Emotron MSF 2.0
Serial Communication Option

Instruction manual
English

emotron
DEDICATED DRIVE
A CG Product

Valid for the following models:
Emotron Modbus RTU

Serial Communication Option

Instruction Manual - English

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Safety

Instruction manual

It is important to be familiar with the softstarter to fully understand this instruction manual.

Technically qualified personnel

Installation, commissioning, demounting, making measurements, etc. of or on the CG Drives & Automation 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 softstarter

DANGER!
ALWAYS SWITCH OFF THE MAINS VOLTAGE BEFORE OPENING THE UNIT.

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

EMC Regulations

EMC regulations must be followed to fulfil the EMC standards.

Contents

1. General information

1.1 Introduction

The MODBUS RTU optional card is an asynchronous serial interface for the softstarters of the Emotron MSF 2.0 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.

Baudrate is 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

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 MSF 2.0 softstarters:

MSF-017 - MSF-1400

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 softstarter, the user must be familiar with the original instruction manual of the MSF 2.0 softstarter. 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.

WARNING!
Failure to follow these instructions can result in serious injury to the user in addition to serious damage to the softstarter.

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 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.

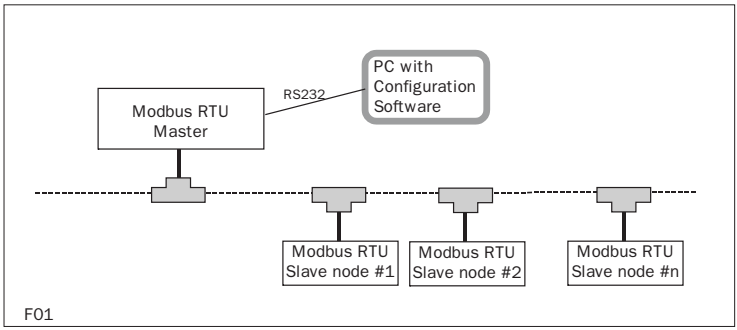


Fig. 1 Network configuration.

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.

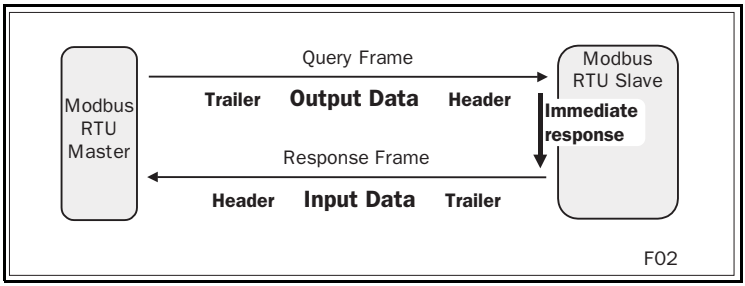


Fig. 2 Shows the MODBUS RTU data exchange.

Modbus RTU uses a binary transmission protocol.

