## BRISBANE CITY COUNCIL

CONTRACT BW70107-06/07
PUMP STATION SWITCHBOARD
REPLACEMENT
SP118 SANDFORD STREET

Supply and Installation of Switchboard

Our Job No. 0720

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1. SOFT STARTERS
2. GRAPHIC DISPLAY
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4. LEVEL TRANSDUCER
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6. MISCELLANEOUS
7. DRAWINGS

By - Whelan Electrical Services Pty Ltd 1 Harvest Street YANDINA OLD 4561

Phone No. 54467133
Fax No. 54468118


# SERIAL <br> COMMUNICATION OPTION 

## INSTRUCTION MANUAL . ENGLISH

Valid for the following models:
EMOTRON Modbus RTU

Document number: 01-1989-01
Edítion: rl
Date of release: 1999-10-07
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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.

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## 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 <br> instructions can result in <br> malfunction or damage to <br> the softstarter or the <br> frequency inverter. |
| :--- | :--- |

WARNING | Failure to follow these |
| :--- |
| instructions can result in serious |
| injury to the user in addition |
| to serious damage to the soft- |
| starter or the frequency inverter. |



### 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.

| $\mathbf{1}$ | Start bit. |
| :---: | :--- |
| $\mathbf{8}$ | Data bits, hexadecimal 0-9,A-F, least signifi- <br> cant bit sent first. |
| $\mathbf{1}$ | Even parity bit. |
| $\mathbf{1}$ | Stop bit. |

If no parity is used each character ( 8 bit data) is sent as:
Table 23 Character frame unich parity.

| $\mathbf{1}$ | Start bit. |
| :---: | :--- |
| $\mathbf{8}$ | Data bits, hexadecimal 0-9,A-F, least signifi- <br> cant bit sent first. |
| $\mathbf{2}$ | 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 tlushes 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 | $n \times 8$ bits |
|  | 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 byce 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 | $1(01 \mathrm{~h})$ |
| Read Input Status | $2(02 \mathrm{~h})$ |
| Read Holding Registers | $3(03 \mathrm{~h})$ |
| Read Input Registers | $4(04 \mathrm{~h})$ |
| Force Single Coil | $5(05 \mathrm{~h})$ |
| Force Single Register | $6(06 \mathrm{~h})$ |
| Force Multiple Coils | $15(0 \mathrm{~h})$ |
| Force Multiple Registers | $16(10 \mathrm{~h})$ |
| Force/Read Multiple <br> Holding Registers | $23(17 \mathrm{~h})$ |

### 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: $\quad$ Modbus no $=29(1 \mathrm{Dh})$
On: $\quad$ 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 | $1 D$ |
| Number of Coils HI | 00 |
| Number of Coils LO | 01 |
| CRC LO | $6 D$ |
| 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 | OA |

## Response message.

| Field name | Hex value |
| :--- | :--- |
| Slave address | 01 |
| Function | 02 |
| Byte count | 01 |
| Input no.2 (O2h)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 $400.0 \mathrm{~V}, 60 \mathrm{~Hz}$ and 15.5 A .
400.0 V , unit $0.1 \mathrm{~V}-4000$ (0FA0h)

60 Hz unit $1 \mathrm{~Hz}-60(003 \mathrm{Ch})$
15.5A, unit $0.1 \mathrm{~A}-155$ ( 009 Bh )

## 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 |  |
| CRC HI | 05 |

## Response message.

| Field name | Hex value |
| :--- | :--- |
| Slave address | 01 |
| Function | 03 |
| Byte count | 06 |
| Reg no. 0, (0h) data HI | $0 F$ |
| Reg no. 0, (0h) data LO | AO |
| Reg no. 1, (1h) data HI | 00 |
| Reg no. 1, (1h) data LO | 3 C |
| Reg no. 2, (2h) data HI | 00 |
| Reg no. 2, (2h) data LO | 9 B |
| 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 $0.1 \mathrm{Nm}-4520$ ( 000011 A 8 h ).

Request message.

| Field name | Hex value |
| :--- | :--- |
| Slave address | 01 |
| Function | 04 |
| Start address Hi | 00 |
| Start address LO | 0 A |
| Number of Registers H! | 00 |
| Number of Registers LO | 02 |
| CRC LO | 51 |
| CRC HI | C9 |

Response message.

| Field name | Hex value |
| :--- | :--- |
| Siave address | 01 |
| Function | 04 |
| Byte count | 04 |
| Reg no. 10 (OAh) data HI | 00 |
| Reg no. 10 (OAh) data LO | 00 |
| Reg no. 11 (OBh) data HI | 11 |
| Reg no. 11 (OBh) data LO | A8 |
| CRC LO | F6 |
| CRC HI | 6 A |

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

Ser 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)
12.5 s , unit $0.1 \mathrm{~s}-125$ (7Dh)

Request message.

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

Response message.

| Field name | Hex value |
| :--- | :--- |
| Slave address | 01 |
| Function | 06 |
| Start address HI | 00 |
| Start address LO | 0 D |
| Data HI | 00 |
| Data LO | 7 D |
| 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 $>1$

$$
\text { Run }=1
$$

->- 00000011 (03h)
Request message.

| Field name | Hex value |
| :--- | :--- |
| Slave address | 01 |
| Function | 0 F |
| 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 <br> (O000 0011B) | 03 |
| CRC LO | 9 E |
| CRC HI | 96 |

## Response message.

| Field name | Hex value |
| :--- | :--- |
| Slave address | 01 |
| Function | OF |
| Start address HI | 00 |
| Start address LO | 00 |
| Number of Coils HI | 00 |
| Number of Coils LO | 02 |
| CRC LO | D4 |
| CRC HI | OA |

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 $0.1 \mathrm{sec}->-250$ ( 00 FAh )
$55 \%$, unit $1 \%->55$ ( 0037 h )

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 $\mathbf{1 7}(11 \mathrm{~h})$ | 00 |
| Data LO reg $\mathbf{1 7}(11 \mathrm{~h})$ | FA |
| Data HI reg 18 $(12 \mathrm{~h})$ | 00 |
| Data LO reg $\mathbf{1 8}(12 \mathrm{~h})$ | 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 Reglster

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 $1 \mathrm{rpm}->1450$ (05AAh)
17000 W , unit $1 \mathrm{~W} \rightarrow 17000$ (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 <br> function | This unit doesn't support the <br> function code. |
| 02 | Illegal data <br> address | The data address is not <br> within its boundaries. |
| 03 | Illegal data <br> value | The data value is not within <br> it's boundaries. |
| 06 | Busy | The unit is unable to perform <br> the request at this time. <br> Retry later. |

## 3. SOFTSTARTER MSFDATA

### 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 voitage 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. $8 \quad$ 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.


NOTEI 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]

| 11   <br>    <br>    <br>    |  | 1 |
| :--- | :--- | :--- |

## Serial comm. baudrate[112]



Serial comm. parity[113]

| $113{ }_{0}^{0}$ |  | Serial comm parity |
| :---: | :---: | :---: |
|  | 0 |  |
| Default: | 0 |  |
| Range: | 0.1 |  |
| This parameter will select the parity. 0 No parity. <br> 1 Even parity. |  |  |

## Serlal 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.


### 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 conm.
- 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.


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 <br> 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 <br> logical <br> no | Modbus <br> no | Function/Name | Range/Unit | Product <br> MSF <br> menu |
| :--- | :--- | :--- | :--- | :---: |
| 1 | 0 | Alarm reset | O->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- <br> sumption | 0->1 = Reset | 206 |
| 26 | 25 | Pump control | Off, on; off=0, on=1 | 022 |
| 27 | 26 | Full voltage start <br> 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 <br> 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 <br> input failure | No, yes; no=0, yes=1 | 101 |
| 32 | 31 | Run at current limit <br> time-out | No, yes; no=0, yes=1 | 102 |
| 33 | 32 | Jog forward from <br> keyb. enable | No, yes; no=0, yes=1 | 103 |
| 34 | 33 | Jog reverse from keyb. <br> 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 <br> logical <br> no | Modbus <br> no | Function/Name | Range/Unit | Product <br> MSF <br> menu |
| :--- | :--- | :--- | :--- | :---: |
| 10001 | 0 | Locked keyboard <br> info | 0=Unlocked, 1=Locked | 221 |
| 10002 | 1 | Extended start <br> ramp time | No, yes; no=0, yes=1 | S05 |
| 10003 | 2 | Pre-Alarm status | 0=No Pre-Alarm, <br> 1=Pre-Alarm |  |
| 10004 | 3 | Max Pre-Alarm <br> status | O=No Pre-Alarm, <br> 1=Pre-Alarm |  |
| 10005 | 4 | Min Pre-Alarm <br> status | O=No Pre-Alarm, <br> 1=Pre-alarm |  |

