 2 and Relay 1 function to 1 and read the Nominal Motor Speed and the Nominal Motor Power. They are 1450 rpm and 17000 W.

1450 rpm, unit 1 rpm -> 1450 (05AAh)
17000 W, unit 1 W -> 17000 (4268h)

Request message.

Field name	Hex value
Slave address	01
Function	17
Start read address HI	00
Start read address LO	03
Number of read Regs HI	00
Number of read Regs LO	02
Start write address HI	00
Start write address LO	15
Number of write Regs HI	00
Number of write Regs LO	02
Byte count	04
Data HI Reg 21 (15h)	00
Data LO Reg 21 (15h)	02
Data HI Reg 22 (16h)	00
Data LO Reg 22 (16h)	01
CRC LO	62
CRC HI	77

Response message.

Field name	Hex value
Slave address	01
Function	17
Byte count	04
Reg no. 3, (3h) data HI	05
Reg no. 3, (3h) data LO	AA
Reg no. 4, (4h) data HI	42
Reg no. 4, (4h) data LO	68
CRC LO	E8
CRC HI	85

See 3.11, page 45 and 4.10, page 65 for all parameters changeable with this function code.

2.4 Errors, exception codes

Two kinds of errors are possible:
- Transmission errors.
- Operation errors.

2.4.1 Transmission errors

Transmission errors are:
- Frame error (stop bit error).
- Parity error (if parity is used).
- CRC error.
- No message at all.

These errors are caused by i.e. electrical interference from machinery or damage to the communication channel (cables, contact, I/O ports etc.). This unit will not act on or answer the master when a transmission error occurs. (Same result as if a non-existing slave is addressed). The master will eventually cause a time-out condition.

2.4.2 Operation errors

If no transmission error is detected in the master query, the message is examined. If an illegal function code, data address or data value is detected, the message is not acted upon but an answer with an exception code is sent back to the master. This unit can also send back an exception code when a set (force) function message is received during some busy operation states.

Bit 8 (most significant bit) in the function code byte is set to a '1' in the exception response message. Example with an illegal data address when reading an input register.

Exception response message.

Field name	Hex value
Slave address	01
Function	84
Exception code	02
CRC LO	C2
CRC HI	C1

Table 24 Exception codes.

Exc. code	Name	Description
01	Illegal function	This unit doesn't support the function code.
02	Illegal data address	The data address is not within its boundaries.
03	Illegal data value	The data value is not within it's boundaries.
06	Busy	The unit is unable to perform the request at this time. Retry later.

3. SOFTSTARTER MSF DATA

3.1 Installation bookshelf types

Fig. 4 shows the parts of the MODBUS RTU option.

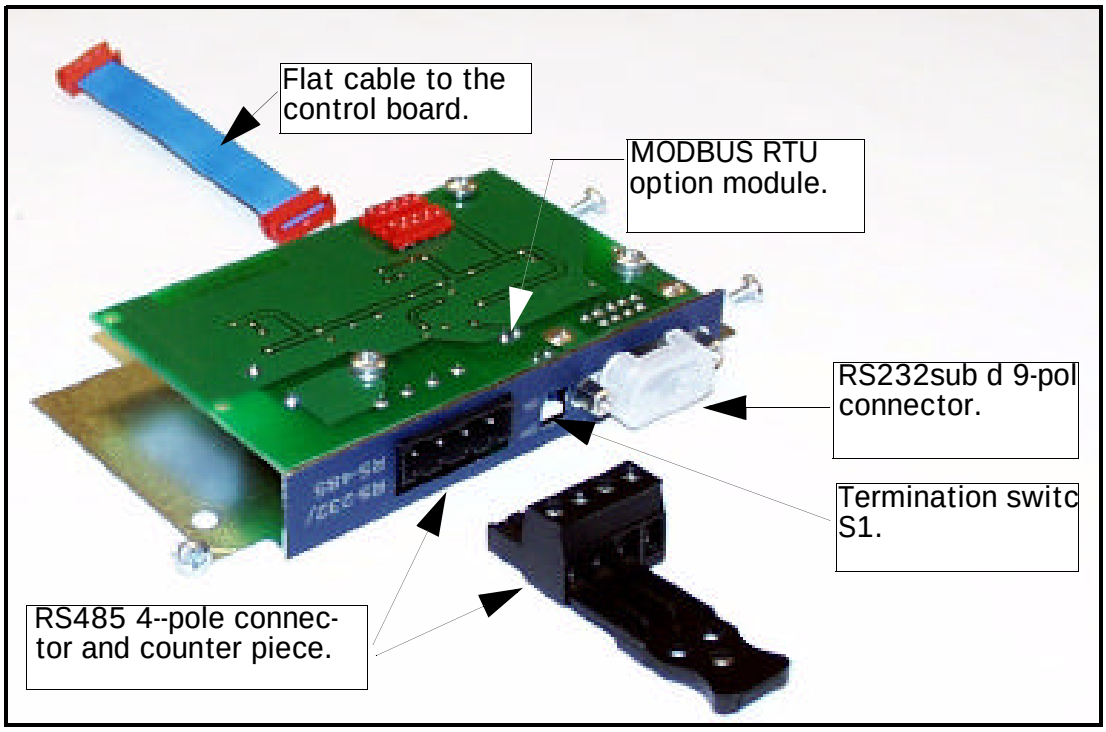


Fig. 4 MODBUS RTU option card.

WARNING! Opening the softstarter. Always switch off the mains voltage before opening the softstarter and wait at least 5 minutes to allow the buffer capacitors to discharge.

Remove first the lid on the top side of the softstarter. Mount the option card according to the sequence in Fig. 4.

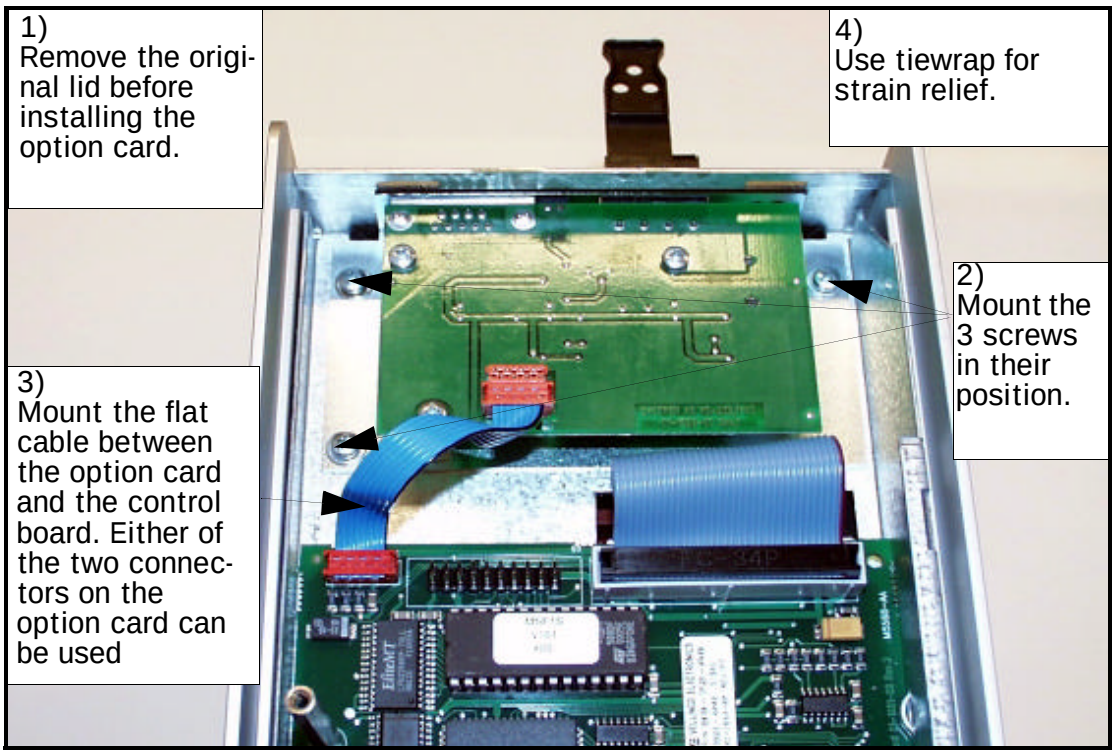


Fig. 5 Installation of the option card.

Fig. 6 Mounting of the option card seen from the top.

3.2 Installation of MSF-170 to MSF-1400

NOTE! Under construction, to be defined.

3.3 RS485 Multipoint network

The RS485 port (see Fig. 4) is used for multi point communication. A host computer (PC/PLC) can address (master) maximum 247 slave stations (nodes). See Fig. 7.

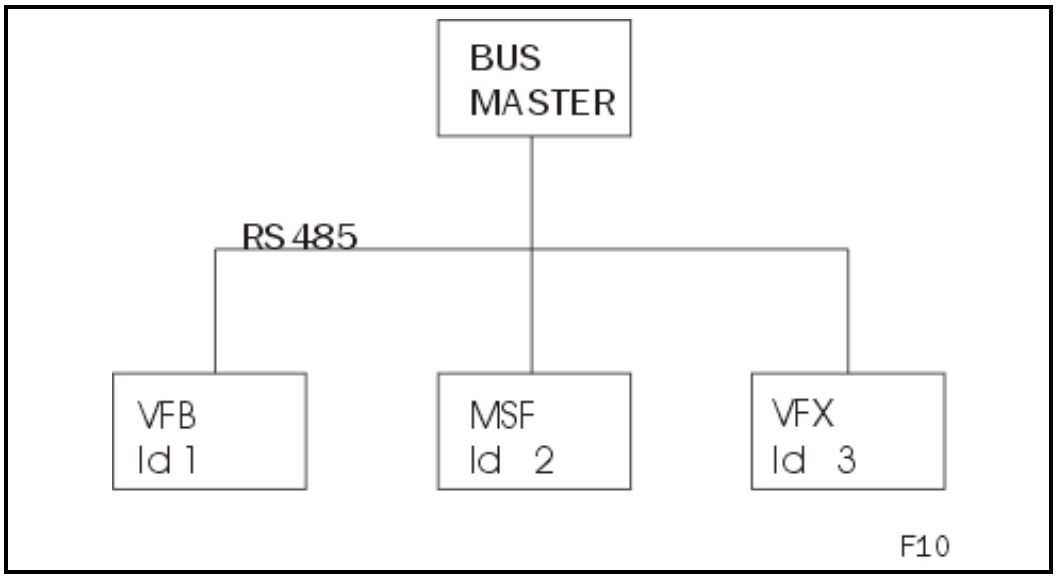


Fig. 7 RS 485 mulitpoint network

3.3.1 RS485 connection

Table 25 RS485 pinning

RS485 pin	Function
1	Ground
2	A-line
3	B-line
4	PE

The connector is a 4-pole male connector. The wiring should be done according to Fig. 8.