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

Table 1

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 2

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

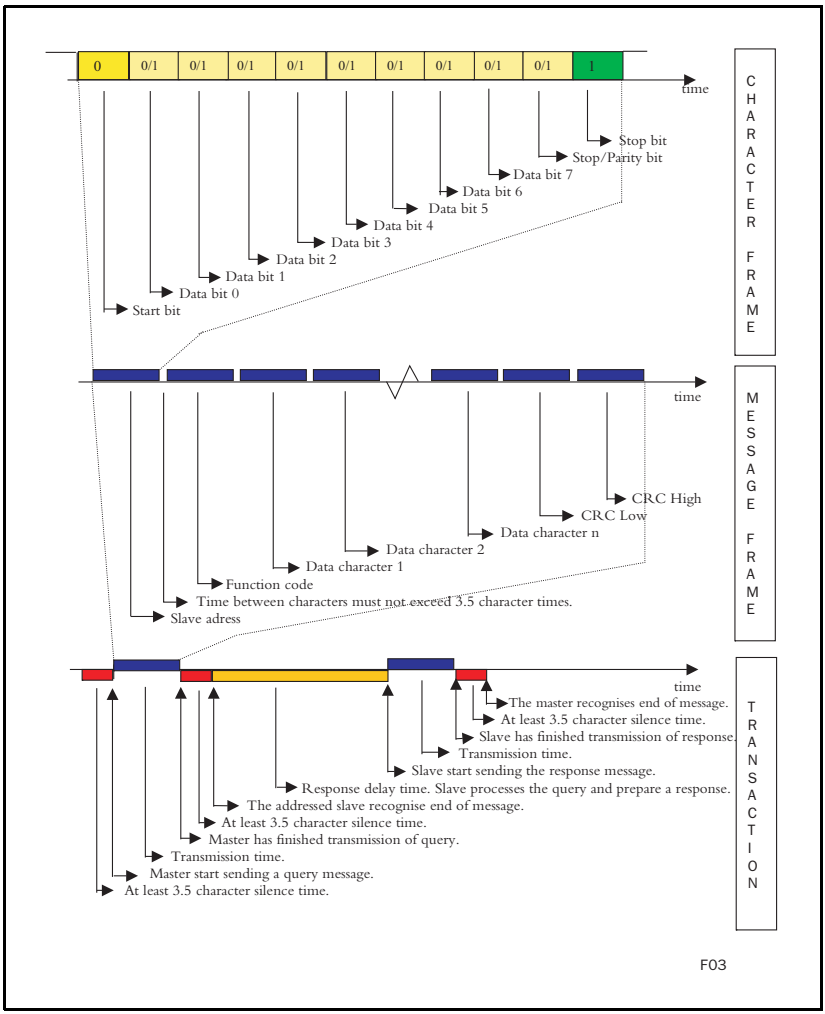


Fig. 3 Timing diagram for a transaction (query and response messages) (bottom in figure), a message frame (middle in figure) and a character frame (top in figure).

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.

Table 3

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 section 2.2, page 8.

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 section 2.4.2, page 22.

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 49.

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 section 4.4, page 37 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 section 4.5, page 38 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 section 4.7, page 42 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 section 4.6, page 38 and section 4.9, page 47 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 - address 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 section 4.4, page 37 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 section 4.7, page 42 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 section 4.4, page 37 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 min power alarm response delay to 25.0 sec and the min alarm margin 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 section 4.7, page 42 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 section 4.7, page 42 for all parameters change-able 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 4 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.
07	Read only	The data is not available for write access.

3. Installation

3.1 Installation on MSF-017 to MSF-145

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

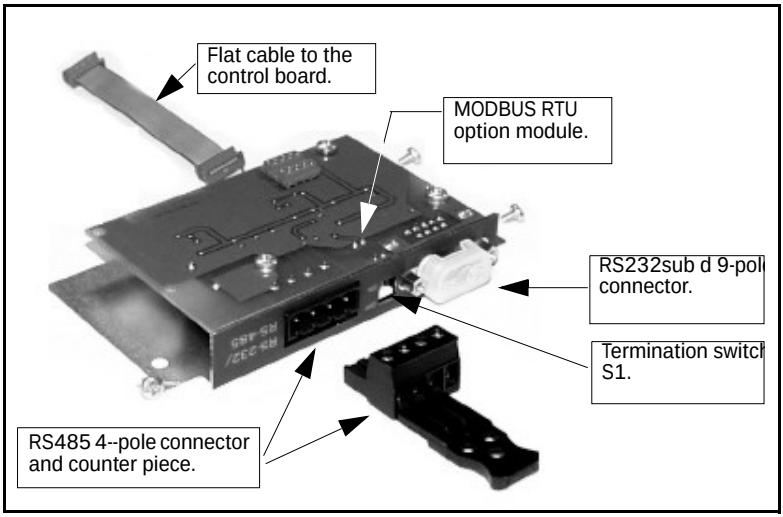


Fig. 4 MODBUS RTU option card.

WARNING!
Opening the softstarter. Always switch off the mains voltage before opening the softstarter.

Remove first the lid on the top side of the softstarter. Mount the option card according to the sequence in Fig. 5.

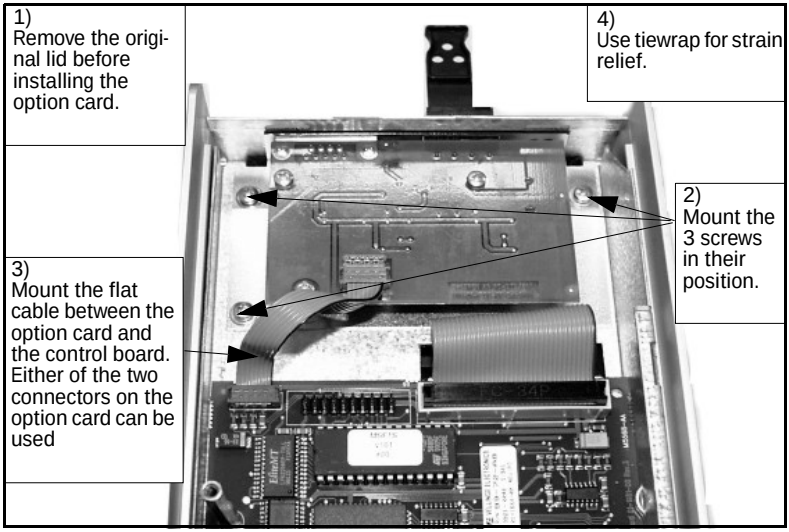


Fig. 5 Installation of the option board.