### 3.10 Input register list

Table 30 Input register list

| $\begin{gathered} \text { Modbus } \\ \text { logial } \\ \text { no } \end{gathered}$ | 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 | $0+2 \mathrm{E} 9 \mathrm{~W}, 1 \mathrm{~W}$ <->1 | S51 |
| 30004 | 3 | Electrical power low word |  | S51 |
| 30005 | 4 | Output shaft power high word | O-+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 | $\begin{aligned} & 0-2 \mathrm{E} 8 \mathrm{Nm}, 0.1 \mathrm{Nm} \\ & <->1 \end{aligned}$ | 207 |
| 30012 | 11 | Shaft torque low word | " | 207 |
|  |  |  |  |  |
| 30017 | 16 | Software version | $\begin{aligned} & \text { r23 -> r= release, } \\ & \text { Bit } 15-14=0,0 \\ & \operatorname{LB}=23 \end{aligned}$ |  |
| 30018 | 17 | Software variant | V001 $\rightarrow$ > $\mathrm{HB}=0, L B=01$ |  |
| 30019 | 18 | Current | $0-6553.5 \mathrm{~A}, 0.1 \mathrm{~A}<->1$ | 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 | $\begin{aligned} & 1=\text { Keyboard } \\ & 2=\text { Remote } \\ & 3=\text { Serial comm. } \end{aligned}$ | 006 |
|  |  |  |  |  |
| 30031 | 30 | Serial comm. unit address | 1-247 | 111 |

Table 30 Input register list (continuing)

| Modbus logial no | Modbus no | Function/Name | Range/Unit | Product MSF menu |
| :---: | :---: | :---: | :---: | :---: |
| 30032 | 31 | Serial comm. baudrate | $\begin{aligned} & 2400-38400 \text { Baud, } \\ & 100 \text { Baud <> } 1 \end{aligned}$ | 112 |
| 30033 | 32 | Serial comm. parity | O=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 \% | $\begin{aligned} & -200 \%-+200 \% \\ & 1 \%<->1 \end{aligned}$ | 090 |
| 30037 | 36 | Cooler temperature | $\begin{array}{\|c} 30.0-100.0^{\circ} \mathrm{C} \\ 0.1^{\circ} \mathrm{C}<-1 \end{array}$ |  |
|  |  |  |  |  |
| 30041 | 40 | Operation mode | $\begin{aligned} & \text { 1-7 See description in } \\ & \text { 3.12.3. } \end{aligned}$ |  |
| 30042 | 41 | Operation status | $\begin{aligned} & \text { 1-11 See description } \\ & \text { in 3.12.4. } \end{aligned}$ |  |
|  |  |  |  |  |
| 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 | $\begin{aligned} & 0-2 \\ & 0=\text { None, } \\ & 1=\text { RST, } \\ & 2=\text { RTS } \end{aligned}$ | 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 <br> logial <br> no | Modbus <br> no | Function/Name | Range/Unit | Product <br> MSF <br> 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 | $\begin{aligned} & 200.0-700.0 \mathrm{~V} \\ & 0.1 \mathrm{~V}<->1 \end{aligned}$ | 041 |
| 40002 | 1 | Nominal motor frequency | $50-60 \mathrm{~Hz} \mathrm{1Hz<->1}$ | 046 |
| 40003 | 2 | Nominal motor current | $\begin{aligned} & 25 \%-150 \% \text { Insoft in } \\ & \text { Amp.0.1A<->1 } \end{aligned}$ | 042 |
| 40004 | 3 | Nominal motor speed | $\begin{aligned} & 500-3600 \mathrm{Rpm} \\ & \text { Bit15 }=0->1 \mathrm{rpm}<->1 \end{aligned}$ | 044 |
| 40005 | 4 | Nominal motor power | $\begin{aligned} & 25 \%-150 \% \text { Pnsoft in } \\ & \text { W; } \\ & \text { Bit15=0->1W<->1 } \\ & \text { Bit15=1->100W }<->1 \end{aligned}$ | 043 |
| 40006 | 5 | Nominal motor cos phi | $\begin{aligned} & 50-100, \text { Cos phi = } \\ & 1.00<->100 \end{aligned}$ | 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 | $\begin{aligned} & 0=\text { External input } \\ & \text { selection } \\ & 1-4=\text { Par. set 1-4 } \end{aligned}$ | 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 | Anln 1, setup | O= OFF, No remote analogue control. $\begin{aligned} & 1=0-10 \mathrm{~V} / 0-20 \mathrm{~mA} \\ & 2=2.10 \mathrm{~V} / 4-20 \mathrm{~mA} \end{aligned}$ | 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 | $0=0 F F$, No analogue output. $\begin{aligned} & 1=0-10 \mathrm{~V} / 0-20 \mathrm{~mA} \\ & 2=2-10 \mathrm{~V} / 4-20 \mathrm{~mA} \end{aligned}$ | 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 | $1-60 \mathrm{sec}, 1 \mathrm{sec}<->1$ | 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, $1 \mathrm{sec}<->1$ | 012 |
| 42007 | 2006 | Step down voltage stop ramp 2 | $\begin{aligned} & 100-40 \% \text { U, } \\ & 1 \% \text { Un<->1 } \end{aligned}$ | 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 | $\begin{aligned} & 50-200 \% \mathrm{Tn}, \\ & 1 \% \mathrm{Tn}<->1 \end{aligned}$ | 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 $1 \% \ln <->1$ | 020 |
| 42013 | 2012 | Current limit at start | Off, 150-500\% In $1 \% \ln <->1$ | 021 |
| 42014 | 2013 | DC-Brake current limit | $\begin{aligned} & 100-300 \% \operatorname{In} \\ & 1 \% \ln <->1 \end{aligned}$ | 035 |
| 42015 | 2014 | DC-Brake active time | Off, 1-120sec, 1s<->1 | 034 |
| 42016 | 2015 | Torque boost current limit | $\begin{aligned} & 300-500 \% \ln \\ & 1 \% \ln <->1 \end{aligned}$ | 031 |
| 42017 | 2016 | Torque boost active time | $\begin{aligned} & \text { Off, 0.1-2.Osec } \\ & 0.1 \text { sec }<->1 \end{aligned}$ | 030 |

Table 31 Holding register list (continuing)

| Modbus <br> logical <br> no | Modbus <br> no | Function/Name | Range/Unit | Product <br> MSF <br> menu |
| :--- | :--- | :--- | :--- | :--- |
| 42018 | 2017 | Slow speed digital input | Off, 1-100 edges, 1 <br> 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 <br> 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.Osec <br> 0.1 sec<->1 | 075 |
| 42026 | 2025 | Voltage unbalance alarm | $5-25 \%$ Un, 1\% Un<->1 | 081 |
| 42027 | 2026 | Response delay voltage <br> unbal. | Off,1-60sec, 1sec<->1 | 082 |
| 42028 | 2027 | Over voltage alarm | $100-150 \%$ Un <br> $1 \%$ Un<->1 | 083 |
| 42029 | 2028 | Response delay over voltage | Off, 1-60sec, 1s<->1 | 084 |
| 42030 | 2029 | Under voltage alarm | $75-100 \%$ Un <br> $1 \%$ Un<->1 | 085 |
| 42031 | 2030 | Response delay under volt- <br> age | Off, 1-60sec, <br> 1 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 Sofistarter 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 Serinl comm. contact broken

| $\mathbf{0}$ | No action when communication is lost. |
| :---: | :--- |
| $\mathbf{1}$ | Stop and alarm after 15 sec. when communication is <br> lost. |
| $\mathbf{2}$ | Continue and alarm after 15 sec. when communication <br> is lost. |

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

### 3.12.3 Operation mode (30041).

| $\mathbf{1}$ | Voltage control. |
| :--- | :--- |
| $\mathbf{2}$ | Torque control. |
| $\mathbf{3}$ | Current limit control. |
| $\mathbf{4}$ | Ramp with current limit control. |
| $\mathbf{5}$ | Pump application. |
| $\mathbf{6}$ | Analogue input voltage control. |
| $\mathbf{7}$ | Direct On Line start. |

### 3.12.4 Operation status (30042).

| $\mathbf{1}$ | Stopped. |
| :---: | :--- |
| $\mathbf{2}$ | Stopped with alarm condition. |
| $\mathbf{3}$ | Run with alarm condition. |
| $\mathbf{4}$ | Run acceleration. |
| $\mathbf{5}$ | Run full voltage. |
| $\mathbf{6}$ | Run deceleration. |
| $\mathbf{7}$ | Run by passed. |
| $\mathbf{8}$ | Run power factor control. |
| $\mathbf{9}$ | Run DC brake. |
| $\mathbf{1 0}$ | Run at slow speed forward. |
| $\mathbf{1 1}$ | Run at slow speed reverse. |

### 3.12.5 Alarm (30103).

| $\mathbf{1}$ | Phase input failure | F1 |
| :---: | :--- | :--- |
| $\mathbf{2}$ | Motor protection, overload | F2 |
| $\mathbf{3}$ | Soft start overheated | F3 |
| $\mathbf{4}$ | Current limit timeout | F4 |
| $\mathbf{5}$ | Locked rotor | F5 |
| $\mathbf{6}$ | Above max power limit | F6 |
| $\mathbf{7}$ | Below min power limit | F7 |
| $\mathbf{8}$ | Voltage unbalance | F8 |
| $\mathbf{9}$ | Over voltage | F9 |
| $\mathbf{1 0}$ | Under voltage | F10 |
| $\mathbf{1 1}$ | Starts/hour exceeded | F11 |
| $\mathbf{1 2}$ | Shorted thyristor | F12 |
| $\mathbf{1 3}$ | Open thyristor | F13 |
| $\mathbf{1 4}$ | Motor terminal open | F14 |
| $\mathbf{1 5}$ | Serial comm. broken | F15 |
| $\mathbf{1 6}$ | Phase reversal alarm | F16 |