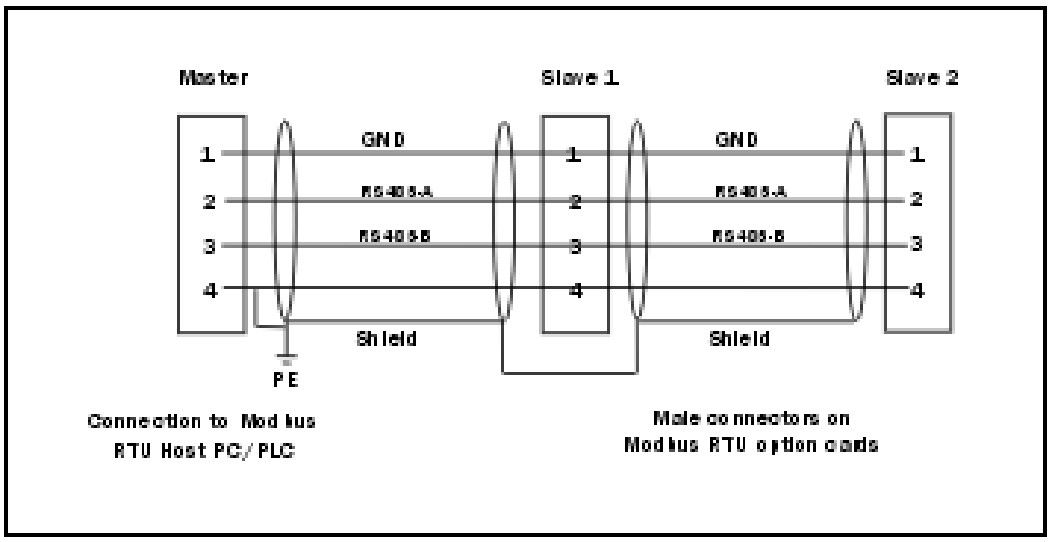


Fig. 8 RS485 wiring

3.3.2 RS485 termination.

The RS485 network must always be terminated, to avoid transmission problem. The termination must take place at the end of the network. In Fig. 8 this means that the termination must take place at the slave 2 unit.

Switch S1 (see Fig. 4) sets the termination ON or OFF as indicated in the Fig. 9 and Fig. 10.

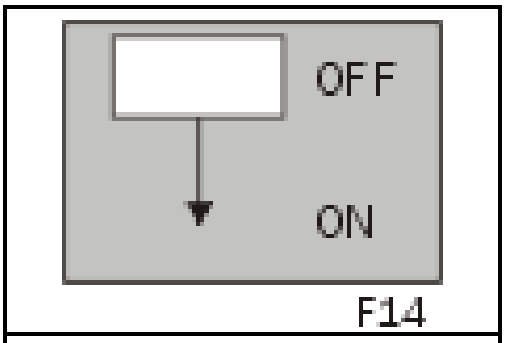


Fig. 9 Termination is OFF.

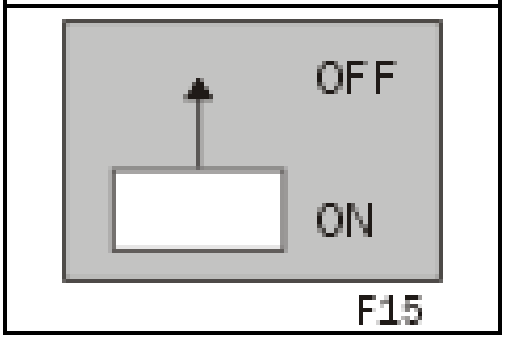


Fig. 10 Termination is ON.

NOTE! Physical connection can be either RS232 or RS485, not both on the same time.

3.4 RS232 point to point network

The RS232 port is used for point to point communication as a master slave. See fig Fig. 11.

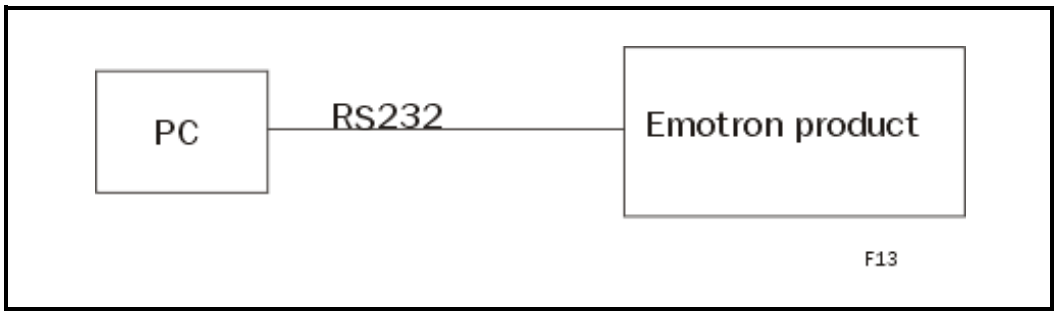


Fig. 11 RS232 point to point network

3.4.1 RS232 connection

Table 26 RS232 pinning

RS232 pin	Function
2	TX from module
3	RX to module
5	Ground

3.4.2 RS232 wiring

The RS232 port consists of a sub-D 9 pole female connector. The wiring should be done according to Fig. 11.

NOTE! Use an 1:1 cable WITHOUT a pin 2-3 crossing.

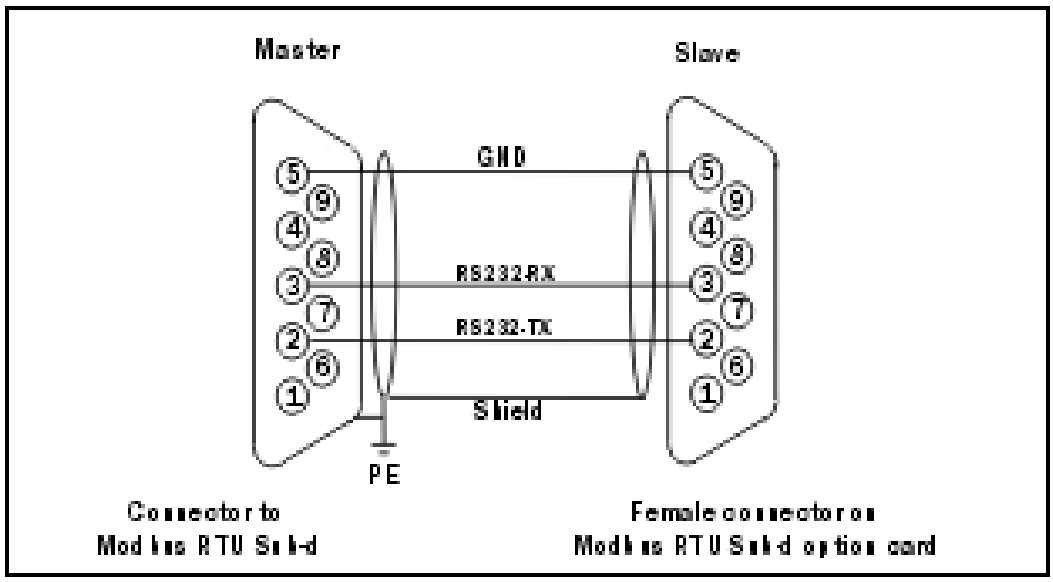


Fig. 12 RS232 wiring.

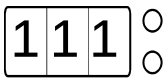
NOTE! Physical connection can be either RS232 or RS485, not both on the same time.

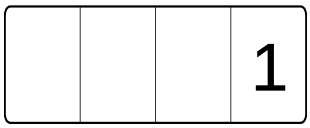
3.5 Set-up Communication Parameters for Softstarter MSF

The following parameters have to be set-up:
- Unit address.
- Baud rate.
- Parity
- Behaviour when contact broken.

Setting up the communication parameter must be made in local 'Keyboard control' mode. See 3.6.1, page 38.

Serial comm. unit address[111]

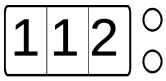


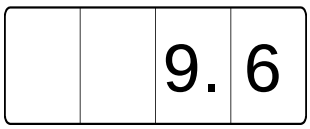


Serial comm unit address

Default:	1
Range:	1-247
This parameter will select the unit address.	

Serial comm. baudrate[112]

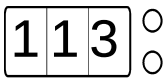


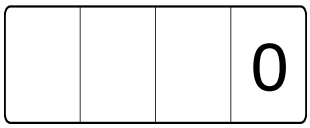


Serial comm baudrate

Default:	9.6
Range:	2.4, 4.8, 9.6, 19.2, 38.4 kBaud
This parameter will select the baudrate.	

Serial comm. parity[113]





Serial comm parity

Default:	0
Range:	0.1

This parameter will select the parity.
0 No parity.
1 Even parity.

Serial comm. broken alarm[114]

If control mode is 'Serial comm. control' and no contact is established or contact is broken the Soft starter consider the contact to be broken after 15 sec, the softstarter can act in three different ways:

1 Continue without any action at all.
2 Stop and alarm after 15 sec.
3 Continue and alarm after 15 sec.

If an alarm occurs, it is automatically reset if the communication is re-established. It is also possible to reset the alarm from the soft starter keyboard.

114 ○ ○ 1	**Serial comm. contact interrupted**
Default:	1
Range:	oFF, 1, 2
This parameter will control the behaviour in the soft starter when the serial comm. is interrupted. oFF No alarm and continue operation. 1 Alarm and stop operation. 2 Alarm and continue operation.	