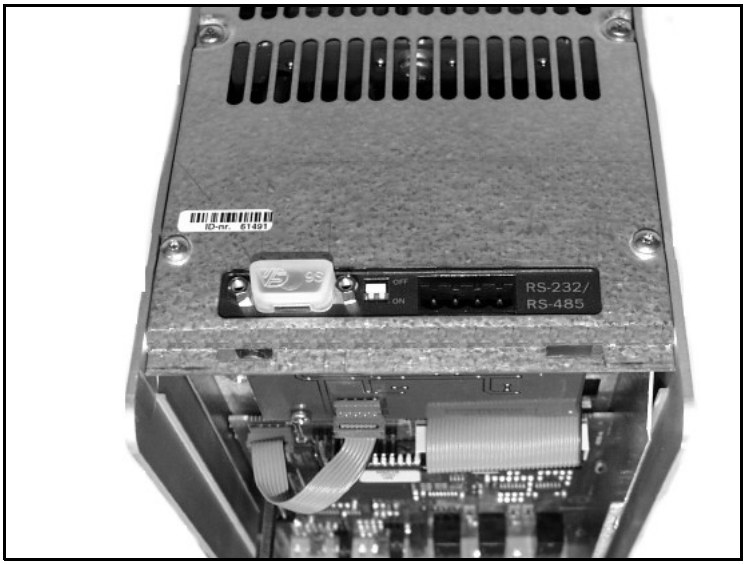


Fig. 6 Mounting of the option card seen from the top.

3.2 Installation of MSF-170 to MSF-1400

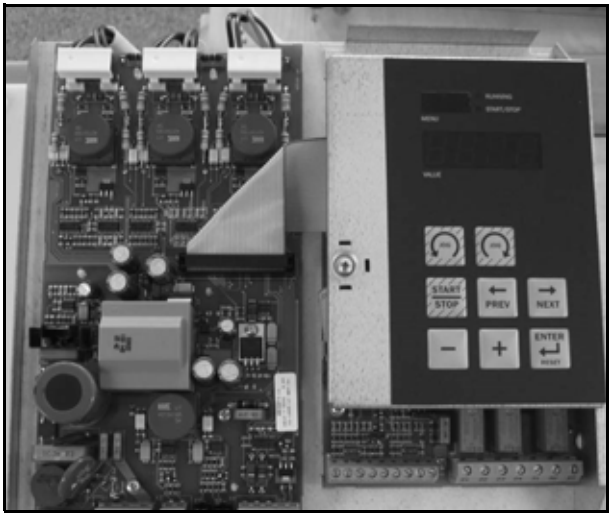


Fig. 7

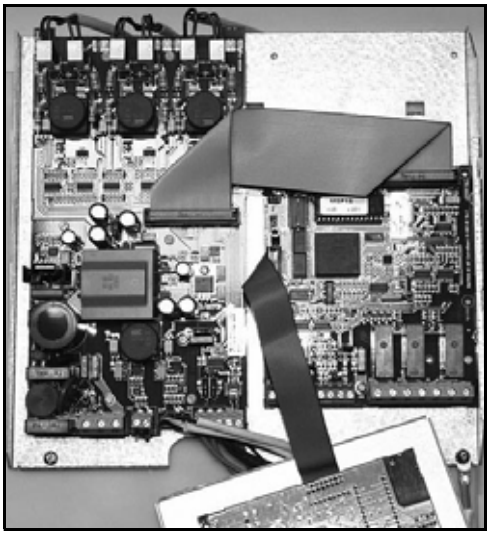


Fig. 8

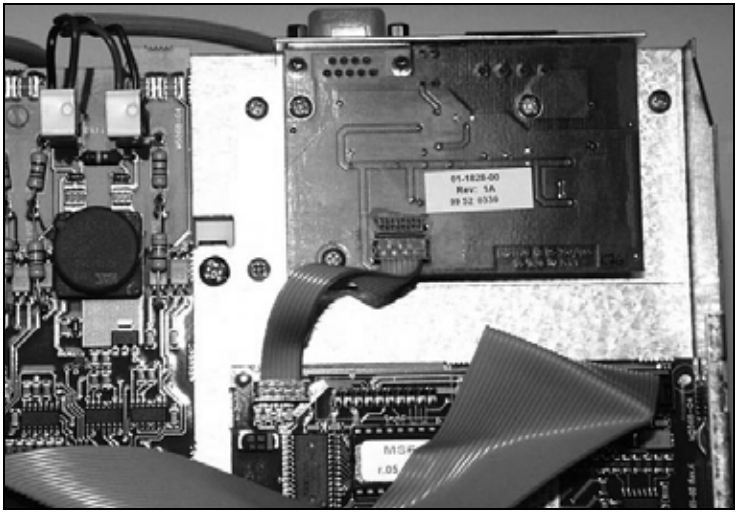


Fig. 9 Installation of the option board

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. 10.

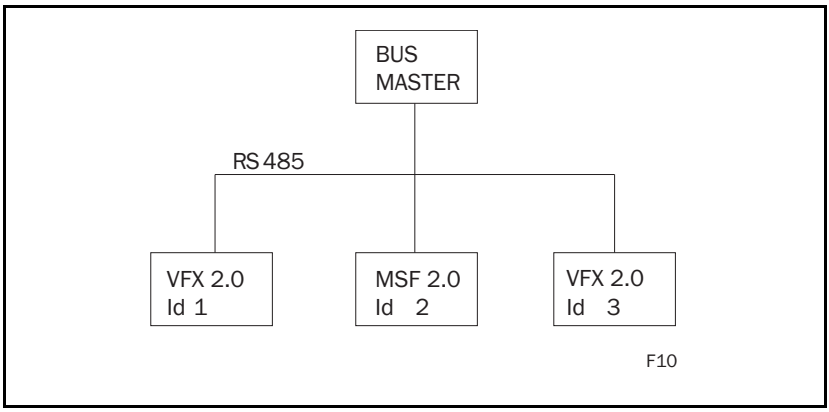


Fig. 10 RS 485 mulitpoint network

3.3.1 RS485 connection

Table 5

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. 11.