3.12.6 Relay indication K1 (40023).

| $\mathbf{1}$ | Indicates 'Operation'. |
| :---: | :--- |
| $\mathbf{2}$ | Indicates 'Full voltage'. |
| $\mathbf{3}$ | Indicates 'Pre alarm'. |

3.12.7 Relay indication K2 (40024).

| $\mathbf{1}$ | Indicates 'Operation'. |
| :---: | :--- |
| $\mathbf{2}$ | Indicates 'Full voltage'. |
| $\mathbf{3}$ | Indicates 'Pre alarm'. |
| $\mathbf{4}$ | Indicates 'DC-brake function is chosen'. |

### 3.12.8 Analogue output value (40037).

| $\mathbf{1}$ | RMS current (range $0-5(\mathrm{In})$. |
| :---: | :--- |
| $\mathbf{2}$ | Main input RMS voltage <br> (range $0-532 \mathrm{~V}$ ). |
| $\mathbf{3}$ | Output shaft power (range $0-2(\mathrm{Pn})$. |

### 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 able for setting (forcing) registers

| Modbus <br> logical nr | Parameter | Response delay/ <br> recommended time <br> out |
| :--- | :--- | :--- |
| $40001-40006$ | Nominal motor data | $500 \mathrm{~ms} /$ data |
| 42032 | Reset to factory set- <br> tings | 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.


NOTEI 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.

| PC | EmOtron product |
| :---: | :---: |

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 $\mathbf{2 - 3}$ crossing.


Fig. 21 RS232 wiring

NOTEI 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 <br> Stp |
| :--- | :--- |
| Default: | 1 |
| Range | $1-247$ |
| This parameter will select the unit address. |  |

Serial comm. baud rate[261]

|  | 261 Baudrate <br> Stp |
| :--- | :--- |
| 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.

|  | 212 Ref Control <br> Stp |
| :--- | :--- |
| Default: | Remote |
| Range | Remote, keyboard, Comm, Rem/ <br> Digln1,or Comm/Digln1 |
| 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.
$\left.\begin{array}{|l|ll|}\hline & \begin{array}{ll}213 & \text { Run/Stp } \\ \text { Stp }\end{array} & \text { Ctrl } \\ \text { Somm }\end{array}\right]$.

### 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 <br> logical <br> numbers | Modbus actual numbers |
| :--- | :--- | :--- |
| Coil Status | $1-10000$ | $0-9999$ (Logical-1) |
| Input Registers | $30001-$ <br> 40000 | $0-9999$ (Logical-30001) |
| Holding Registers | $40001-$ <br> 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 | $\begin{aligned} & \text { Off, on; off=0, } \\ & \text { on=1 } \end{aligned}$ | 242 |
| 11 | 10 | Auto-restart, $\mathrm{I}^{2} \mathrm{t}$ | $\begin{aligned} & \text { Off, on; off=0, } \\ & \text { on=1 } \end{aligned}$ | 243 |
| 12 | 11 | Auto-restart, Overvolt D | $\begin{aligned} & \text { Off, on; off=0, } \\ & \text { on=1 } \end{aligned}$ | 244 |
| 13 | 12 | Auto-restart, Overvolt G | $\begin{aligned} & \text { Off, on; off=0, } \\ & \text { on=1 } \end{aligned}$ | 245 |
| 14 | 13 | Auto-restart, Overvolt L | $\begin{aligned} & \text { Off, on; off=0, } \\ & \text { on=1 } \end{aligned}$ | 246 |
| 15 | 14 | Auto-restart, PTC | $\begin{aligned} & \text { Off, on; off=0, } \\ & \text { on=1 } \end{aligned}$ | 247 |
| 16 | 15 | Auto-restart, External trip | $\begin{aligned} & \text { Off, on; off=0, } \\ & \text { on=1 } \end{aligned}$ | 248 |
| 17 | 16 | Auto-restart, Phase loss motor | $\begin{aligned} & \text { Off, on; off=0, } \\ & \text { on=1 } \end{aligned}$ | 249 |
| 18 | 17 | Auto-restart, Alarm | $\begin{aligned} & \text { Off, on; off=0, } \\ & \text { on=1 } \end{aligned}$ | 24A |
| 19 | 18 | Auto-restart, Locked rotor | $\begin{aligned} & \text { Off, on; off=0, } \\ & \text { on=1 } \end{aligned}$ | 24B |
| 20 | 19 | Auto-restart, Power fault | $\begin{aligned} & \text { Off, on; off=0, } \\ & \text { on=1 } \end{aligned}$ | 24C |
|  |  |  |  |  |
| 30 | 29 | Motor PTC input | $\begin{aligned} & \text { no, yes; no=0, } \\ & \text { yes=1; } \end{aligned}$ | 271 |

### 4.9 Input register list

Table 39 Input register list

| Modbus logical no | Modbus no | Function/Name | Range/Unit | $\begin{gathered} \text { Product } \\ \text { VFB } / \text { VFX } \\ \text { menu } \end{gathered}$ |
| :---: | :---: | :---: | :---: | :---: |
| 30001 | 0 | Power consumption high word | 0-2E9 Wh, 1 Wh<->1 | 6FO |
| 30002 | 1 | Power consumption low word |  | 6FO |
| 30003 | 2 | Electrical power high word | $0-+-2 \mathrm{E} 9 \mathrm{~W}, 1 \mathrm{~W}<->1$ | 640 |
| 30004 | 3 | Electrical power low word |  | 640 |
| 30005 | 4 | Output shaft power high word | $\begin{aligned} & 0-+-2 \mathrm{E} 9 \mathrm{~W}, \\ & 1 \mathrm{~W}<->1 \end{aligned}$ | 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, $1 \mathrm{~h}<->1$ | 6E0 |
| 30010 | 9 | Mains time min | 0-59 Min, 1 min<->1 | 6E0 |
| 30011 | 10 | Shaft torque high word | $\begin{aligned} & 0-2 \mathrm{E} 8 \mathrm{Nm}, \\ & 0.1 \mathrm{Nm}<->1 \end{aligned}$ | 620 |
| 30012 | 11 | Shaft torque low word | " | 620 |
| 30013 | 12 | Process speed high word | $\begin{aligned} & 1-+-2 \text { E8 Rpm, } \\ & 1 \text { rpm<->1000 } \end{aligned}$ | 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 | $\begin{aligned} & \text { V1.23 -> Release } \\ & \text { Bit } 15-14=0,0 \\ & \text { Bit } 13-8=1, \\ & \text { LB }=23 \text { See } 4.11 . \end{aligned}$ | 920 |
| 30018 | 17 | Option/variant version | $\begin{aligned} & \text { OPT V2.34 -> } \\ & \mathrm{HB}=2, \\ & \mathrm{LB}=34 \end{aligned}$ | 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 |

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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 | $\begin{aligned} & 0=\text { Remote, } \\ & 1=\text { Keyboard, } \\ & 2=\text { Serial comm } \end{aligned}$ |  |
| 30030 | 29 | Control ref by | $\begin{aligned} & 0=\text { Remote } \\ & 1=\text { Keyboard } \\ & 2=\text { Serial comm } \end{aligned}$ |  |
| 30031 | 30 | Serial comm. unit address | 1-247 | 262 |
| 30032 | 31 | Serial comm. baudrate | $\begin{aligned} & 1=2400,4=19200, \\ & 2=4800 \quad 5=38400 \\ & 3=9600, \end{aligned}$ | 261 |
| 30035 | 34 | Actual parameter set | $\begin{array}{ll} 0-3 ; & \\ 0=A, & 2=C, \\ 1=B & 3=D \end{array}$ | $3 X X$ |
| 30036 | 35 | Shaft torque \% | -400\%+400\% 1\%<->1 | 620 |
| 30037 | 36 | Cooler temperature | $\begin{aligned} & -40.0+100.0^{\circ} \mathrm{C}, \\ & 0.1^{\circ} \mathrm{C}<-1 \end{aligned}$ | 690 |
| 30038 | 37 | Frequency | $\begin{aligned} & \mathrm{O}-2000.0 \mathrm{~Hz}, \\ & 0.1 \mathrm{~Hz}<->1 \end{aligned}$ | 670 |
| 30039 | 38 | OC-link voltage | O-1000V, 0.1V<->1 | 680 |
| 30040 | 39 | Warning | 0-31 See description in 4.11.3. | 6HO |
| 30043 | 42 | Digital input status | See description in 4.11.6. | 6B0 |
| 30044 | 43 | Analog input status 1 | -100 +100\%, 1\%<->1 | 6 CO |
| 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 | $0-65535 \mathrm{~h}, 1 \mathrm{~h}<->1$ | 720 |
| 30105 | 104 | Trip time 2 min | O-59 Min, 1 min<->1 | 720 |