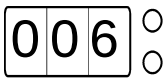
3.6 Softstarter MSF in serial comm. control mode

The source from where operation and parameter settings are made is selected in the Control Mode para-meter menu 006.
When serial communication control mode (3) is selected, it is possible to:

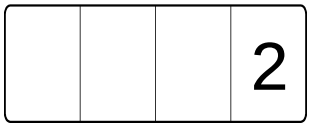
- Operate the soft starter only via serial comm.
- Set up parameters only via serial comm.
  Exceptions for the serial comm. parameters described above.
- Readout all view information and all parameters.
- Set up the control mode parameter from local MSF keyboard, but not via serial comm.
- Inspect all parameters and open the menu expansions from local MSF keyboard.

3.6.1 Selection of control mode [006]

Setting up the control mode has to be done from the local MSF keyboard.



Selection of control mode



Default:	2
Range:	1, 2, 3

This parameter will select the control mode (source).

1 Keyboard control.
2 Remote input control.
3 Serial communication control.

In all control modes it is possible to read out all the information in the soft starter via serial communication, both parameters and view information.

NOTE! When Reset to factory settings is made via serial comm., the control mode will remain in serial comm. control.

See also 6.1.7 ’Overview of soft starter operation and parameter set-up’ in MSF instruction manual.

3.7 Parameter List

Logical number is often used to give a parameter a unique number. But it is not the logical number inside the actual MODBUS message.

The following table explains the relations between logical numbers and actual numbers inside MODBUS messages.

Table 27 Parameter types

Parameter type	Modbus logical numbers	Modbus actual numbers
Coil Status	1 - 10000	0 - 9999 (Logical-1)
Input Status	10001 - 20000	0 - 9999 (Logical-10001)
Input Registers	30001 - 40000	0 - 9999 (Logical-30001)
Holding Registers	40001 - 50000	0 - 9999 (Logical-40001)

The product MSF menu column show the menu number on the PPU (Parameter Presentation Unit) for the parameter.

For more information on any parameter/function, see Instruction Manual MasterStart MSF Softstarter.

3.8 Coil status list

Table 28 Coil status list

Modbus logical no	Modbus no	Function / Name	Range / Unit	Product MSF menu
1	0	Alarm reset	0->1 = Reset	
2	1	Run /-Stop	Stop=0, Run=1	
5	4	Auto-set monitor	0->1 = Auto-set	089
6	5	Reset power con-sumption	0->1 = Reset	206
26	25	Pump control	Off, on; off=0, on=1	022
27	26	Full voltage start D.O.L.	Off, on; off=0, on=1	024
28	27	By pass	Off, on; off=0, on=1	032
29	28	Power factor control PFC	Off, on; off=0, on=1	033
30	29	Motor PTC input	No, yes; no=0, yes=1	071
31	30	Run at single phase input failure	No, yes; no=0, yes=1	101
32	31	Run at current limit time-out	No, yes; no=0, yes=1	102
33	32	Jog forward from keyb. enable	No, yes; no=0, yes=1	103
34	33	Jog reverse from keyb. enable	No, yes; no=0, yes=1	104
35	34	Phase reversal alarm	Off, on; off=0, on=1	088

3.9 Input status list

Table 29 Input status list

Modbus logical no	Modbus no	Function / Name	Range / Unit	Product MSF menu
10001	0	Locked key-board info	0=Unlocked, 1=Locked	221
10002	1	Extended start ramp time	No, yes; no=0, yes=1	S05
10003	2	Pre-Alarm status	0=No Pre-Alarm, 1=Pre-Alarm	
10004	3	Max Pre-Alarm status	0=No Pre-Alarm, 1=Pre-Alarm	
10005	4	Min Pre-Alarm status	0=No Pre-Alarm, 1=Pre-alarm	

3.10 Input register list

Table 30 Input register list

Modbus logial no	Modbus no	Function / Name	Range / Unit	Product MSF menu
30001	0	Power consumption high word	0-2E9 Wh,1Wh<->1	205
30002	1	Power consumption low word		205
30003	2	Electrical power high word	0-+-2E9 W,1 W<->1	S51
30004	3	Electrical power low word		S51
30005	4	Output shaft power high word	0-+-2E9 W,1 W<->1	203
30006	5	Output shaft power low word		203
30007	6	Operation time high word	0.1 days <->1	208
30008	7	Operation time low word	0.1 days <->1	208
30011	10	Shaft torque high word	0- +-2E8 Nm, 0.1Nm <-> 1	207
30012	11	Shaft torque low word	"	207
30017	16	Software version	r23 -> r = release, Bit 15-14 = 0,0 LB =23	
30018	17	Software variant	v001 -> HB=0, LB=01	
30019	18	Current	0-6553.5A, 0.1A<->1	005
30020	19	Phase 1 current	"	211
30021	20	Phase 2 current	"	212
30022	21	Phase 3 current	"	213
30024	23	Line main voltage	"	202
30025	24	Line main voltage 1	"	214
30026	25	Line main voltage 2	"	215
30027	26	Line main voltage 3	"	216
30028	27	Product type number	1-19 See description in 3.12.1.	
30029	28	Control start by / Control mode	1= Keyboard 2= Remote 3= Serial comm.	006

Table 30 Input register list (continuing)

Modbus logial no	Modbus no	Function / Name	Range / Unit	Product MSF menu
30031	30	Serial comm. unit address	1-247	111
30032	31	Serial comm. baudrate	2400--38400 Baud, 100 Baud <-> 1	112
30033	32	Serial comm. parity	0=No parity 1=Even parity	113
30034	33	Serial comm. contact broken	0-2 See description in 3.12.2.	114
30035	34	Actual parameter set	1-4	
30036	35	Shaft power %	-200% -+200% 1%<-> 1	090
30037	36	Cooler temperature	30.0 - 100.0°C 0.1°C <-> 1	
30041	40	Operation mode	1-7 See description in 3.12.3.	
30042	41	Operation status	1-11 See description in 3.12.4.	
30047	46	Used thermal capacity	0-150 %, 1%<->1	073
30048	47	Power factor	0.00-1.00,0.01<->1	204
30049	48	Current ratio	80 -150%, 1%<->1	
30050	49	Voltage ratio	50 -150%, 1%<->1	F12
30051	50	Phase sequence	0-2 0 = None, 1 = RST, 2 = RTS	087
30052	51	Emotron product	1=VFB / VFX, 2=MSF	
30103	102	Trip message 1	0- 16 See description in 3.12.5.	901
30106	105	Trip message 2	See trip message 1.	902
30109	108	Trip message 3	See trip message 1.	903
30112	111	Trip message 4	See trip message 1.	904

Table 30 Input register list (continuing)

Modbus logial no	Modbus no	Function / Name	Range / Unit	Product MSF menu
30115	114	Trip message 5	See trip message 1.	905
30118	117	Trip message 6	See trip message 1.	906
30121	120	Trip message 7	See trip message 1.	907
30124	123	Trip message 8	See trip message 1.	908
30127	126	Trip message 9	See trip message 1.	909
30130	129	Trip message 10	See trip message 1.	910

3.11 Holding register list

Table 31 Holding register list

Modbus logical no	Modbus no	Function / Name	Range / Unit	Product MSF menu
40001	0	Nominal motor voltage	200.0-700.0V 0.1V<->1	041
40002	1	Nominal motor frequency	50-60Hz 1Hz<->1	046
40003	2	Nominal motor current	25 %- 150% Insoft in Amp.0.1A<->1	042
40004	3	Nominal motor speed	500 - 3600 Rpm Bit15=0->1rpm<->1	044
40005	4	Nominal motor power	25% -150% Pnsoft in W; Bit15=0->1W<->1 Bit15=1->100W<->1	043
40006	5	Nominal motor cos phi	50-100, Cos phi = 1.00 <-> 100	045
40013	12	Start delay monitor	1-250sec,1sec<->1	091
40014	13	Max alarm response delay	0.1-25.0sec 0.1s->1	093
40015	14	Max alarm limit	5-200% Pn 1%<->1	092
40017	16	Max pre-alarm	5-200% Pn 1%<->1	094
40018	17	Min alarm response delay	0.1-25.0sec 0.1s<->1	099
40019	18	Min alarm limit	5-200% Pn 1%<->1	098
40020	19	Min pre-alarm response delay	0.1-25.0sec 0.1s<->1	097
40021	20	Min pre-alarm	5-200% Pn 1%<->1	096
40022	21	Parameter set	0 = External input selection 1-4 = Par. set 1-4.	061
40023	22	Relay 1	1-3 See description in 3.12.6.	051
40024	23	Relay 2	1-4 See description in 3.12.7.	052
40028	27	AnIn 1, setup	0= OFF, No remote analogue control. 1= 0-10V / 0-20mA 2= 2-10V / 4-20mA	023

Table 31 Holding register list (continuing)

Modbus logical no	Modbus no	Function / Name	Range / Unit	Product MSF menu
40037	36	AnOut 1, function	1 - 3 See description in 3.12.8.	055
40038	37	AnOut 1, setup	0= OFF, No analogue output. 1= 0-10V / 0-20mA 2= 2-10V / 4-20mA	054
40040	39	AnOut 1, scaling	5 - 150% 1% <-> 1	056
42001	2000	Initial voltage at start	25-90% U, 1% Un<->1	001
42002	2001	Start time ramp 1	1-60sec, 1 sec<->1	002
42003	2002	Step down voltage at stop	100-40% U,1% Un<->1	003
42004	2003	Stop time ramp 1	Off,1-120sec, 1s<->1	004
42005	2004	Initial voltage start ramp 2	30-90% U, 1% Un<->1	011
42006	2005	Start time ramp 2	Off,1-60sec, 1sec<->1	012
42007	2006	Step down voltage stop ramp 2	100-40% U, 1% Un<->1	013
42008	2007	Stop time ramp 2	Off,1-120sec, 1s<->1	014
42009	2008	Initial torque at start	0-200% Tn,1% Tn<->1	016
42010	2009	End torque at start	50-200% Tn, 1% Tn<->1	017
42011	2010	Torque control	Off = Torque control OFF 1 = Linear characteristic. 2 = Square characteristic.	025
42012	2011	Voltage ramp with current limit	Off, 150-500% In 1% In<->1	020
42013	2012	Current limit at start	Off, 150-500% In 1% In<->1	021
42014	2013	DC-Brake current limit	100-300% In 1% In<->1	035
42015	2014	DC-Brake active time	Off, 1-120sec, 1s<->1	034
42016	2015	Torque boost current limit	300-500% In 1% In<->1	031
42017	2016	Torque boost active time	Off, 0.1-2.0sec 0.1sec<->1	030