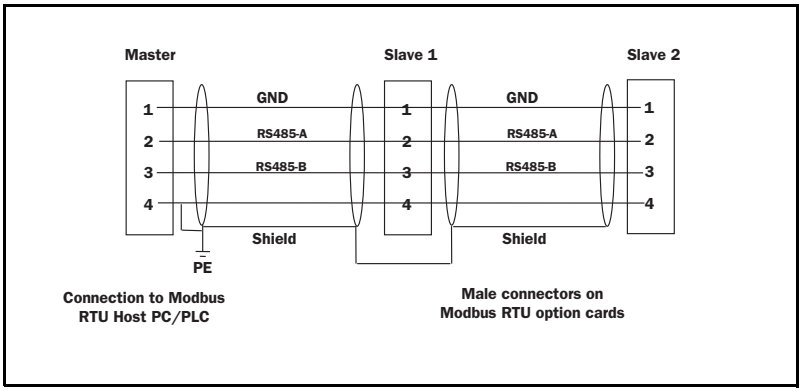


Fig. 11 RS485 wiring

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. 11 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. 12 and Fig. 13.

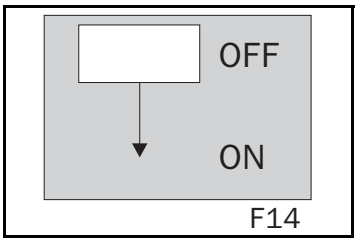


Fig. 12 Termination is OFF.

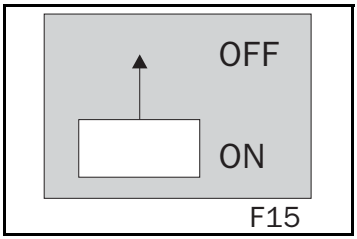


Fig. 13 Termination is ON.

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. 14.

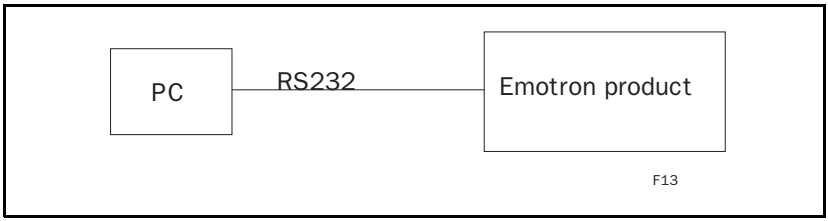


Fig. 14 RS232 point to point network

3.4.1 RS232 connection

Table 6

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. 14.

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

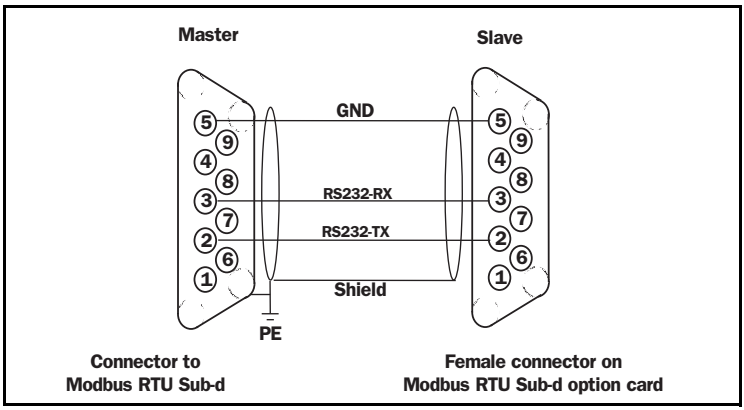


Fig. 15 RS232 wiring.

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

4. Communication parameters

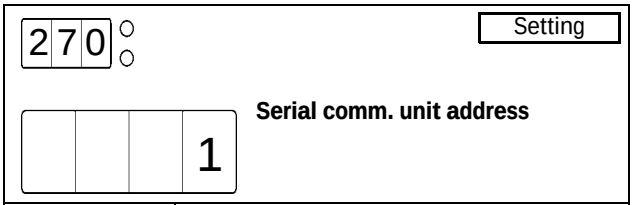
4.1 Set-up Communication Parameters

The following parameters have to be set-up:

- Unit address.
- Baud rate.
- Parity
- Behaviour when contact broken.

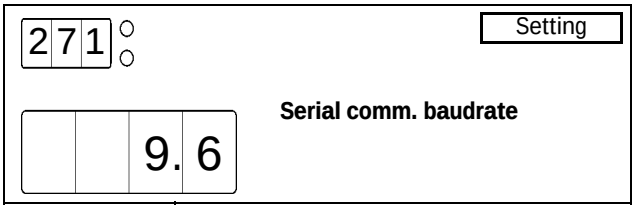
Setting up the communication parameter must be made in local 'Control panel' mode. See section 4.2.1, page 36.