Table 39 Input register list (contimuing)

| Modbus logical no | Modbus no 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 | $065535 \mathrm{~h}, 1 \mathrm{l}<->1$ | 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 | $0-65535 \mathrm{~h}, 1 \mathrm{~h}<->1$ | 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 | $0-65535 \mathrm{~h}, 1 \mathrm{~h}<->1$ | 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 | $0-65535 \mathrm{~h}, 1 \mathrm{~h}<->1$ | 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 | $0-65535 \mathrm{~h}, 1 \mathrm{~h}<->1$ | 770 |
| 30120 | 119 | Trip time 7 min | $0-59 \mathrm{Min}, 1 \mathrm{~min}<->1$ | 770 |
| 30121 | 120 | Trip message 7 | See trip message 1. | 770 |
| 30122 | 121 | Trip time 8 h | $0-65535 \mathrm{~h}, 1 \mathrm{~h}<->1$ | 780 |
| 30123 | 122 | Trip time 8 min | --59 Min, 1 min<->1 | 780 |
| 30124 | 123 | Trip message 8 | See trip message 1. | 780 |
| 30125 | 124 | Trip time 9 h | $0-65535 \mathrm{~h}, 1 \mathrm{~h}<->1$ | 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 | $0-65535 \mathrm{~h}, 1 \mathrm{~h}<->1$ | 7 AO |
| 30129 | 128 | Trip time 10 min | 0-59 Min, 1 min<->1 | 7AO |
| 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 | $50-300 \mathrm{~Hz}$ | 223 |
| 40003 | 2 | Nominal motor current | 25\% I_nom-3200.0A | 224 |
| 40004 | 3 | Nominal motor speed | $\begin{aligned} & 100-18000 \mathrm{rpm} \\ & \text { Bit15 }=0->1 \mathrm{rpm}<->1 \\ & \text { Bit15=1->100rpm<->1 } \end{aligned}$ | 225 |
| 40005 | 4 | Nominal motor power | $\begin{aligned} & 1-3276700 \mathrm{~W} \\ & \text { Bit15 }=0 \rightarrow 1 \mathrm{~W}<->1 \\ & \text { Bit15=1->100W }<->1 \end{aligned}$ | 221 |
| 40006 | 5 | Nominal motor cos phi | $50-100$, cos phi $=1.00<->100$ | 226 |
| 40007 | 6 | Motor ventilation | $\begin{aligned} & 0=\text { Off, } \\ & 1=\text { Self, } \\ & 2=\text { Forced } \end{aligned}$ | 227 |
| 40008 | 7 | Remote input level edge | $\begin{aligned} & 0=\text { Level, } \\ & 1=\text { Edge } \end{aligned}$ | 215 |
| 40009 | 8 | Encoder pulses | 5-32767 pulses/rev | 252 |
| 40010 | 9 | Encoder enable | $\begin{aligned} & 0=O f f \\ & 1=O n \end{aligned}$ | 251 |
| 40011 | 10 | Aarm select | $\begin{aligned} & \text { O=Off, } \\ & 1=\text { Max, } \\ & 2=\text { Min, } \\ & 3=\text { Min+max } \end{aligned}$ | 811 |
| 40012 | 11 | Ramp enable | $\begin{aligned} & 0=O f f, \\ & 1=O n \end{aligned}$ | 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 <br> no | Function/Name | Range/Unit | Product VFB/VFX menu |
| :---: | :---: | :---: | :---: | :---: |
| 40022 | 21 | Parameter set | $0=A$, $4=D 13$, <br> $1=B$, $5=D 13+4$, <br> $2=C$, $6=C o m m$ <br> $3=D$,  | 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 | Anln 1, function | $\begin{aligned} & 0=\text { Off, } \\ & 1=\text { Speed, }, \\ & 2=\text { Torque } \end{aligned}$ | 411 |
| 40028 | 27 | Anin 1, setup | $\begin{aligned} & 0=0-10 \mathrm{~V} / 0-20 \mathrm{~mA} \\ & 1=2-10 \mathrm{~V} / 4-20 \mathrm{~mA} \\ & 2=U s e r ~ d e f i n e d \end{aligned}$ | 412 |
| 40029 | 28 | Anin 1, offset | -100\% - +100\% 1\% <-> 1 | 413 |
| 40030 | 29 | Anln 1, gain | $-4.00-+4.00,0.01<->1$ | 414 |
| 40031 | 30 | AnIn 1, bipolar | $\begin{aligned} & 0=\text { Off, } \\ & 1=O n \end{aligned}$ | 415 |
| 40032 | 31 | Anln 2, function | $\begin{aligned} & 0=\text { Off, } \\ & 1=\text { Speed, } \\ & 2=\text { Torque } \end{aligned}$ | 416 |
| 40033 | 32 | Anln 2, setup | $\begin{aligned} & 0=0-10 \mathrm{~V} / 0-20 \mathrm{~mA}, \\ & 1=2-10 \mathrm{~V} / 4-20 \mathrm{~mA}, \\ & 2=\text { User defined } \end{aligned}$ | 417 |
| 40034 | 33 | Anln 2, offset | -100\% - +100\% 1\% <-> 1 | 418 |
| 40036 | 35 | AnIn 2, bipolar | $\begin{aligned} & 0=0 f f, \\ & 1=O n \end{aligned}$ | 41A |
| 40037 | 36 | AnOut 1, function | $\begin{aligned} & 0=\text { Torque, } \\ & 1=\text { Speed, } \quad 4=\text { Current, } \\ & 2=\text { Shaft power, } 5=\text { El. power, } \\ & 3=\text { Frequency, } 6=\text { Outp.voltage } \end{aligned}$ | 431 |
| 40038 | 37 | AnOut 1, setup | $\begin{aligned} & 0=0-10 \mathrm{~V} / 0-20 \mathrm{~mA} \\ & 1=2-10 \mathrm{~V} / 4-20 \mathrm{~mA} \\ & 2=U s e r \text { defined } \end{aligned}$ | 432 |
| 40039 | 38 | AnOut 1, offset | -100\% - +100\% 1\% <-> 1 | 433 |
| 40040 | 39 | AnOut 1, gain | $-4.00 \cdot+4.000 .01<->1$ | 434 |

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Table 40 Holding register list (continuing)

| Modbus logical no | Modbus no | Function/Name | Range/Unit | Product VFB/VFX menu |
| :---: | :---: | :---: | :---: | :---: |
| 40041 | 40 | AnOut 1, bipolar | $\begin{aligned} & 0=\mathrm{Off}, \\ & 1=\mathrm{On} \end{aligned}$ | 435 |
| 40042 | 41 | AnOut 2, function | $0=$ Torque, $4=$ Current, <br> $1=$ Speed, $5=$ El.power, <br> $2=$ Shaft power, 6=Outp. <br> $3=$ Frequency, voltage | 436 |
| 40043 | 42 | AnOut 2, setup | $\begin{aligned} & 0=0-10 \mathrm{~V} / 0-20 \mathrm{~mA} \\ & 1=2-10 \mathrm{~V} / 4-20 \mathrm{~mA}, \\ & 2=\text { User defined } \end{aligned}$ | 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 | $\begin{aligned} & 0=0 f f, \\ & 1=0 n \end{aligned}$ | 43A |
| 40047 | 46 | AnOut 3, function | O=Torque, 4=Current, <br> $1=$ Speed, $5=$ El.power, <br> $2=$ Shaft power, 6=Outp <br> $3=$ Frequency, voltage |  |
| 40048 | 47 | AnOut 3, setup | $\begin{aligned} & 0=0-10 \mathrm{~V} / 0-20 \mathrm{~mA} \\ & 1=2-10 \mathrm{~V} / 4-20 \mathrm{~mA}, \\ & 2=\text { User defined } \end{aligned}$ |  |
| 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 | $\begin{aligned} & 0=\mathrm{Off}, \\ & 1=0 \mathrm{n} \end{aligned}$ |  |
| 40052 | 51 | AnOut 4, function | 0=Torque, 4=Current, <br> $1=$ Speed, $5=$ El. power, <br> $2=$ Shaft power, $6=0 u t p$ <br> $3=$ Frequency, voltage |  |
| 40053 | 52 | AnOut 4, setup | $\begin{aligned} & 0=0-10 \mathrm{~V} / 0-20 \mathrm{~mA}, \\ & 1=2-10 \mathrm{~V} / 4-20 \mathrm{~mA}, \\ & 2=\text { User defined } \end{aligned}$ |  |
| 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, <br> $1=$ Speed, $5=$ El.power, <br> $2=$ Shaft power, $6=$ Outp <br> $3=$ Frequency, voltage |  |
| 40058 | 57 | AnOut 5, setup | $\begin{aligned} & 0=0-10 \mathrm{~V} / 0-20 \mathrm{~mA}, \\ & 1=2-10 \mathrm{~V} / 4-20 \mathrm{~mA}, \\ & 2=\text { User defined } \end{aligned}$ |  |