Table 31 Holding register list (continuing)

Modbus logical no	Modbus no	Function / Name	Range / Unit	Product MSF menu
42018	2017	Slow speed digital input	Off, 1-100 edges, 1 edge<->1	036
42019	2018	Slow speed torque	10-100, 10 <->10	037
42020	2019	Slow speed time at start	Off, 1-60sec, 1s<->1	038
42021	2020	Slow speed time at stop	Off, 1-60sec, 1s<->1	039
42022	2021	Slow speed DC-Brake time	Off, 1-60sec, 1s<->1	040
42023	2022	Motor thermal protection class	Off, 2-40sec, 1s<->1	072
42024	2023	Starts per hour limitation	Off, 1-90 / hour, 1<->1	074
42025	2024	Locked rotor alarm	Off, 0.1-10.0sec 0.1 sec<->1	075
42026	2025	Voltage unbalance alarm	5-25% Un, 1% Un<->1	081
42027	2026	Response delay voltage unbal.	Off,1-60sec, 1sec<->1	082
42028	2027	Over voltage alarm	100-150% Un 1% Un<->1	083
42029	2028	Response delay over voltage	Off, 1-60sec, 1s<->1	084
42030	2029	Under voltage alarm	75-100% Un 1% Un<->1	085
42031	2030	Response delay under voltage	Off, 1-60sec, 1sec<->1	086
42032	2031	Reset to factory settings	No, yes; no=0, yes=1	199

3.12 Parameter description MSF

The MODBUS logical number inside brackets.

For more information on any parameter/function, see Instruction Manual MasterStart MSF Softstarter.

3.12.1 Softstarter type (30028).

Table 32 Softstarter type

1 MSF-017	2 MSF-030	3 MSF-045	4 MSF-060	5 MSF-075	6 MSF-085
7 MSF-110	8 MSF-145	9 MSF-170	10 MSF-210	11 MSF-250	12 MSF-310
13 MSF-370	14 MSF-450	15 MSF-570	16 MSF-710	17 MSF-835	18 MSF-1000
19 MSF-1400					

3.12.2 Serial comm. contact broken (30034).

Table 33 Serial comm. contact broken

0	No action when communication is lost.
1	Stop and alarm after 15 sec. when communication is lost.
2	Continue and alarm after 15 sec. when communication is lost.

Communication is considered lost if no request is made to this unit within 15 sec.

3.12.3 Operation mode (30041).

1	Voltage control.
2	Torque control.
3	Current limit control.
4	Ramp with current limit control.
5	Pump application.
6	Analogue input voltage control.
7	Direct On Line start.

3.12.4 Operation status (30042).

1	Stopped.
2	Stopped with alarm condition.
3	Run with alarm condition.
4	Run acceleration.
5	Run full voltage.
6	Run deceleration.
7	Run by passed.
8	Run power factor control.
9	Run DC brake.
10	Run at slow speed forward.
11	Run at slow speed reverse.

3.12.5 Alarm (30103).

1	Phase input failure	F1
2	Motor protection, overload	F2
3	Soft start overheated	F3
4	Current limit timeout	F4
5	Locked rotor	F5
6	Above max power limit	F6
7	Below min power limit	F7
8	Voltage unbalance	F8
9	Over voltage	F9
10	Under voltage	F10
11	Starts/hour exceeded	F11
12	Shorted thyristor	F12
13	Open thyristor	F13
14	Motor terminal open	F14
15	Serial comm. broken	F15
16	Phase reversal alarm	F16

3.12.6 Relay indication K1 (40023).

1	Indicates ’Operation’.
2	Indicates ’Full voltage’.
3	Indicates ’Pre alarm’.

3.12.7 Relay indication K2 (40024).

1	Indicates 'Operation'.
2	Indicates 'Full voltage'.
3	Indicates 'Pre alarm'.
4	Indicates 'DC-brake function is chosen'.

3.12.8 Analogue output value (40037).

1	RMS current (range 0 - 5(In).
2	Main input RMS voltage (range 0 - 532V).
3	Output shaft power (range 0 - 2(Pn).

3.12.9 Reset to factory setings (42032)

Reset to factory settings from serial communication will have the same effect as if it was done from the PPU keyboard, except for one parameter. The control mode (menu 006) will remain in 3 (serial comm. control) instead of being set to the default value 2 (remote control).

3.13 Performance

It is important to configure the communication master according to the slave performance/restrictions. The total message size must not exceed 64 bytes.
Max number of registers at a time is limited to 25 (both for read and write).

Max 2 requests per sec. to reduce system disturbance.

Min 1 request per 15 sec. to avoid serial comm. contact broken alarm.

3.13.1 MSF response delay

The read function codes (1 - 4), will have a maximum delay of 250 ms.

Table 34 Response delay table for setting (forcing) registers

Modbus logical nr	Parameter	Response delay / recommended time out
40001-40006	Nominal motor data	500 ms / data
42032	Reset to factory settings	3.5 sec
	Other registers	250 ms

4. INVERTER VFB / VFX DATA

4.1 Installation bookshelf types

Fig. 13 shows the parts of the MODBUS RTU option.

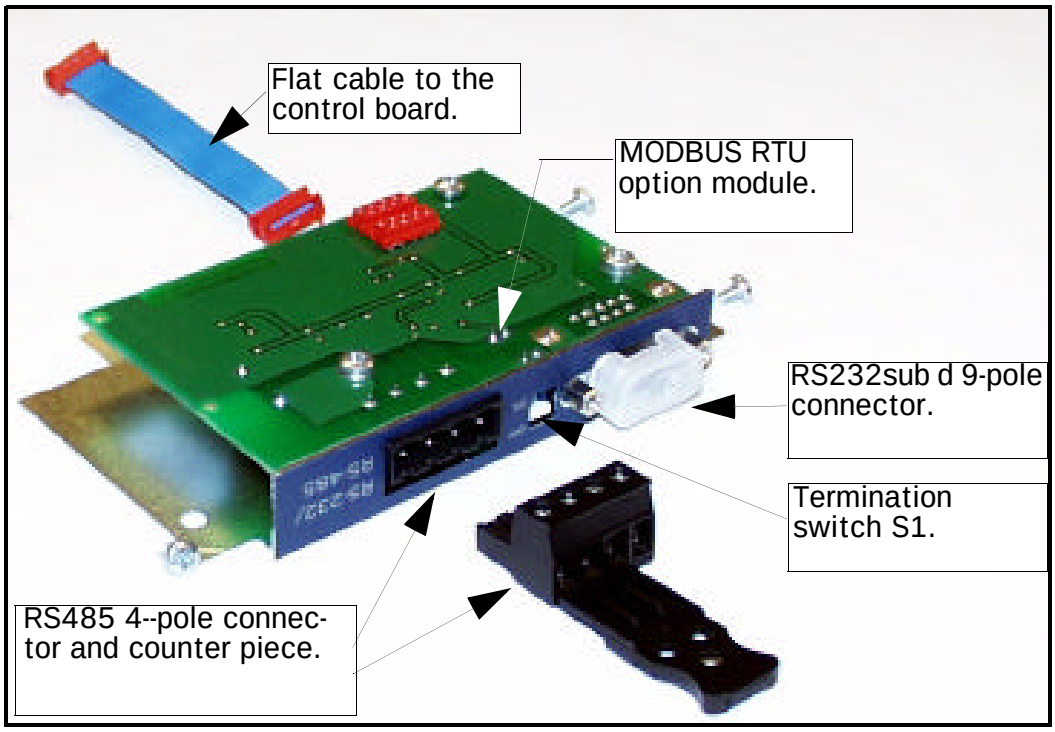


Fig. 13 MODBUS RTU option card.

WARNING! Opening the inverter. Always switch off the mains voltage before opening the inverter and wait at least 5 minutes to allow the buffer capacitors to discharge.

Remove first the lid on the top side of the inverter. Mount the option card according to the sequence in Fig. 14.

4.1.1 Mounting option card

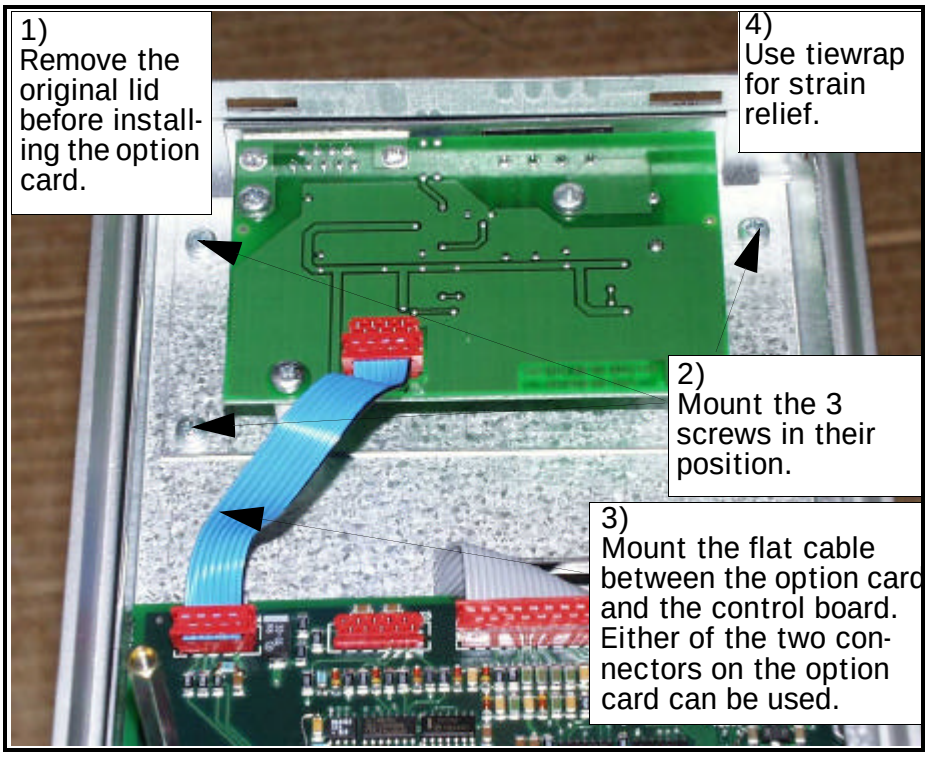


Fig. 14 Installation of the option card in VFB.