Serial comm. unit address [270].



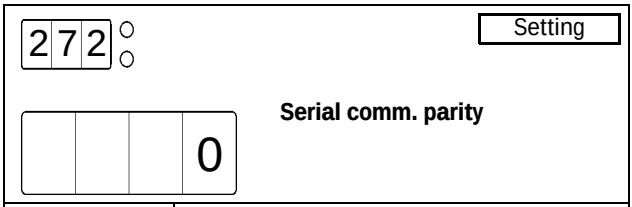
Default:	1
Range:	1-247
1-247	Unit address.

Serial comm. baudrate [271]



Default:	9.6 kBaud
Range:	2.4 - 38.4 kBaud
2.4-38.4	Baudrate.

Serial comm. parity [272]



Default:	0
Range:	0, 1
0	No parity
1	Even parity.

Serial comm. broken alarm [273]

If the softstarter is configured for control via serial communications (menu [200] = 3) and the serial communication contact is broken during operation, an F15 alarm can be configured to occur. In this menu the alarm can be enabled and an action to be performed can be chosen. The following options are available:

OFF

Serial communication contact broken alarm is disabled.

WARNING

Alarm message F15 is shown in the display and relay K3 is activated (for default configuration of the relays). However, the motor is not stopped and operation continues. The alarm message will disappear and the relay will be reset when the fault disappears. The alarm may also be reset manually from the control panel.

COAST

Alarm message F15 is shown in the display and relay K3 is activated (for default configuration of the relays). The motor voltage is automatically switched off. The motor freewheels until it stops.

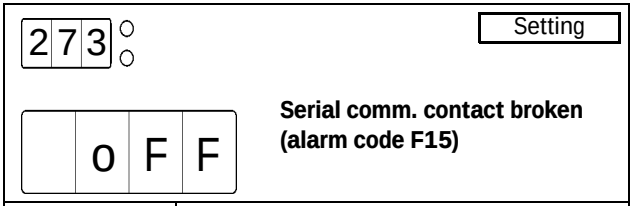
STOP

Alarm message F15 is shown in the display and relay K3 is activated (for default configuration of the relays). The motor is stopped according to the stop settings in menu [320] - [325].

BRAKE

Alarm message F15 is shown in the display and relay K3 is activated (for default configuration of the relays). The brake function is activated according to the braking method chosen in menu [323] and the motor is stopped according to the alarm brake settings in menu [326] - [327] (braking strength and braking time).

A serial communication broken alarm is automatically reset when a new start signal is given. The start signal can be given via control panel, remotely or via serial communication depending on the control source chosen in menu 200. Regardless of the chosen control source, it is always possible to initiate a reset via control panel.



Default:	2
Range:	oFF, 1, 2, 3, 4
oFF	Serial comm. contact broken disabled
1	Warning
2	Coast
3	Stop
4	Brake

4.2 Serial communication as control source

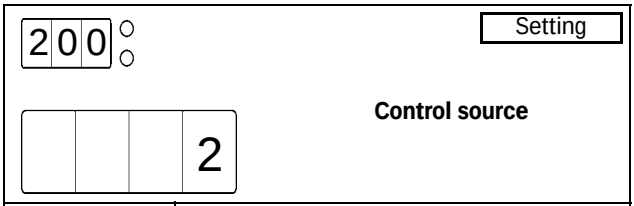
The source from where operation and parameter settings are made is selected in the Control Source parameter menu 200.

When serial communication control source (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 source parameter from local MSF control panel.
- Inspect all parameters from local MSF control panel.

4.2.1 Selection of control sources

Setting up the control source has to be done from the local MSF 2.0 control panel.



Default:	2 (remote control)
Range:	1, 2, 3
1	Control panel.
2	Remote control.
3	Serial communication control.

Independent of the chosen control source it is always possible to read out all the information in the softstarter via serial communication, both parameters and view information.

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

4.3 Parameter List

The product MSF menu column show the menu number on the control panel for the parameter.

For more information on any parameter/function, see Instruction Manual MSF 2.0 Softstarter.