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 | $-4.00 \cdot+4.00,0.01<->1$ |  |
| 40061 | 60 | AnOut 5, bipolar | $\begin{aligned} & 0=0 f f, \\ & 1=0 n \end{aligned}$ |  |
| 41001 | 1000 | Comm, ref | 100\% <-> 0x2000 |  |
| 41002 | 1001 | Operation.drive mode | $\begin{aligned} & 0=\text { Speed, } \\ & 1=\text { Torque, } \\ & 2=\mathrm{V} / \mathrm{Hz} \end{aligned}$ | 211 |
| 41003 | 1002 | Operation.ref ctrl | $\begin{aligned} & 0=\text { Remote, } \\ & 1=\text { Keyboard, } \\ & 2=\text { Comm } \end{aligned}$ | 212 |
| 41004 | 1003 | Operation.run stop ctrl | $\begin{aligned} & 0=\text { Remote, } \quad \text { 3=Rem/digin1, } \\ & 1=\text { Keyboard, } \\ & \text { 4=Comm/ } \\ & \text { digin1 } \\ & 2=\text { Comm, } \end{aligned}$ | 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 | Digln 1 | -11 See description in 4.11.6. | 421 |
| 41009 | 1008 | Digln 2 | 0-11 See description in 4.11.6. | 422 |
| 41010 | 1009 | Digln 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 | $\begin{aligned} & 0=\mathrm{Off}, \\ & 1=0 \mathrm{n} \end{aligned}$ | 281 |
| 41019 | 1018 | Crio control | $\begin{aligned} & 0=4 \text {-Speed } \\ & 1=3 \text {-pos, } \\ & 2=\text { Analogue } \end{aligned}$ | 282 |

Table 40 Holding register list (continuing)

| Modbus logical no | $\left\|\begin{array}{c} \text { Modbus } \\ \text { no } \end{array}\right\|$ | 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, $3=\mathrm{m} / \mathrm{s}$, <br> $1=r p m$, $4=/ \mathrm{min}$, <br> $2=\%$, $5=/ \mathrm{hr}$ | 6G1 |
| 41023 | 1022 | Process scale | 0-10.000, $0.0001<=>1$ | 6G2 |
| 41024 | 1023 | Multiple display 1 | $0=$ Speed, $6=$ Frequency, <br> $1=$ Torque, $7=$ DC voltage, <br> $2=$ Shaft power, $8=$ Temp,  <br> $3=$ El power, $9=$ Drive <br> $4=$ Current, status, <br> $5=$ Voltage, $10=$ Process <br>  speed | 110 |
| 41025 | 1024 | Multiple display 2 | See 41024 | 120 |
| 41026 | 1025 | Utility language | $\begin{array}{ll} \text { 0=English, } & \text { 3=Dutch, } \\ 1=\text { German, } & 4=\text { French } \\ 2=\text { Swedish, } & \end{array}$ | 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 | $\begin{array}{ll} 1=2400, & 4=19200, \\ 2=4800 & 5=38400 \\ 3=9600, & \end{array}$ | 261 |
| 41030 | 1029 | Serial com. parity | 0=None |  |
|  |  |  |  |  |
| 41032 | 1031 | MVB card on/off | $\begin{aligned} & 0=\mathrm{Off}, \\ & 1=0 \mathrm{n} \end{aligned}$ | 291 |

Table 41 Parameter set $A$

| *** | *** | VFB/VFX <br> 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 | $\begin{aligned} & 0=\text { Linear, } \\ & 1=\text { S-curve } \end{aligned}$ | 312 |
| 41105 | 1104 | Deceleration shape | $\begin{aligned} & 0=\text { Linear, } \\ & 1=\text { S-curve } \end{aligned}$ | 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 | $\begin{aligned} & 0=\mathrm{Off}, \\ & 1=0 \mathrm{n} \end{aligned}$ | 31A |
| 41113 | 1112 | Spinstart | $\begin{aligned} & 0=0 \mathrm{ff}, \\ & 1=0 \mathrm{n} \end{aligned}$ | 31C |
| 41114 | 1113 | Motor pot function | $0=$ Volatile, 1=Non-volatile | 325 |
| 41115 | 1114 | Minspeed mode | $\begin{aligned} & 0=\text { Scale, } \\ & 1=\text { Limit, } \\ & 2=\text { Stop } \end{aligned}$ | 323 |
| 41116 | 1115 | Minimum speed | O- 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 <br> 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 | $0- \pm 2$ 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 | $\begin{aligned} & 0=\mathrm{Off}, \\ & 1=0 \mathrm{n} \end{aligned}$ | 344 |
| 41134 | 1133 | PID-controller | $\begin{aligned} & 0=0 f f, \\ & 1=0 n, \\ & 2=\text { Invert } \end{aligned}$ | 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, $0.01 \mathrm{~s}<->1$ | 348 |
| 41138 | 1137 | Low voltage overrride | $0=0 f f, 1=0 n$ | 351 |
| 41139 | 1138 | Rotor locked | $0=0 f f, 1=0 n$ | 352 |
| 41140 | 1139 | Motor lost | $\begin{aligned} & 0=0 \mathrm{ff}, \\ & 1=\text { Resume, } \\ & 2=\text { Trip } \end{aligned}$ | 353 |
| 41141 | 1140 | Motor 12t type | $\begin{aligned} & 0=\text { Off, } \\ & 1=\text { Trip, } \\ & 2=\text { Limit } \end{aligned}$ | 354 |
| 41142 | 1141 | Motor 12t current | 0-150\% inverter i_nom, 0.1A<->1 | 355 |
| 41143 | 1142 | Speed direction | $\begin{aligned} & 0=R, \\ & 1=L, \\ & 2=R+L \end{aligned}$ | 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 |
| Bit 7-0 | Minor version | 00000000 | 0 |
|  |  | 00000001 | 1 |
|  |  | 111111110 | 254 |
|  |  | 11111111 | 255 |
|  |  | $3508 \mathrm{~h}->$ |  |
|  |  |  |  |
|  |  |  |  |

### 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 | 230 V |
|  |  | 01 | 400 V |
|  |  | 10 | 500 V |
|  |  | 11 | 690 V |

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

| O=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 | $0 \times 0800$ |
| Bit 10 | POWER_FAULT | $0 \times 0400$ |
| Bit 9 | LOCKED_ROTOR | $0 \times 0200$ |
| Bit 8 | MON_ALARM | $0 \times 0100$ |
| Bit 7 | MOTOR_LOST | $0 \times 0080$ |
| Bit 6 | EXT_TRIP | $0 \times 0040$ |
| Bit 5 | MOTOR_TEMP | $0 \times 0020$ |
| Bit 4 | OVER_VOLT_L | $0 \times 0010$ |
| Bit 3 | OVER_VOLT_G | $0 \times 0008$ |
| Bit 2 | OVER_VOLT_D | $0 \times 0004$ |
| Bit 1 | IIT | $0 \times 0002$ |
| Bit 0 | OVER_TEMP | $0 \times 0001$ |

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 $0 \times 0 \mathrm{~A} 00$ should be written to the register.

If the value $0 \times 0123$ 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.ii.6 Digln (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 $0 x F F F F$ (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 000000000001 ).
- 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 $2 \ldots 5$ 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 $C R C$ generation is shown on this page.
The function takes two arguments:

- Unsigned char ${ }^{\star}$ 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 ^}=*\mathrm{ *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.

SP118 Sanford Street St Lucia SPS Ēectrical Switcöhöard OM Manual

Emotron AB
MÖrsaregatan 12

## Box 22225

SE-250 24 Helsingborg
Sweden
Tel.: +46 42169900
Fax: +46 42169949
E-mail: info@emotron.com
Internet: www.emotron.com


## MASTERSTART ${ }^{\text {TM }}$ MSF SOFTSTARTERS

INSTRUCTION MANUAL

Valid for the following Soft starter Models: MSF-017 to MSF-1400

## MSF

## SOFT STARTER

## INSTRUCTION MANUAL

Document number: 01-1363-01
Edition: r3
Date of release: 2003-02-03
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## SAFETY INSTRUCTIONS

## Safety

The soft starter should be installed in a cabinet or in an electrical control room.

- The device must be installed by trained personnel.
- Disconnect all power sources before servicing.
- Always use standard commercial fuses, slow blow e.g. type $\mathrm{gl}, \mathrm{gG}$, to protect the wiring and prevent short circuiting. To protect the thyristors against short-circuit currents, superfast semiconductor fuses can be used if preferred. The normal guarantee is valid even if superfast semiconductor fuses are not used.


## Operating and maintenance personnel

1. Read the whole Instruction Manual before installing and putting the equipment into operation.
2. During all work (operation, maintenance, repairs, etc.) observe the switch-off procedures given in this instruction as well as any other operating instruction for the driven machine or system. See Emergency below.
3. The operator must avoid any working methods which reduce the safety of the device.
4. The operator must do what he can to ensure that no unauthorised person is working on the device.
5. The operator must immediately report any changes to the device which reduce its safety to the user.
6. The user must undertake all necessary measures to operate the device in perfect condition only.

## Installation of spare parts

We expressly point out that any spare parts and accessories not supplied by us have also not been tested or approved by us.

Installing and/or using such products can have a negative effect on the characteristics designed for your device. The manufacturer is not liable for damage arising as a result of using non-original parts and accessories.

## Emergency

You can switch the device off at any time with the mains switch connected in front of the soft starter (both motor and control voltage must be switched off).

## Dismantling and scrapping

The enclosure of the soft starter is made of recyclable material as aluminium, iron and plastic. Legal requirements for disposal and recycling of these materials must be complied with.

The soft starter contains a number of components demanding special treatment, as for example thyristors. The circuit board contain small amounts of tin and lead. Legal requirements for disposal and recycling of these materials must be complied with.