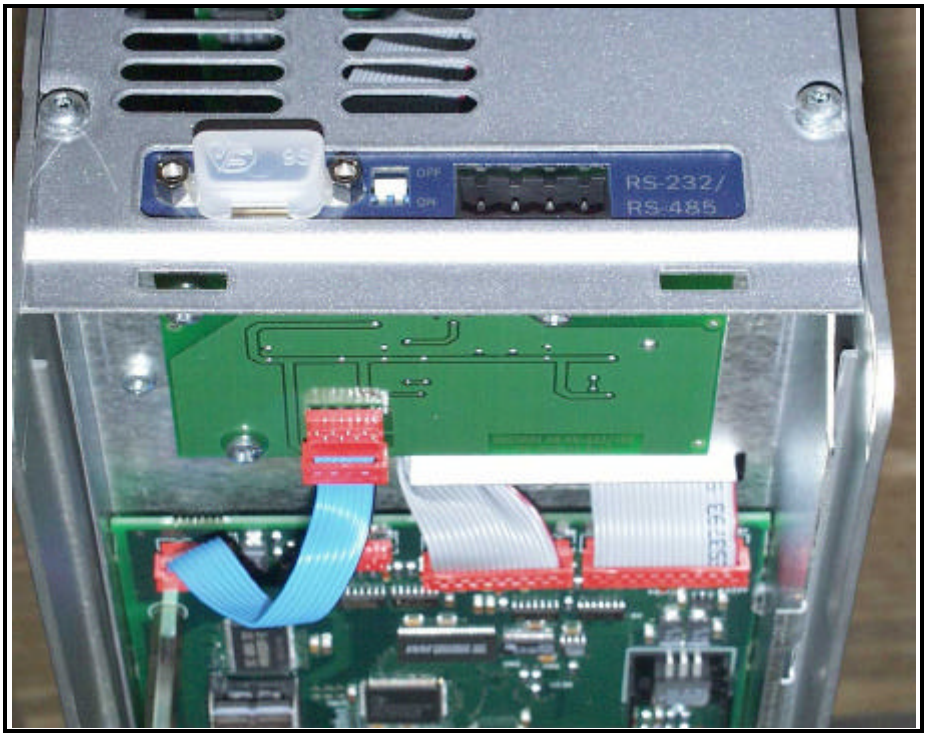


Fig. 15 Mounting of option card from above in VFB.

4.2 Installation of VFX types

NOTE! Pictures are under construction, to be defined.

4.3 RS485 Multipoint network

The RS485 port (see Fig. 13) is used for multi point communication. A host computer (PC/PLC) can address (master) maximum 247 slave stations (nodes). See Fig. 16.

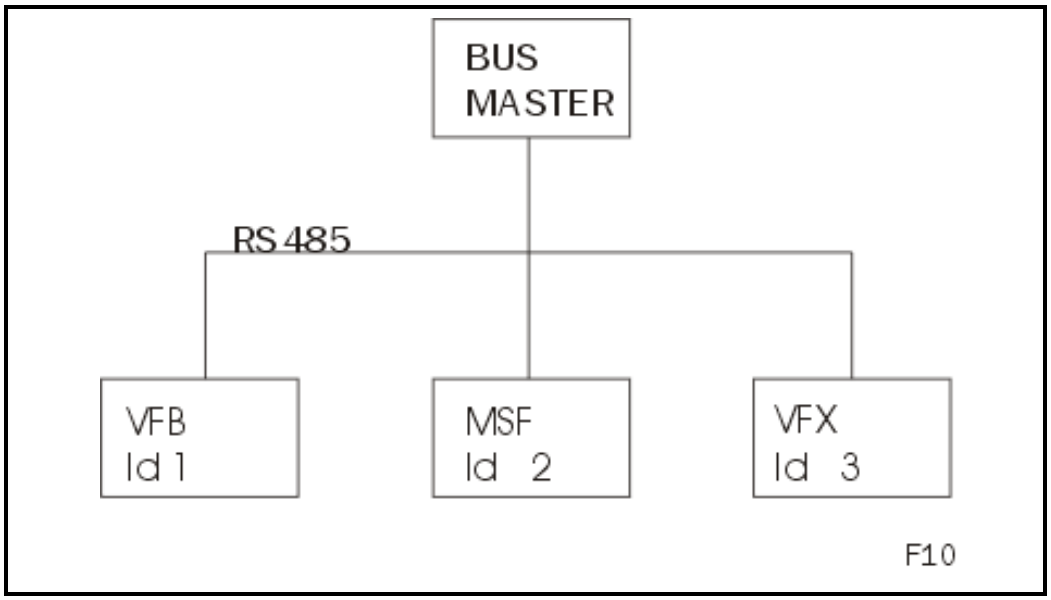


Fig. 16 RS 485 multipoint network

4.3.1 RS485 connection

Table 35 RS485 pinning

RS485 pin	Function
1	Ground
2	A-line
3	B-line
4	PE

The connector is a 4-pole male connector. The wiring should be done according to Fig. 17.

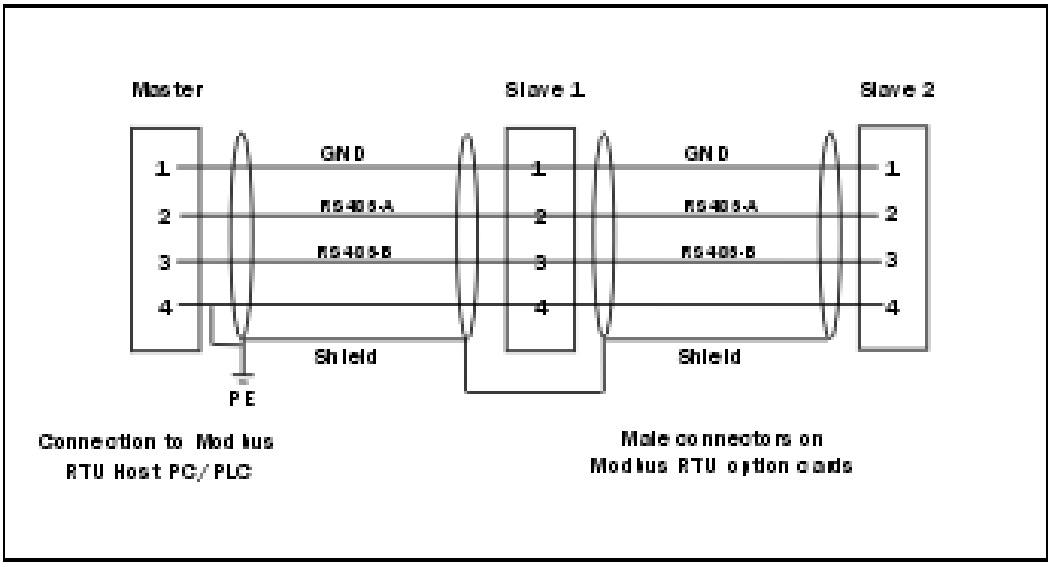


Fig. 17 RS485 wiring

4.3.2 RS485 termination.

The RS485 network must always be terminated, to avoid transmission problem. The termination must take place at the end of the network. In finure 5 this means that the termination must take place at the slave 2 unit.

Switch S1 (see Fig. 4) sets the termination ON or OFF as indicated in the Fig. 18 and Fig. 19.

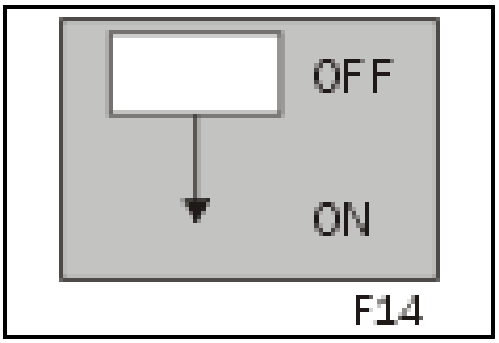


Fig. 18 Termination is OFF

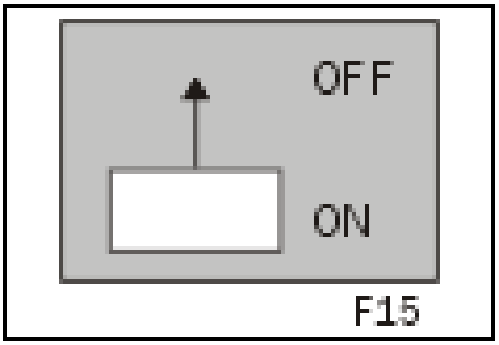


Fig. 19 Termination is ON

NOTE! Physical connection can be either RS232 or RS485, not both on the same time.

4.4 RS232 point to point network

The RS232 port is used for point to point communication as a master slave. See fig Fig. 20.

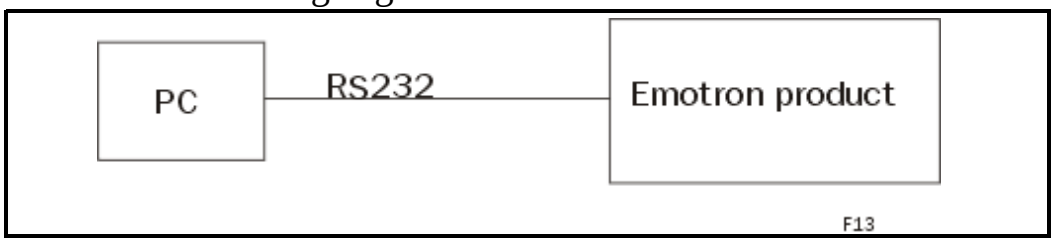


Fig. 20 RS232 point to point network

4.4.1 RS232 connection

Table 36 RS232 pinning

RS232 pin	Function
2	TX from module
3	RX to module
5	Ground

4.4.2 RS232 wiring

The RS232 port consists of a sub-D 9 pole female connector. The wiring should be done acc. to Fig. 20.

NOTE! Use an 1:1 cable WITHOUT a pin 2-3 crossing.