4.4 Coil status list

Table 7

Modbus no	Function / Name	Range	Comment	Menu no.
0	Reset alarm	0, 1	0->1=Reset	
1	Start / Stop	0, 1	Stop=0, Run=1	
2	Jog forward	0, 1	0=No Jog, 1=Jog	
3	Jog reverse	0, 1	0=No Jog, 1=Jog	
4	Autoset	0, 1	0->1=Auto-set	411
5	Reset power consumption	0, 1	0->1=Reset	732
20	Control panel locked for settings	0, 1	0=Unlocked. 1=Locked	201
24	Enable US-units	0, 1	0=Off, 1=On	202
25	Preset pump control parameters	0, 1	0=No, 1=Yes	300
27	Bypass	0, 1	Off, on; off=0, on=1	340
28	Power Factor Control PFC	0, 1	Off, on; off=0, on=1	341
29	PTC input	0, 1	No, yes; no=0, yes=1	221
32	Jog forward enable	0, 1	No, yes; no=0, yes=1	334
33	Jog reverse enable	0, 1	No, yes; no=0, yes=1	335
36	Fan continuously on	0, 1	Off, on; off=0, on=1	342

4.5 Input status list

Table 8 Input status list

Modbus no	Function / Name	Range	Range / Unit
2	Pre-alarm	0, 1	0=No alarm, 1=Alarm
3	Pre-alarm max	0, 1	0=No alarm, 1=Alarm
4	Pre-alarm min	0, 1	0=No alarm, 1=Alarm

4.6 Input register list

Table 9

Modbus no	Function / Name	Range / Unit	Comments	Product MSF menu
0	Power consumption high word	0-2E9 Wh	1 Wh<->1	731
1	Power consumption low word			
2	Electrical power high word	-2E9-2E9 W	1 Wh<->1	
3	Electrical power low word			
4	Output shaft power high word	-2E9-2E9 kW	0.1 kW<->1	703
5	Output shaft power low word			
6	Operation time high word	0-9999999 h		730
7	Operation time low word			
10	Shaft torque high word	-2E9-2E9 Nm	0.1Nm <-> 1	705
11	Shaft torque low word			
16	Software version text		r23 -> HB = 0, LB = 23	902
17	Software variant text		v001 -> HB = 0, LB = 01	901
18	Current	0.0-6553.5 A	0.1A<->1	100/ 700
19	Current phase L1	0.0-6553.5 A	0.1A<->1	708
20	Current phase L2	0.0-6553.5 A	0.1A<->1	709
21	Current phase L3	0.0-6553.5 A	0.1A<->1	710
22	Shaft torque in percentage units	0 - 250% Tn		706

Table 9

Modbus no	Function / Name	Range / Unit	Comments	Product MSF menu
23	Line main voltage	0.0-720.0 V	0.1V<->1	701
24	Line main voltage L1-L2	0.0-720.0 V	0.1V<->1	711
25	Line main voltage L1-L3	0.0-720.0 V	0.1V<->1	712
26	Line main voltage L2-L3	0.0-720.0 V	0.1V<->1	713
27	Softstarter type	1-19	See description in 4.8.1.	900
29	Analogue output value	0-100%		725
30	Serial comm. unit address	1-247		270
31	Serial comm. baudrate	2.4--38.4 kBaud	0.1 kBaud <-> 1	271
32	Serial comm. parity	0=No parity 1=Even parity		272
34	Actual parameter set	1, 2, 3, 4		241
35	Output Shaft power %	0% -200% P_n		413/ 704
36	Softstarter temperature	29.0-96.0 °C 84.0-204.0 °F	0.1 deg <-> 1	707
37	Time to next allowed start	0-60 min		227
40	Mode	1-8	See description in § 4.8.3.	
41	Softstarter status	1-12		720
42	Digital input status	0000-1111	L<->0, H<->1	721
43	Analogue/digital input value	0-100%		723
44	Analogue/digital input status	0,1	L<->0, H<->1	722
45	Relay status	000-111	L<->0, H<->1	724
46	Used thermal capacity	0-150%		223/ 715
47	Power factor	0.00-1.00	1.00 <-> 100	702
50	Phase sequence	0, 1, 2	0 = None, 1 = RTS, 2 = RST	439/ 714
51	Emotron product	2	2=MSF	

Table 9

Modbus no	Function / Name	Range / Unit	Comments	Product MSF menu
100	Alarm list, latest error, time stamp high word	0-9999999 h	1 h<->1	
101	Alarm list, latest error, time stamp low word			
102	Alarm list, latest error	0- 17		800
103	Alarm list, error 14, time stamp high word	0-9999999 h	1 h<->1	
104	Alarm list, error 14, time stamp low word			
105	Alarm list, error 14	0- 17		801
106	Alarm list, error 13, time stamp high word	0-9999999 h	1 h<->1	
107	Alarm list, error 13, time stamp low word			
108	Alarm list, error 13	0- 17		802
109	Alarm list, error 12, time stamp high word	0-9999999 h	1 h<->1	
110	Alarm list, error 12, time stamp low word			
111	Alarm list, error 12	0- 17		803
112	Alarm list, error 11, time stamp high word	0-9999999 h	1 h<->1	
113	Alarm list, error 11, time stamp low word			
114	Alarm list, error 11	0- 17		804
115	Alarm list, error 10, time stamp high word	0-9999999 h	1 h<->1	
116	Alarm list, error 10, time stamp low word			
117	Alarm list, error 10	0- 17		805
118	Alarm list, error 9, time stamp high word	0-9999999 h	1 h<->1	
119	Alarm list, error 9, time stamp low word			