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## 1. GENERAL INFORMATION

### 1.1 Integrated safety systems

The device is fitted with a protection system which reacts to:

- Over temperature.
- Voltage unbalance.
- Over- and under voltage.
- Phase reversal
- Phase loss
- Motor overload protection thermal and PTC.
- Motor load monitor, protecting machine or process max or min alarm
- Starts per hour limitation

The soft starter is fitted with a connection for protective earth $\xlongequal{\perp}$ (PE).

MSF soft starters are all enclosed IP 20, except MSF-1000 and MSF-1400 which are delivered as open chassi IP00.

### 1.2 Safety measures

These instructions are a constituent part of the device and must be:

- Available to competent personnel at all times.
- Read prior to installation of the device.
- Observed with regard to safety, warnings and information given.

The tasks in these instructions are described so that they can be understood by people trained in electrical engineering. Such personnel must have appropriate tools and testing instruments available. Such personnel must have been trained in safe working methods.

The safety measures laid down in DIN norm VDE 0100 must be guaranteed.

The user must obtain any general and local operating permits and meet any requirements regarding:

- Safety of personnel.
- Product disposal.
- Environmental protection.

NOTE! The safety measures must remaln In force at all times. Should questions of uncertalntles arise, please contact your local sales outlet.

### 1.3 Notes to the Instruction Manual



WARNING! Warnings are marked with a warning trlangle.

## Serial number

The information given in these instructions only applies to the device with the serial number given on the label on the front page. A plate with the serial number is fixed to the device.

## Important

For all enquiries and spare parts orders, please quote the correct name of the device and serial number to ensure that your inquiry or order is dealt with correctly and swiftly.

NOTE! These Instructions only apply to the soft starters having the serlal number given on the front page, and not for all models.

### 1.4 How to use the Instruction Manual

This instruction manual tells you how to install and operate the MSF soft starter. Read the whole Instruction Manual before installing and putting the unit into operation. For simple start-up, read chapter 2. page 8 to chapter 3. page 10.

Once you are familiar with the soft starter, you can operate it from the keyboard by referring to the chapter 13. page 79. This chapter describes all the functions and possible setting.

### 1.5 Standards

The device is manufactured in accordance with these regulations.

- IEC 947-4-2
- EN 60204-1 Electrical equipment of machines, part 1, General requirements and VDE 0113.
- EN 50081-2, EMC Emission
- EN 50081-1, EMC Emission with bypass
- EN 50082-2, EMC Immunity
- GOST
- UL508


### 1.6 Tests in accordance with norm EN60204

Before leaving the factory, the device was subjected to the following tests:

- Through connection of earthing system;
a) visual inspection.
b) check that earthing wire is firmly connected.
- Insulation
- Voltage
- Function


### 1.7 Inspection at delivery



Fig. 1 Scope of delivery.

### 1.7.1 Transport and packing

The device is packed in a carton or plywood box for delivery. The outer packaging can be returned. The devices are carefully checked and packed before dispatch, but transport damage cannot be ruled out.

## Check on receipt:

- Check that the goods are complete as listed on the delivery note, see type no. etc. on the rating plate.


## Is the packaging damaged?

- Check the goods for damage (visual check).


## If you have cause for complaint

If the goods have been damaged in transport:

- Contact the transport company or the supplier immediately.
- Keep the packaging (for inspection by the transport company or for returning the device).


## Packaging for returning the device

- Pack the device so that it is shock-resistant.


## Intermediate storage

After delivery or after it has been dismounted, the device can be stored before further use in a dry room.

### 1.8 Unpacking of MSF-310 and larger types

The soft starter is attached to the plywood box/loading stool by screws, and the soft starter must be unpacked as follows:

1. Open only the securing plates at the bottom of the box (bend downwards). Then lift up the box from the loading stool, both top and sides in one piece.
2. Loosen the three ( 3 pcs ) screws on the front cover of the soft starter, down by the lower logo.
3. Push up the front cover about 20 mm so that the front cover can be removed.
4. Remove the two ( 2 pcs ) mounting screws at the bottom of the soft starter.
5. Lift up the soft starter at the bottom about 10 mm and then push backwards about 20 mm so that the soft starter can be removed from the mounting hooks* at the top. The hooks are placed under the bottom plate and cannot be removed until the soft starter is pulled out.
6. Loosen the screws ( 2 pcs ) for the mounting hooks and remove the hooks.
7. The hooks are used as an upper support for mounting the soft starter.


Fig. 2 Unpacking of MSF-310 and larger models.

### 2.1 General

The MSF is installed directly between the mains and the supply cable to the motor. If a mains contactor is used it can be activated by the integrated K1 relay.


The MSF is developed for soft starting, stopping and braking three-phase motors.

There are 3 different kinds of soft starting control methods:

## - Control method 1-Phase

The single phase controlled soft starters provide only a reduction in starting torque no control of current or torque. These starters need a main and bypass contactor as well as external motor protections. This is a open loop voltage controller. These starters are mainly in the power up to 7.5 kW .

- Control method 2-Phase

The two phase starters can start a motor without a mains contactor, but in that case voltage still is present at the motor when it's stopped. These starters are mainly in the power up to 22 kW .

- Control method 3-Phase

In the three phase Soft Starters there are different technologies:

- Voltage control
- Current control
- Torque control


## Voltage control

This method is the most used control method. The starter gives a smooth start but doesn't get any feedback on current or torque. The typical settings to optimize a voltage ramp are: Initial voltage, ramp time, dual ramp time.


Fig. 3 Voltage control

## Current control

The voltage ramp can be used with a current limit which stops the voltage ramp when the set maximum current level is reached. The maximum current level is the main setting and must be set by the user depending the maximum current allowed for the application.


Fig. 4 Current control

## Torque control

Is the most sufficient way of starting motors. Unlike voltage and current based systems the soft starter monitors the torque need and allows to start with the lowest possible current. Using a closed loop torque controller also linear ramps are possible. The voltage ramp can not hold back the motor starting torque this results in a current peak and unlinear ramps. In the current ramp there will be no peak current, but a higher current for a longer period of time during the start compared to torque control. Current starting doesn't give linear ramps. The linear ramps are very important in many applications. For an example, to stop a pump with an unlinear ramp will give water hammer. Soft starters which doesn't monitor the torque, will start and stop to fast if the load is lighter than the setting of current or ramp time.


Fig. 5 Torque control

### 2.2 MSF control methods

MSF Soft Starters control all three phases supplied to the motor. It manages all the 3 possible starting methods where the closed loop Torque control is the most efficient way of starting and stopping motors.

### 2.2.1 General features

As mentioned above soft starters offer you several features and the following functions are available:

- Torque controlled start and stop
- Current limit control at start
- Application "Pump"
- External analogue input control
- Torque booster at start
- Full voltage start (D.O.L)
- Dual voltage ramp at start and stop
- Bypass
- Dynamic DC-brake or Softbrake
- Slow speed at start and stop
- Jogging forward and reverse
- Four parameter sets
- Analogue output indicating current, power or voltage
- Viewing of current, voltage, power, torque, power consumption, elapsed time etc.
- Integrated safety system acc. to $\$ 1.1$, page 6 , with an alarm list.


Fig. 6 Standard wiring.
This chapter describes brietly the set-up for basic soft start and soft stop by using the default "Voltage Ramp" function.


## WARNING! Mounting, wiring and setting the device

 Into operation must be carried out by properly tralned personnel. Before setup, make sure that the Installation is according to chapter 6. page 24 and the Checkilst below.
### 3.1 Checklist

- Mount the soft starter in accordance with chapter 6. page 24.
- Consider the power loss at rated current when dimensioning a cabinet, nax. ambient temperature is $40^{\circ} \mathrm{C}$ (see chapter 12 . page 74 ).
- Connect the motor circuit according to Fig. 6.
- Connect the protective earth.
- Connect the control voltage to terminals 01 and 02 ( $100-240 \mathrm{VAC}$ or $380-500 \mathrm{VAC}$ ).
- Connect relay K1 (PCB terminals 21 and 22) to the contactor - the soft starter then controls the contactor.
- Connect PCB terminals 12 and 13 to, e.g., a 2 -way switch (closing non-return) or a PLC, etc., to obtain control of soft start/soft stop. ${ }^{1}$ )
- Check that the motor and supply voltage corresponds to values on the soft starter's rating plate.
- Ensure the installation complies with the appropriate local regulations.

1) The menu 006 must be put to 01 for start/stop command from keyboard.

### 3.2 Main functions/Applications



WARNING! Make sure that all safety measures have been taken before switching on the supply.

Switch on the control voltage (normally $1 \times 230 \mathrm{~V}$ ), all segments in the display and the two LED's will be illuminated for a few seconds. Then the display will show menu 001. An illuminated display indicates there is supply voltage on the PCB. Check that you have mains voltage on the mains contactor or on the thyristors. The settings are carried out according to following:

The first step in the settings is to set menu 007 and 008 to "ON" to reach the main functions $020-025$ and motor data 041-046.

NOTE! The main function Is chosen according to the application. The tables in the applications and functions selection (table 1, page 15), glves the information to choose the proper maln function.

### 3.3 Motor Data

Set the data, according to the motor type plate to obtain optimal settings for starting, stopping and motor protection.