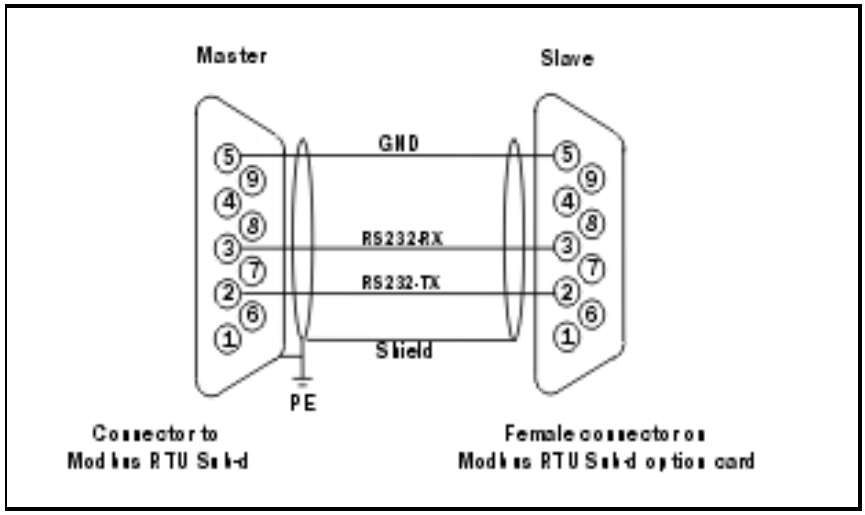


Fig. 21 RS232 wiring

NOTE! Physical connection can be either RS232 or RS485, not both on the same time.

4.5 Set-up Communication Parameters for frequency inverter VFB / VFX

The following parameters have to be set-up:
- Unit address.
- Baud rate.

Serial comm. unit address[262]

	262 Address Stp **1**
Default:	1
Range	1-247
This parameter will select the unit address.	

Serial comm. baud rate[261]

	261 Baudrate Stp **9600**
Default:	9600
Range	2400, 4800, 9600, 19200, 38400
This parameter will select the baudrate.	

4.6 Frequency inverter VFB/VFX in serial comm Control Mode

The serial comm link will have access to all parameters in the VFB/VFX inverter. If a valid setting for a parameter is received over the serial link that parameter will be accepted and changed. This means that the control panel and serial comm can be used in parallel. There are some limitations of writing data when the inverter is started, see manual for further information. The only parameters that can't be used in parallell is start/stop and reference values, see 4.5.

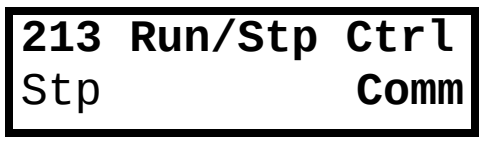
Ref control

To be able to use the serial comm as a source for the speed or torque reference menu 212 has to be set to Comm or Comm/DigIn1. See Instruction Manual VFB/VFX for further description.

	
Default:	Remote
Range	Remote, keyboard, Comm, Rem/DigIn1,or Comm/DigIn1
This parameter will select reference source	

Run/Stp ctrl

To be able to use the serial comm as a source for starting and stopping the inverter menu 213 has to be set to Comm or Comm/DigIn1. See Instruction Manual VFB/VFX for further description.

	
Default:	Remote
Range	Remote, keyboard, Comm, Rem/DigIn1, or Comm/DigIn1
This parameter will select run/stop source	

4.7 Parameter List

Logical number is often used to give a parameter a unique number. But it is not the logical number inside the actual MODBUS message.

The following table explains the relations between logical numbers and actual numbers inside MODBUS messages.

Table 37 Parameter type

Parameter type	Modbus logical numbers	Modbus actual numbers
Coil Status	1 - 10000	0 - 9999 (Logical-1)
Input Registers	30001 - 40000	0 - 9999 (Logical-30001)
Holding Registers	40001 - 50000	0 - 9999 (Logical-40001)

The product VFB/VFX menu column show the menu number on the control panel for the parameters.

For more information on any parameter/function, see Instruction Manual VFB/VFX.

4.8 Coil status list

Table 38 Coil status list

Modbus logical no	Modbus no	Function / Name	Range / Unit	Product VFB / VFX menu
1	0	Alarm reset	0->1 = Reset	
2	1	Run /-Stop	Stop=0, Run=1	
3	2	Run Right	1=Run R	
4	3	Run Left	1=Run L	
5	4	Auto-set monitor	0->1 = Auto-set	815
6	5	Reset power consumption	0->1 = Reset	6F1
7	6	Reset Run-Time	0->1 = Reset	6D1
8	7	Reset Trip Log	0->1 = Reset	7B0
10	9	Auto-restart, Overtemp trip	Off, on; off=0, on=1	242
11	10	Auto-restart, I^2t	Off, on; off=0, on=1	243
12	11	Auto-restart, Overvolt D	Off, on; off=0, on=1	244
13	12	Auto-restart, Overvolt G	Off, on; off=0, on=1	245
14	13	Auto-restart, Overvolt L	Off, on; off=0, on=1	246
15	14	Auto-restart, PTC	Off, on; off=0, on=1	247
16	15	Auto-restart, External trip	Off, on; off=0, on=1	248
17	16	Auto-restart, Phase loss motor	Off, on; off=0, on=1	249
18	17	Auto-restart, Alarm	Off, on; off=0, on=1	24A
19	18	Auto-restart, Locked rotor	Off, on; off=0, on=1	24B
20	19	Auto-restart, Power fault	Off, on; off=0, on=1	24C
30	29	Motor PTC input	no, yes; no=0, yes=1	271

4.9 Input register list

Table 39 Input register list

Modbus logical no	Modbus no	Function / Name	Range / Unit	Product VFB / VFX menu
30001	0	Power consumption high word	0-2E9 Wh, 1 Wh<->1	6F0
30002	1	Power consumption low word		6F0
30003	2	Electrical power high word	0 -+ -2E9 W, 1 W<->1	640
30004	3	Electrical power low word		640
30005	4	Output shaft power high word	0 - + - 2E9 W, 1 W<->1	630
30006	5	Output shaft power low word		630
30007	6	Operation time high word	0 - 65535 h, 1 h<->1	6D0
30008	7	Operation time low word	0 - 59 Min, 1 min<->1	6D0
30009	8	Mains time hour	0 - 65535 h, 1 h<->1	6E0
30010	9	Mains time min	0 - 59 Min, 1 min<->1	6E0
30011	10	Shaft torque high word	0- +-2E8 Nm, 0.1Nm <->1	620
30012	11	Shaft torque low word	"	620
30013	12	Process speed high word	1 - + - 2E8 Rpm, 1 rpm<->1000	6G0
30014	13	Process speed low word	"	6G0
30015	14	Shaft speed high word	0-2E8 rpm,1 rpm<->1	610
30016	15	Shaft speed low word	"	610
30017	16	Software version	V1.23 -> Release Bit 15-14= 0,0 Bit 13-8=1, LB =23 See 4.11.	920
30018	17	Option / variant version	OPT V2.34 -> HB = 2, LB =34	920
30019	18	Current	0-6553.5 A, 0.1A <-> 1	650
30023	22	Output voltage	0-6553.5 V, 0.1V<->1	660
30028	27	Product type number	See description in 4.11.	910

Table 39 Input register list (continuing)

Modbus logical no	Modbus no	Function / Name	Range / Unit	Product VFB / VFX menu
30029	28	Control start by / Control mode	0=Remote, 1=Keyboard, 2=Serial comm	
30030	29	Control ref by	0=Remote 1=Keyboard 2=Serial comm	
30031	30	Serial comm. unit address	1-247	262
30032	31	Serial comm. baudrate	1=2400, 4=19200, 2=4800 5=38400 3=9600,	261
30035	34	Actual parameter set	0-3; 0= A, 2=C, 1=B 3=D	3XX
30036	35	Shaft torque %	-400%-+400% 1%<->1	620
30037	36	Cooler temperature	-40.0-+100.0°C, 0.1°C<->1	690
30038	37	Frequency	0-2000.0Hz, 0.1Hz<->1	670
30039	38	DC-link voltage	0-1000V, 0.1V<->1	680
30040	39	Warning	0-31 See description in 4.11.3.	6H0
30043	42	Digital input status	See description in 4.11.6.	6B0
30044	43	Analog input status 1	-100 -+100%, 1%<->1	6C0
30045	44	Analog input status 2	-100 -+100%, 1%<->1	6C0
30046	45	Param_version	For internal use	
30052	51	Emotron product	1=VFB / VFX, 2=MSF	
30101	100	Trip time 1 h	0-65535 h, 1h<->1	710
30102	101	Trip time 1 min	0-59 Min, 1 min<->1	710
30103	102	Trip message 1	0-31 See description in 4.11.3.	710
30104	103	Trip time 2 h	0-65535 h, 1h<->1	720
30105	104	Trip time 2 min	0-59 Min, 1 min<->1	720

Table 39 Input register list (continuing)

Modbus logical no	Modbus no	Function / Name	Range / Unit	Product VFB / VFX menu
30106	105	Trip message 2	See trip message 1.	720
30107	106	Trip time 3 h	0-65535 h, 1h<->1	730
30108	107	Trip time 3 min	0-59 Min, 1 min<->1	730
30109	108	Trip message 3	See trip message 1.	730
30110	109	Trip time 4 h	0-65535 h, 1h<->1	740
30111	110	Trip time 4 min	0-59 Min, 1 min<->1	740
30112	111	Trip message 4	See trip message 1.	740
30113	112	Trip time 5 h	0-65535 h, 1h<->1	750
30114	113	Trip time 5 min	0-59 Min, 1 min<->1	750
30115	114	Trip message 5	See trip message 1.	750
30116	115	Trip time 6 h	0-65535 h, 1h<->1	760
30117	116	Trip time 6 min	0-59 Min, 1 min<->1	760
30118	117	Trip message 6	See trip message 1.	760
30119	118	Trip time 7 h	0-65535 h, 1h<->1	770
30120	119	Trip time 7 min	0-59 Min, 1 min<->1	770
30121	120	Trip message 7	See trip message 1.	770
30122	121	Trip time 8 h	0-65535 h, 1h<->1	780
30123	122	Trip time 8 min	0-59 Min, 1 min<->1	780
30124	123	Trip message 8	See trip message 1.	780
30125	124	Trip time 9 h	0-65535 h, 1h<->1	790
30126	125	Trip time 9 min	0-59 Min, 1 min<->1	790
30127	126	Trip message 9	See trip message 1.	790
30128	127	Trip time 10 h	0-65535 h, 1h<->1	7A0
30129	128	Trip time 10 min	0-59 Min, 1 min<->1	7A0
30130	129	Trip message 10	See trip message 1.	7A0