Table 9

Modbus no	Function / Name	Range / Unit	Comments	Product MSF menu
120	Alarm list, error 9	0- 17		806
121	Alarm list, error 8, time stamp high word	0-9999999 h	1 h<->1	
122	Alarm list, error 8, time stamp low word			
123	Alarm list, error 8	0- 17		807
124	Alarm list, error 7, time stamp high word	0-9999999 h	1 h<->1	
125	Alarm list, error 7, time stamp low word			
126	Alarm list, error 7	0- 17		808
127	Alarm list, error 6, time stamp high word	0-9999999 h	1 h<->1	
128	Alarm list, error 6, time stamp low word			
129	Alarm list, error 6	0- 17		809
130	Alarm list, error 5, time stamp high word	0-9999999 h	1 h<->1	
131	Alarm list, error 5, time stamp low word			
132	Alarm list, error 5	0- 17		810
133	Alarm list, error 4, time stamp high word	0-9999999 h	1 h<->1	
134	Alarm list, error 4, time stamp low word			
135	Alarm list, error 4	0- 17		811
136	Alarm list, error 3, time stamp high word	0-9999999 h	1 h<->1	
137	Alarm list, error 3, time stamp low word			
138	Alarm list, error 3	0- 17		812
139	Alarm list, error 2, time stamp high word	0-9999999 h	1 h<->1	

Table 9

Modbus no	Function / Name	Range / Unit	Comments	Product MSF menu
140	Alarm list, error 2, time stamp low word			
141	Alarm list, error 2	0- 17		813
142	Alarm list, error 1, time stamp high word	0-9999999 h	1 h<->1	
143	Alarm list, error 1, time stamp low word			
144	Alarm list, error 1	0- 17		814

4.7 Holding register list

Table 10

Modbus no	Function / Name	Range / Unit	Comment	Product MSF menu
0	Nominal motor voltage	200.0-700.0V	0.1 V<->1	210
1	Nominal frequency	50-60Hz	1 Hz<->1	215
2	Nominal motor current	25-200% Insoft in A	0.1 A<->1	211
3	Nominal motor speed	500 - 3600 rpm		213
4	Nominal motor power	25 - 400% Pnsoft in kW	Bit15=0 1 W<->1, 0.001 hp<->1 Bit15=1 0.1 kW<->1, 0.1 hp<->1	212
5	Nominal motor power factor	0.50-1.00	1.00 <-> 100	214
6	Analogue start-stop on-value	0-100%		502
7	Analogue star-stop off-value	0-100%		503
8	Analogue start-stop delay time	1-999 s		504
9	Automatic return menu	0.1-159	Off <-> 0, Menu 100 <-> 1, Menu 101 <-> 2, ..	101

Table 10

Modbus no	Function / Name	Range / Unit	Comment	Product MSF menu
10	Control source	1,2,3		200
11	Normal load	0-200% P_n		412
12	Start delay power alarms	1-999 s		402
13	Max power alarm response delay	0.1-90.0 s	0.1s->1	404
14	Max power alarm margin	0-100% P_{normal} 1		403
15	Max power pre-alarm response delay	0.1-90.0 s	0.1s->1	406
16	Max power pre-alarm margin	0-100% P_{normal}		405
17	Min power alarm response delay	0.1-90.0 s	0.1s->1	410
18	Min power alarm margin	0-100% P_{normal}		409
19	Min power pre-alarm response delay	0.1-90.0 s	0.1s->1	408
20	Min power pre-alarm margin	0-100% P_{normal}		407
21	Select parameter set	0, 1, 2, 3, 4		240
22	Relay K1	0, 1-19		530
23	Relay K2	0, 1-19		531
24	Relay K3	0, 1-19		532
25	Digital input 1 function	1, 2, 3, 4, 5, 6, 7		510
26	Digital input 2 function	1, 2, 3, 4, 5, 6, 7		511
28	Digital input 3 function	1, 2, 3, 4, 5, 6, 7		512
29	Digital input 4 function	1, 2, 3, 4, 5, 6, 7		513
30	K1 contact function	1, 2		533
31	K2 contact function	1, 2		534
32	Copy parameter set	0-12	Off<->0, 1-2 <-> 1, 1-3 <-> 2,	242
33	Stop method	1, 2, 3, 4, 5		320
34	Alarm braking time	1-120 s	1 s<->1	327
35	Alarm braking strength	0, 150-500%	Off<->0	326