NOTE! The default settings are for a standard 4-pole motor acc. to the nominal power of the soft-starter. The soft starter will run even If no specific motor data is selected, but the performance will not be optimal.



NOTE! Now go back to menu 007 and set it to "ofF" and then to menu 001.

### 3.4 Setting of the start and stop ramps

The menu's 002 and 003 can now be set to adjust the start ramp up time and the stop ramp down time.


Estimate the starting-time for the motor/machine. Set "ramp up time" at start ( $1-60 \mathrm{sec}$ ).
Key "ENTER - " to confirm new value.
Key "NEXT $\rightarrow$ ", "PREV $\leftarrow$ " to change menu.


Set "ramp down time" at stop (2-120 s).
"oFF" if only soft start requires.

### 3.5 Setting the start command

As default the start command is set for remote operation via terminal 11, 12 and 13. For easy commissioning it is possible to set the statt command on the start key on the keyboards. This is set with menu 006.

| 0 | 0 | 6 |
| :--- | :--- | :--- |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
| Default: | 2 |  |
| Range: | $1,2,3$ |  |

Menu 006 must be set to 1 to be able to opetate from keyboard.

NOTE! Factory default setting is remote control (2).
To start and stop from the keyboard, the "START/ STOP" key is used.

To reset from the keyboard, the "ENTER $\leftarrow /$ RESET" key is used. A reset can be given both when the motor is running and when the motor is stopped. A reset by the keyboard will not start or stop the motor.

### 3.6 Viewing the motor current

Set the display to menu 005. Now the Motor current can be viewed on the display.


NOTEI The menu 005 can be selected at any tlme when the
motor ls runing.

### 3.7 Starting



WARNING! Make sure that all safety measures have been taken before starting the motor in order to avold personal Injury.

Start the motor by pressing the "START/STOP" key on the keyboard or through the remote control, PCB terminal 11, 12 and 13. When the start command is given, the mains contactor will be activated by relay K1 (PCB terminal 21 and 22), and the motor then starts softly.


Fig. 7 Example of start ramp with main function voltage mamp.

This chapter is a guide to select the correct soft starter rating and the selection of the Main function and additional functions for each different application.

To make the right choice the following tools are used:

- The norm AC53a.

This norm helps selecting the soft starter rating with regard to duty cycle, starts per hour and maximum starting current.

- The Application Rating List.

With this list the soft starter rating can be selected depending on the kind of application used. The list use 2 levels of the AC53a norm. See table 1, page 15.

- The Application Function List.

This table gives an complete overview of most common applications and duties. For each applications the menu's that can be used are given. See table 2, page 17.

- Function and Combination matrix.

With these tables it is easy to see which combinations of Main and additional functions are possible, see table 3 , page 19 and table 4 , page 19.

### 4.1 Soft starter rating according to AC53a

The IEC947-4-2 standard for electronic starters defines AC53a as a norm for dimensioning of a soft starter.

The MSF soft starter is designed for continuous running. In the Applications table (table 1, page 15) two levels of AC53a are given. This is also given in the technical data tables (see chapter 12. page 74 ).


Fig. 8 Rating example AC53a.
The above example indicates a current rating of 210 Amps with a start current ratio of $5.0 \times$ FLC (1050A) for 30 seconds with a $50 \%$ duty cycle and 10 starts per hour.

NOTE! If more than $\mathbf{1 0}$ starts/hour or other duty cycles are needed, please contact your supplier.


Fig. 9 Duty cycle, non bypass.

### 4.2 Soft starter rating according to AC53b

This norm is made for Bypass operation. Because the MSF soft starter is designed for continuous operation this norm is not used in the selection tables in this chapter.


Fig. 10 Rating example $A C 53 b$.


Fig. 11 Duty cycle, bypassed
The above example indicates a current rating of 210 Amps with a start current ratio of $5.0 \times$ FLC (1050A) for 30 seconds with a 24 -minute period between starts.

### 4.3 MSF Soft starter ratings

According to the norms AC53a and AC53b a soft starter can have many current ratings.

NOTE! Because the MSF soft starter Is designed for continuous operation the norm AC53b is not used in the application rating list.

With help of the Application Rating List with typical starting currents and categories in the AC53a level (see table 1 , page 15 and table 2 , page 17 ) it is easy to select the proper soft starter rating with the application.

The Application Rating List uses two levels for the AC53a norm:

- AC53a 5.0-30:50-10 (heavy duty)

This level will be able to start all applications and follows directly the type number of the soft starter. Example: MSF 370 is 370 Amps FLC and then 5 time this current in starting.

- AC 53a 3.0-30:50-10 (normal/light duty)

This level is for a bit lighter applications and here the MSF can manage a higher FLC.
Example: MSF 370 in this norm manage 450 Amps
FLC and the 3 times this current in starting
NOTE! To compare Soft Starters it's Important to ensure that not only FLC (Full Load Current) Is compared but also that the operating parameters are identical.

### 4.4 The Application Ratings List

Table 1 gives the Application Ratings List. With this list the rating for the soft starter and Main Function menu can be selected.

Description and use of the table:

## - Applications.

This column gives the various applications. If the machine or application is not in this list, try to identify a similar machine or application. If in doubt pleas contact your supplier.

- AC53a ratings.

The rating according to AC53a norm is here classified in 2 ratings. The first for normal/light duty (3.0-30:50-10) and the second for heavy duty (5.0-30:50-10)

- Typical Starting current.

Gives the typical starting current for each application

- Main Function menu.

The Main Function menu is advised here.
"25;=1", means: program selection 1 in menu 25.

- Stop function.

Gives a possible Stop function if applicable. " $36 ;=1 / 38-40$ ", means: program selection 1 in menu 36 , also menus 38 to 40 can be selected.

## EXAMPLE:

Roller Mill:

- This is an application for heavy duty,
- Typical starting current of $450 \%$.
- Main function Torque ramp start (menu 25) will give the best results.
- Stop function Dynamic Brake (menu 36, selection 1) can be used.
- As well as the Slow Speed at start and stop (menu $38-40$ ) can be used for better start and stop performance.

Table 1 Applications Rating List


### 4.5 The Application Functions List

This list gives an overview of many different applications/duties and a possible solution with one of the many MSF functions.

Description and use of the table:

- Application /Duty.

This column gives the various applications and level of duty. If the machine or application is not in this list, try to identify a similar machine or application.
If in doubt pleas contact your supplier.

- Problem.

This column describes possible problems that are familiar for this kind of application.

- Solution MSF.

Gives the possible solution for the problem using one the MSF function.

- Menus.

Gives the menu numbers and selection for the MSF function.
"25;=1", means: program selection 1 in menu 25.
"36;=1/34,35", means: program selection 1 in
menu 36 , menus 34 and 35 are related to this function.

Table 2 Application Function List

| Application/ Duty | Problem | Solution MSF | Menus |
| :---: | :---: | :---: | :---: |
| PUMP Normal | Too fast start and stops | MSF Pump application with following start/stop features: | 22 |
|  | Non linear ramps | Linear ramps without tacho. |  |
|  | Water hammer | Torque ramps for quadratic load |  |
|  | High current and peaks during starts. |  |  |
|  | Pump is going in wrong direction | Phase reversal alarm | 88 |
|  | Dry running | Shaft power underload | 96-99 |
|  | High load due to dirt in pump | Shaft power overload | 92-95 |
| COMPRESSOR Normal | Mechanical shock for compressor, motor and transmissions | Linear Torque ramp or current limit start. | $\begin{aligned} & 25 ;=1 \text { or } \\ & 20,21 \end{aligned}$ |
|  | Small fuses and low current available. |  |  |
|  | Screw compressor going in wrong direction | Phase sequence alarm | 88 |
|  | Damaged compressor if liquid ammonia enters the compressor screw. | Shaft power overload | 92-95 |
|  | Energy consumption due to compressor is running unloaded | Shaft power underload | 96-99 |
| CONVEYOR Normal/Heavy | Mechanical shocks for transmissions and transported goods. | Linear Torque ramp | 25;=1 |
|  | Filling or untoading conveyors | Slow speed and accurate position control. | 37-40,57,58 |
|  | Conveyor jammed | Shaft power overload | 92-95 |
|  | Conveyor belt or chain is off but the motor is still running | Shaft power underload | 96-99 |
|  | Starting after screw conveyor have stopped due to overload. | Jogging in reverse direction and then starting in forward. |  |
|  | Conveyor blocked when starting | Locked rotor function | 75 |
| FAN Normal | High starting current in end of ramps | Torque ramp for quadratic need | 25; $=2$ |
|  | Slivering belts. |  |  |
|  | Fan is going in wrong direction when starting. | Catches the motor and going easy to zero speed and then starting in right direction. |  |
|  | Belt or coupling broken | Shaft power undertoad | 96-99 |
|  | Blocked filter or closed damper. |  |  |
| PLANER Heavy | High inertia load with high demands on torque and current control. | Linear Torque ramp gives linear acceleration and lowest possible starting current. | $25 ;=1$ |
|  | Need to stop quick both by emergency and production efficiency reasons. | Dynamic DC brake without Contactor for medium loads and controlled sensor less soft brake with reversing contactor for heavy loads. | $\begin{aligned} & 36 ;=1,34,35 \\ & 36 ;=2,34,35 \end{aligned}$ |
|  | High speed lines | Conveyor speed set from planer shaft power analog output. | 54-56 |
|  | Worn out tool | Shaft power overload | 92-95 |
|  | Broken coupling | Shaft power underload | 96-99 |
| ROCK CRUSHER Heavy | High enertia | Linear Torque ramp gives linear acceleration and lowest possible starting current. | $25 ;=1$ |
|  | Heavy load when starting with material | Torque boost | 30,31 |
|  | Low power if a diesel powered generator is used. |  |  |
|  | Wrong material in crusher | Shaft power overload | 92-95 |
|  | Vibrations during stop | Dynamic DC brake without Contactor | 36; $1,34,35$ |
| BANDSAW Heavy | High inertia load with high demands on torque and current control. | Linear Torque ramp gives tinear acceleration and lowest possible starting current. | 25;=1 |
|  | Need to stop quick both by emergency and production efficiency reasons. | Dynamic DC brake without Contactor for medium loads and controlled sensor less soft brake with reversing contactor for heavy loads. | $\begin{aligned} & 36 ;=1,34,35 \\ & 36 ;=2,34,35 \end{aligned}$ |
|  | High speed lines | Conveyor speed set from band saw shaft power analog output. | 54-56 |
|  | Worn out saw blade | Shaft power overload |  |
|  | Broken coupling, saw blade or belt | Shaft power underload |  |
| CENTRIFUGE Heavy | High inertia load | Linear Torque ramp gives linear acceleration and lowest possible starting current. | $25 ;=1$ |
|  | To high load or unbalanced centrifuge | Shaft power overload |  |
|  | Controlled stop | Dynamic DC brake without Contactor for medium loads and controlled sensor less soft brake with reversing contactor for heavy loads. | $\begin{aligned} & 36:=1,34,35 \\ & 36 ;=2,34,35 \end{aligned}$ |
|  | Need to open centrifuge in a certain position. | Braking down to slow speed and then positioning control. | 37-40,57,58 |