4.10 Holding register list

Table 40 Holding register list

Modbus logical no	Modbus no	Function / Name	Range / Unit	Product VFB / VFX menu
40001	0	Nominal motor voltage	100.0-700.0V	222
40002	1	Nominal motor frequency	50-300Hz	223
40003	2	Nominal motor current	25% I_nom-3200.0A	224
40004	3	Nominal motor speed	100-18000 rpm Bit15=0->1rpm<->1 Bit15=1->100rpm<->1	225
40005	4	Nominal motor power	1-3276700W Bit15=0->1W<->1 Bit15=1->100W<->1	221
40006	5	Nominal motor cos phi	50-100, cos phi =1.00<->100	226
40007	6	Motor ventilation	0=Off, 1=Self, 2=Forced	227
40008	7	Remote input level edge	0=Level, 1=Edge	215
40009	8	Encoder pulses	5-32767 pulses / rev	252
40010	9	Encoder enable	0=Off 1=On	251
40011	10	Aarm select	0=Off, 1=Max, 2=Min, 3=Min+max	811
40012	11	Ramp enable	0=Off, 1=On	812
40013	12	Start delay monitor	0-3600sec	813
40014	13	Max alarm response delay	0.1- 90.0sec	814
40015	14	Max alarm limit	0-400% Tn	816
40017	16	Max pre-alarm	0-400% Tn	817
40018	17	Min alarm response delay	40014 is used for all delays	
40019	18	Min alarm limit	0-400% Tn	818
40020	19	Min pre-alarm response delay	40014 is used for all delays	
40021	20	Min pre-alarm	0-400% Tn	819

Table 40 Holding register list (continuing)

Modbus logical no	Modbus no	Function / Name	Range / Unit	Product VFB / VFX menu
40022	21	Parameter set	0=A, 4=DI3, 1=B, 5=DI3+4, 2=C, 6=Comm 3=D,	234
40023	22	Relay 1	0-21 See description in 4.11.4.	451
40024	23	Relay 2	0-21 See description in 4.11.4.	452
40025	24	Relay 3	Not defined yet.	
40026	25	Relay 4	Not defined yet.	
40027	26	AnIn 1, function	0=Off, 1=Speed, 2=Torque	411
40028	27	AnIn 1, setup	0=0-10V / 0-20mA 1=2-10V / 4-20mA 2=User defined	412
40029	28	AnIn 1, offset	-100% - +100% 1% <-> 1	413
40030	29	AnIn 1, gain	-4.00 - +4.00, 0.01 <-> 1	414
40031	30	AnIn 1, bipolar	0=Off, 1=On	415
40032	31	AnIn 2, function	0=Off, 1=Speed, 2=Torque	416
40033	32	AnIn 2, setup	0=0-10V / 0-20mA, 1=2-10V / 4-20mA, 2=User defined	417
40034	33	AnIn 2, offset	-100% - +100% 1% <-> 1	418
40036	35	AnIn 2, bipolar	0=Off, 1=On	41A
40037	36	AnOut 1, function	0=Torque, 1=Speed, 4=Current, 2=Shaft power, 5=El.power, 3=Frequency, 6=Outp.voltage	431
40038	37	AnOut 1, setup	0=0-10V / 0-20mA 1=2-10V / 4-20mA 2=User defined	432
40039	38	AnOut 1, offset	-100% - +100% 1% <-> 1	433
40040	39	AnOut 1, gain	-4.00 - +4.00 0.01 <-> 1	434

Table 40 Holding register list (continuing)

Modbus logical no	Modbus no	Function / Name	Range / Unit	Product VFB / VFX menu
40041	40	AnOut 1, bipolar	0=Off, 1=On	435
40042	41	AnOut 2, function	0=Torque, 4=Current, 1=Speed, 5=El.power, 2=Shaft power, 6=Outp. 3=Frequency, voltage	436
40043	42	AnOut 2, setup	0=0-10V / 0-20mA, 1=2-10V / 4-20mA, 2=User defined	437
40044	43	AnOut 2, offset	-100% - +100% 1% <-> 1	438
40045	44	AnOut 2, gain	-4.00 - +4.00, 0.01 <-> 1	439
40046	45	AnOut 2, bipolar	0=Off, 1=On	43A
40047	46	AnOut 3, function	0=Torque, 4=Current, 1=Speed, 5=El.power, 2=Shaft power, 6=Outp 3=Frequency, voltage	
40048	47	AnOut 3, setup	0=0-10V / 0-20mA, 1=2-10V / 4-20mA, 2=User defined	
40049	48	AnOut 3,offset	-100% - +100% 1% <-> 1	
40050	49	AnOut 3, gain	-4.00 - +4.00, 0.01 <-> 1	
40051	50	AnOut 3, bipolar	0=Off, 1=On	
40052	51	AnOut 4, function	0=Torque, 4=Current, 1=Speed, 5=El.power, 2=Shaft power, 6=Outp 3=Frequency, voltage	
40053	52	AnOut 4, setup	0=0-10V / 0-20mA, 1=2-10V / 4-20mA, 2=User defined	
40054	53	AnOut 4, offset	-100% - +100% 1% <-> 1	
40055	54	AnOut 4, gain	-4.00 - +4.00, 0.01 <-> 1	
40057	56	AnOut 5, function	0=Torque, 4=Current, 1=Speed, 5=El.power, 2=Shaft power, 6=Outp 3=Frequency, voltage	
40058	57	AnOut 5, setup	0=0-10V / 0-20mA, 1=2-10V / 4-20mA, 2=User defined	

Table 40 Holding register list (continuing)

Modbus logical no	Modbus no	Function / Name	Range / Unit	Product VFB / VFX menu
40059	58	AnOut 5, offset	-100% - +100% 1% <-> 1	
40060	59	AnOut 5, gain	-4.00 - +4.00, 0.01 <-> 1	
40061	60	AnOut 5, bipolar	0=Off, 1=On	
41001	1000	Comm, ref	100% <-> 0x2000	
41002	1001	Operation.drive mode	0=Speed, 1=Torque, 2=V / Hz	211
41003	1002	Operation.ref ctrl	0=Remote, 1=Keyboard, 2=Comm	212
41004	1003	Operation.run stop ctrl	0=Remote, 3=Rem / digin1, 1=Keyboard, 4=Comm / digin1 2=Comm,	213
41005	1004	Operation.rotation	0=R+L, 1=R, 2=L	214
41006	1005	Utility.auto restart mask	16-bit mask	
41007	1006	Utility.auto restart	0-10	241
41008	1007	DigIn 1	0-11 See description in 4.11.6.	421
41009	1008	DigIn 2	0-11 See description in 4.11.6.	422
41010	1009	DigIn 3	0-11 See description in 4.11.6.	423
41011	1010	DigIn 4	0-11 See description in 4.11.6.	424
41014	1013	DigOut 1	0-21 See description in 4.11.4.	441
41015	1014	DigOut 2	0-21 See description in 4.11.4.	442
41018	1017	Crio enable	0=Off, 1=On	281
41019	1018	Crio control	0=4-Speed, 1=3-pos, 2=Analogue	282

Table 40 Holding register list (continuing)

Modbus logical no	Modbus no	Function / Name	Range / Unit	Product VFB / VFX menu
41020	1019	Crio relay 1	0-21 See description in 4.11.4.	283
41021	1020	Crio relay 2	0-21 See description in 4.11.4.	284
41022	1021	Process unit	0=None, 3=m/s, 1=rpm, 4=/min, 2=%, 5=/hr	6G1
41023	1022	Process scale	0-10.000, 0.0001 <=> 1	6G2
41024	1023	Multiple display 1	0=Speed, 6=Frequency, 1=Torque, 7=DC voltage, 2=Shaft power,8=Temp, 3=El power, 9=Drive 4=Current, status, 5=Voltage, 10=Process speed	110
41025	1024	Multiple display 2	See 41024	120
41026	1025	Utility language	0=English, 3=Dutch, 1=German, 4=French 2=Swedish,	231
41027	1026	Utility keyboard locked	0=Unlocked, 1=Locked	232
41028	1027	Serial com. address	1-247	262
41029	1028	Serial com. Baud-rate	1=2400, 4=19200, 2=4800 5=38400 3=9600,	261
41030	1029	Serial com. parity	0=None	
41032	1031	MVB card on/off	0=Off, 1=On	291

Table 41 Parameter set A

***	***	VFB / VFX Parameter set A	***	***
41101	1100	Acceleration time	0.00-3600.00 See description in 4.11.7	311
41102	1101	Deceleration time	0.00-3600.00 See description in 4.11.7	313
41103	1102	Q-stop time	0.00-3600.00 See description in 4.11.7	31B
41104	1103	Acceleration shape	0=Linear, 1=S-curve	312
41105	1104	Deceleration shape	0=Linear, 1=S-curve	314
41106	1105	Q-stop shape	0=Linear	
41111	1110	Wait before brake time	0.00-3.00, 0.01s<->1	319
41112	1111	Vector brake	0=Off, 1=On	31A
41113	1112	Spinstart	0=Off, 1=On	31C
41114	1113	Motor pot function	0=Volatile, 1=Non-volatile	325
41115	1114	Minspeed mode	0=Scale, 1=Limit, 2=Stop	323
41116	1115	Minimum speed	0- Maximum speed, see description in 4.11.7	321
41117	1116	Maximum speed	Minimum speed-2*motor sync speed, see description in 4.11.7	322
41118	1117	Preset speed 1	0-2*Motor sync speed, see description in 4.11.7	326
41119	1118	Preset speed 2	0-2*Motor sync speed, see description in 4.11.7	327
41120	1119	Preset speed 3	0-2*Motor sync speed, see description in 4.11.7	328
41121	1120	Preset speed 4	0-2*Motor sync speed, see description in 4.11.7	329
41122	1121	Preset speed 5	0-2*Motor sync speed, see description in 4.11.7	32A
41123	1122	Preset speed 6	0-2*Motor sync speed, see description in 4.11.7	32B
41124	1123	Preset speed 7	0-2*Motor sync speed, see description in 4.11.7	32C