Table 10

Modbus no	Function / Name	Range / Unit	Comment	Product MSF menu
36	Analogue output value	1, 2, 3, 4		521
37	Analogue output	0, 1, 2, 3, 4		520
38	Scaling analogue output, min	0-500%		522
40	Scaling analogue output, max	0-500%		523
2000	Initial voltage at start	25-90% U		313
2001	Start time	1-60 s	1 s<->1	315
2002	Step down voltage at stop	100-40% U		322
2003	Stop time	1-120 s	1 s<->1	325
2008	Initial torque at start	0-250% T_n		311
2009	End torque at start	25-250% T_n,		312
2010	Start method	1, 2, 3, 4		310
2012	Current limit at start	0, 150-500% I_n	Off <-> 0	314
2013	Braking strength	150-500%		324
2015	Torque boost current limit	0, 300-700% I_n	Off <-> 0	316
2016	Torque boost active time	0.1-2.0 s	0.1 s<->1	317
2017	Digital input pulses	1-100		501
2018	Slow speed strength	10-100		330
2019	Slow speed time at start	0, 1-60 s	Off <-> 0	331
2020	Slow speed time at stop	0, 1-60 s	Off <-> 0	332
2021	DC-brake at slow speed	0, 1-60 s	Off <-> 0	333
2022	Internal protection class	0, 2-40 s	1 s<->1	222
2023	Number of starts per hour	0, 1-99		225
2024	Locked rotor alarm	1.0-10.0	1.0 s<->10	229
2025	Unbalance voltage level	2-25% U_n		431
2026	Response delay voltage unbalance alarm	1-90 s	1 s<->1	432
2027	Over voltage level	100-150% U_n		434
2028	Response delay over voltage alarm	1-90 s	1 s<->1	435

Table 10

Modbus no	Function / Name	Range / Unit	Comment	Product MSF menu
2029	Under voltage level	75-100% U_n		437
2030	Response delay under voltage alarm	1-90 s	1 s<->1	438
2031	Reset to factory settings	0, 1		243
2033	End torque at stop	0-100% of T_n		321
2034	Braking method	1=dynamic brake; 2=reverse brake		323
2035	Analogue/digital input	0, 1, 2, 3, 4, 5, 6, 7		500
2036	Min. time between starts	0, 1-60 min	1 min<->1	226
2037	Thermal motor protection	0, 1, 2, 3, 4		220
2038	Start limitation	0, 1, 2		224
2039	Locked rotor alarm	0, 1, 2,		228
2040	Single phase input failure	1, 2		230
2041	Current limit start time expired	0, 1, 2, 3, 4		231
2042	Serial comm. contact broken	0, 1, 2, 3, 4		273
2043	Max power alarm	0, 1, 2, 3, 4		400
2044	Min power alarm	0, 1, 2, 3, 4		401
2045	External alarm	0, 1, 2, 3, 4, 5		420
2046	Voltage unbalance alarm	0, 1, 2, 3, 4		430
2047	Over voltage alarm	0, 1, 2, 3, 4		433
2048	Under voltage alarm	0, 1, 2, 3, 4		436
2049	Phase reversal alarm	0, 1, 2		440
2050	Autoreset attempts	0-10	Off <-> 0	250
2051	Thermal motor protection autoreset	0, 1-3600 s	Off<->0, 1 s<->1	251
2052	Start limitation autoreset	0, 1-3600 s	Off<->0, 1 s<->1	252
2053	Locked rotor alarm autoreset	0, 1-3600 s	Off<->0, 1 s<->1	253
2054	Current limit start time expired autoreset	0, 1-3600 s	Off<->0, 1 s<->1	254

Table 10

Modbus no	Function / Name	Range / Unit	Comment	Product MSF menu
2055	Max power alarm autoreset	0, 1-3600 s	Off<->0, 1 s<->1	255
2056	Min power alarm autoreset	0, 1-3600 s	Off<->0, 1 s<->1	256
2057	External alarm autoreset	0, 1-3600 s	Off<->0, 1 s<->1	257
2058	Phase input failure autoreset	0, 1-3600 s	Off<->0, 1 s<->1	258
2059	Voltage unbalance alarm autoreset	0, 1-3600 s	Off<->0, 1 s<->1	259
2060	Over voltage alarm autoreset	0, 1-3600 s	Off<->0, 1 s<->1	260
2061	Under voltage alarm autoreset	0, 1-3600 s	Off<->0, 1 s<->1	261
2062	Serial communication autoreset	0, 1-3600 s	Off<->0, 1 s<->1	262
2063	Softstarter overheated autoreset	0, 1-3600 s	Off<->0, 1 s<->1	263

4.8 Parameter description

For more information on any parameter/function, see MSF 2.0 Softstarter Instruction manual.

4.8.1 Softstarter type (Input register 27)

Table 11 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					

4.8.2 Serial comm. contact broken (Holding register 2042)

Communication is considered lost if no request is made to this unit within 15 sec. See section 4.1, page 33

4.8.3 Operation mode (Input register 40)

1	Voltage control
2	Torque control
3	Current limit
4	Voltage control with current limit
7	Direct On Line start
5	Torque control with current limit

4.8.4 Reset to factory settings (Holding register 2031)

Reset to factory settings from serial communication will have the same effect as if it was done from the control panel, except for one parameter. The control source parameter (menu 200) will remain in 3 (serial comm. control) instead of being set to the default value 2 (remote control).

4.9 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.

4.9.1 MSF response delay

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

Table 12 Response delay table for setting (forcing) registers

Holding register modbus no.	Parameter	Response delay/ recommended time out
0-5	Nominal motor data	500 ms/data
2031	Reset to factory settings	3.5 sec
	Other registers	250 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 OR-ed 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.

5.1 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.

Table 13

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;
      }
```

Fig. 16 CRC example.

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