Table 41 Parameter set A (continuing)

***	***	VFB / VFX Parameter set A	***	***
41125	1124	Skip speed 1 Low	0-2*Motor sync speed, see description in 4.11.7	32D
41126	1125	Skip speed 1 High	0-2*Motor sync speed, see description in 4.11.7	32E
41127	1126	Skip speed 2 Low	0-2*Motor sync speed, see description in 4.11.7	32F
41128	1127	Skip speed 2 High	0-2*Motor sync speed, see description in 4.11.7	32G
41129	1128	Jog speed	0-±2*Motor sync speed, see description in 4.11.7	32F
41130	1129	Maximum torque	0-400%, 1%<-> 1 or I_max / motor In	331
41131	1130	Speed P gain	0.1-30.0, 0.1<->1	342
41132	1131	Speed I time	0.01-10.00s, 0.01s<->1	343
41133	1132	Flux optimization	0=Off, 1=On	344
41134	1133	PID-controller	0=Off, 1=On, 2=Invert	345
41135	1134	PID-controller P gain	0.1-30.0, 0.1<->1	346
41136	1135	PID-controller I time	0.01-300.00s, 0.01s<->1	347
41137	1136	PID-controller D time	0.01-30.00s, 0.01s<->1	348
41138	1137	Low voltage overr-ride	0=Off, 1=On	351
41139	1138	Rotor locked	0=Off, 1=On	352
41140	1139	Motor lost	0=Off, 1=Resume, 2=Trip	353
41141	1140	Motor I2t type	0=Off, 1=Trip, 2=Limit	354
41142	1141	Motor I2t current	0-150% inverter i_nom, 0.1A<->1	355
41143	1142	Speed direction	0=R, 1=L, 2=R+L	324
41144	1143	Start speed	0 - + -2*Motor sync speed, see description i 4.11.7, page 76.	321

Table 42 Parameter set B, C and D

***	***	**VFB / VFX Parameter set B**	***	***
41201- 41299	1200-1298	/ * Parameter set B * /		
***	***	**VFB / VFX Parameter set C**	***	***
41301- 41399	1300-1398	/ * Parameter set C * /		
***	***	**VFB / VFX Parameter set D**	***	***
41401- 41499	1400-1498	/ * Parameter set D * /		

4.11 Parameter description VFB / VFX

The MODBUS logical number inside brackets.

For more information on any parameter/function, see Instruction Manual Vectorflux VFB/VFX.

4.11.1 Inverter software version (30017).

MSB	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0	LSB

Bit F,E	**Release Type:**	00	Release (V)
		01	Pre release (P)
		10	Beta (B)
		11	Alpha (A)
Bit D-8	**Major version**	000000	0
		000001	1
		111110	62
		111111	63
Bit 7-0	**Minor version**	00000000	0
		00000001	1
		11111110	254
		11111111	255
		3508h ->	
(**5.08**			

4.11.2 Inverter type (30028).

MSB	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0	LSB

Bit F,E,D,C,B	**Reserved for future use**		
Bit A	**Option:**	0	w/o Brake chopper
		1	with Brake chopper
Bit 9,8	**Type:**	10	FDB
		11	FDX
Bit 7,6,5	**Size:**	000	Reserved
		001	Size 1
		010	Size 2
		011	Size 3
		100	Size 4 and 8
		101	Size 5 and 10
		110	Reserved
		111	Size 15 and 20
Bit 4,3,2	**Power:**	000	Reserved
		001	1st Power in size
		010	2nd Power in size
		011	3rd Power in size
		100	4th Power in size
		101	5th Power in size
		110	6th Power in size
		111	7th Power in size
Bit 1,0	**Voltage class:**	00	230V
		01	400V
		10	500V
		11	690V

4.11.3 Warning, Tripmessage 1-10 (30040, 30103, 30106, 30109, 30112, 30115, 30118, 30121, 30124, 30127,30130).

0=No warning	1=Overtemp	2=Overcurrent	3=Overvolt D
4=Overvolt G	5=Overvolt L	6=Motor Temp	7=Ext Trip
8=Spare	9=Max Alarm	10=Locked Rotor	11=Power Fault
12=Int Error	13=Spare	14=Spare	15=Spare
16=Overvoltage	17=Low Voltage	18=Overtemp	19=Motor lost
20=Max Pre-Alrm	21=Min Pre-Alrm	22=Overcurrent	23=Spare
24=Spare	25=Spare	26=Spare	27=Overvolt L
28=Min Alarm	29=Spare	30=Spare	31=Spare

4.11.4 Relay, Digout and CRIO relay (40023,40024,41014,41015,41020, 41021).

0=Run	1=Stop	2=Acc / Dec	3=At speed
4=At max speed	5=No Trip	6=Trip	7=Autorst Trip
8=Limit	9=Warning	10=Ready	11=T=Tlim
12=I>Inom	13=Brake	14=Sgnl<Offset	15=Alarm
16=Pre Alarm	17=Max Alarm	18=Max Pre-Alrm	19=Min Alrm
20=Min Pre-Alrm	21=Deviation		

4.11.5 5.x.x Auto restart mask (41006)

MSB	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0	LSB

Bit 12-15	Spare	
Bit 11	INT_ERROR	0x0800
Bit 10	POWER_FAULT	0x0400
Bit 9	LOCKED_ROTOR	0x0200
Bit 8	MON_ALARM	0x0100
Bit 7	MOTOR_LOST	0x0080
Bit 6	EXT_TRIP	0x0040
Bit 5	MOTOR_TEMP	0x0020
Bit 4	OVER_VOLT_L	0x0010
Bit 3	OVER_VOLT_G	0x0008
Bit 2	OVER_VOLT_D	0x0004
Bit 1	IIT	0x0002
Bit 0	OVER_TEMP	0x0001

The corresponding bits should be set to activate the autoreset function. To enable auto reset for Int error (bit 11) and locked rotor (Bit 9) the value 0x0A00 should be written to the register.

If the value 0x0123 was read, it indicates that MON_ALARM, MOTOR_TEMP, IIT and OVER_TEMP are in auto reset mode and all other functions are swithced off.

4.11.6 DigIn (41008,41009).

0=Off	1=Lim Switch+	2=Lim Switch -	3=Ext. Trip
4=AnIn Select	5=Preset Ref 1	6=Preset Ref 2	7=Preset Ref 4
8=Quick Stop	9=Jog	10=MotPot Up	11=MotPot Down
12=PS selected!			

4.11.7 Representation of speed.

Bit15=0<->1rpm<->1
Bit15=1<->100rpm<->1

4.12 Performance

It is important to configure the communication master according to the slave performance/restrictions.

The total message size must not exceed 64 bytes.

Max number of registers at a time is limited to 25 (both for read and write).

4.12.1 VFB/VFX response delay

The response delay for the VFB/VFX will be maximum 8 ms.

5. CRC GENERATION

The CRC is started by first pre-loading a 16-bit register to all 1's. Then a process begins of applying successive eight-bit bytes of the message to the current contents of the register. Only the eight bits of data in each character are used for generating the CRC. Start and stop bits, and the parity bit, do not apply to the CRC.

During generation of the CRC, each eight-bit character is exclusive ORed with the register contents. The result is shifted in the direction of the least significant bit (LSB), with a zero filled into the most significant bit (MSB) position. The LSB is extracted and examined. If the LSB was a 1, the register is then exclusive OR-ed with a preset, fixed value. If the LSB was a 0, no exclusive OR takes place.

This process is repeated until eight shifts have been performed. After the last (eighth) shift, the next eight-bit character is exclusive OR-ed with the register's current value, and the process repeats for eight more shifts as described above. The final contents of the register, after all the characters of the message have been applied, is the CRC value.

Generation in steps:

- **Step 1** Load a 16-bit register with 0xFFFF (all 1's). Call this the CRC register.
- **Step 2** Exclusive OR the first eight-bit byte of the message with the low order byte of the 16-bit CRC register, putting the result in the CRC register.
- **Step 3** Shift the CRC register one bit to the right (toward the LSB), zero-filling the MSB. Extract and examine the LSB.
- **Step 4** If the LSB is 0, repeat Step 3 (another shift). If the LSB is 1, Exclusive OR the CRC register with the polynomial value 0xA001 (1010 0000 0000 0001) .
- **Step 5** Repeat Steps 3 and 4 until eight shifts have been performed. When this is done, a complete eight-bit byte will have been processed.

- **Step 6** Repeat Steps 2 ... 5 for the next eight-bit byte of the message. Continue doing this until all bytes have been processed.
  Result The final contents of the CRC register is the CRC value.
- **Step 7** When the CRC is placed into the message, its upper and lower bytes must be swapped as described below.
- Placing the CRC into the Message
  When the 16-bit CRC (two eight-bit bytes) is transmitted in the message, the low order byte will be transmitted first, followed by the high order byte - e.g., if the CRC value is 0x1241.

Message	
CRC LO	41
CRC HI	12

Example of CRC Generation Function

An example of a C language function performing CRC generation is shown on this page.
The function takes two arguments:

- Unsigned char *puchMsg; A pointer to the message buffer containing binary data to be used for generating the CRC.
- Unsigned int usDataLen; The quantity of bytes in the message buffer.

The function returns the CRC as a type unsigned int.

- Unsigned int CRC16 (unsigned int usDataLen, unsigned char *puchMsg)

```
#define CRC_POLYNOMIAL    0xA001
  unsigned int crc_reg;
  unsigned char i,k;
  crc_reg = 0xFFFF;
  for (i=0 ; i<usDataLen ; i++)
  {
    crc_reg ^= *puchMsg++;
    for (k=0 ; k<8 ; k++)
    {
      if (crc_reg & 0x0001)
      {
        crc_reg >>= 1;
        crc_reg ^= CRC_POLYNOMIAL;
      }
      else
        crc_reg >>= 1;
    }
  }
  return crc_reg;
```

Fig. 22 CRC example.