Table 2 Application Function List

| Application/ <br> Duty | Problem | Solution MSF | Menus |
| :--- | :--- | :--- | :--- |
| MIXER <br> Heavy | Different materials | Linear Torque ramp gives linear acceleration and lowest <br> possible starting current. | $25 ;=1$ |
|  | Need to control material viscosity | Shaft power analog output | $54-56$ |
|  | Broken or damaged blades | Shaft power overload | $92-95$ |
|  |  | Shaft power underload | $96-99$ |
| HAMMER MILL <br> Heavy | Heavy load with high breakaway torque | Linear Torque ramp gives linear acceleration and lowest <br> possible starting current. | $25 ;=1$ |
|  |  | Torque boost in beginning of ramp. | 30,31 |
|  | Jamming | Shaft power overload | $92-95$ |
|  | Fast stop | Controlled sensor less soft brake with reversing contactor <br> for heavy loads. | $36 ;=2,34,35$ |
|  | Motor blocked | Locked rotor function | 75 |

## EXAMPLE:

Hammer Mill:

- This is an application for heavy duty,
- Main function Torque ramp start (menu 25) will give the best results.
- Torque boost to overcome high breakaway torque (menu 30 and 31)
- Overload alarm function for jamming protection (menu 92 and 95)
- Stop function Soft Brake (menu 36, selection 2) can be used. Menu 34 and 35 to set the brake time and strength.


### 4.6 Function and combination matrix

Table 3 gives an overview of all possible functions and combination of functions.

1. Select function in the horizontal "Main Function" column. Only one function can be selected in this column, at a time.
2. In the vertical column "Additional Functions" you will find all possible function that can be used together with your selected main function.

Table 3 Combination matrix

|  |  | $\begin{array}{\|l} 0 \\ \hline 0 \\ \vdots \\ 0 \\ 0 \\ \vdots \\ 0 \\ 0 \\ \frac{0}{0} \\ 0 \end{array}$ |  | M 0 0 0 0 0 0 0 0 0 0.0 0 0 0 0 0 0 |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Voltage ramp start/stop (default) | X | X | X | X | $x$ | X | X | X | X | X | X |  |
| Torque control start/stop (menu 025) |  |  | X | x | X | X | X | X | X | X | X |  |
| Voltage ramp with current limit (menu 020) |  | X | X | X | X | X | X | X | X | X | X | x |
| Current limit start (menu 021) |  | X | x | X | x | X | X | X | X | X | X | X |
| Pump control (menu 022) |  |  | X |  |  |  |  |  | X | X |  |  |
| Analog input (menu 023) |  |  |  |  |  |  |  |  | X | X |  |  |
| Direct on line start (menu 024) |  |  | X |  |  |  |  |  | X | X |  |  |

By using one parameter set, the following start/stop table is given.

NOTE! Voltage and torque ramp for starting only with softbrake.

Table 4 Start/stop combination.


By using different parameter sets for start and stop, it is possible to combine all start and stop functions.

### 4.7 Special condition

### 4.7.1 Small motor or low load

The minimum load current for the soft starter is $10 \%$ of the rated current of the soft starter. Except for the MSE-017 there the min. current is 2 A . Example MSE-210, rated current $=210 \mathrm{~A}$. Min. Current 21 A . Please note that this is "min. load current" and not min. rated motor current.

### 4.7.2 Ambient temperature below $0^{\circ} \mathrm{C}$

For ambient temperatures below $0^{\circ} \mathrm{C}$ e.g. an electrical heater must be installed in the cabinet. The soft starter can also be mounted in some other place, due to that the distance between the motor and the soft starter is not critical.

### 4.7.3 Phase compensation capacitor

If a phase compensation capacitor is to be used, it must be connected at the inlet of the soft starter, not between the motor and the soft starter.

### 4.7.4 Pole-changing contactor and two speed motor

The switching device must be connected between the output of the soft starter and the motor.

### 4.7.5 Shielded motor cable

It is not necessary to use shielded wires together with soft starters. This is due to the very low radiated emissions.

NOTE! The soft starter should be wired with shielded control cable to fulfill EMC regulations acc. to § 1.5, page 6.

### 4.7.6 Slip ring motors

Slip ring motors can not be used together with the soft starter. Unless the motor is rewinded (as a squirrel cage motor). Or keep the resistors in, please contact your supplier.

### 4.7.7 Pump control with soft starter and frequency inverter together

It is possible e.g. in a pump station with two or more pumps to use one frequency inverter on one pump and soft starters on each of the other pumps. The flow of the pumps can then be controlled by one common control unit.

### 4.7.8 Starting with counter clockwise rotating loads

It is possible to start a motor clockwise, even if the load and motor is rotating counter clockwise e.g. fans. Depending on the speed and the load "in the wrong direction" the current can be very high.

### 4.7.9 Running motors in parallel

When starting and running motors in parallel the total amount of the motor current must be equal or lower than the connected soft starter. Please note that it is not possible to make individual settings for each motor. The start ramp can only be set for an average starting ramp for all the connected motors. This applies that the start time may differ from motor to motor. This is also even if the motors are mechanically linked, depending on the load etc.

### 4.7.10 How to calculate heat dissipation in cabinets

See chapter 12. page 74 "Technical Data", "Power loss at rated motor load ( $\mathrm{I}_{\mathrm{N}}$ )", "Power consumption control card" and "Power consumption fan". For further calculations please contact your local supplier of cabinets, e.g. Rittal.

### 4.7.11 Insulation test on motor

When testing the motor with high voltage e.g. insulation test the soft starter must be disconnected from the motor. This is due to the fact that the thyristors will be seriously damage by the high peak voltage.

### 4.7.12 Operation above 1000 m

All ratings are stated at 1000 m over sea level.
If a MSF is placed for example at 3000 m it must be derated unless that the ambient temperature is lower than 40 C and compensate for this higher pressure.

To get information about motors and drives at higher altitudes please contact your supplier to get technical information nr 151.

### 4.7.13 Reversing

Motor reversing is always possible. See Fig. 31 on page 34 for the advised connection of the reverse contactors.

At the moment that the mains voltage is switched on, the phase sequence is monitored by the control board. This information is used for the Phase Reverse Alarm (menu 88 , see $\S 7.22$, page 56 ).

However if this alarm is not used (factory default), it is also possible to have the phase reversal contactors in the input of the soft starter.

## 5. OPERATION OFTHESOFT STARTER



Fig. 12 MSF soft starter models.

### 5.1 General description of user interface



WARNING! Never operate the soft starter with removed front cover.

To obtain the required operation, a number of parameters must be set in the soft starter.

Setting/configuration is done either from the builtin keyboard or by a computer/control system through the serial interface or bus (option). Controlling the motor i.e. start/stop, selection of parameter set, is done either from the keyboard, through the remote control inputs or through the serial interface (option).

## Setting



WARNING! Make sure that all satety measures have been taken before switching on the supply.

Switch on the supply (normally $1 \times 230 \mathrm{~V}$ ), all segments in the display will light up for a few seconds. Then the display will show menu 001. An illuminated display indicates there is supply voltage on the PCB.

Check that you have voltage on the mains contactor or on the thyristors. To be able to use all extended functions and optimuze of the performance, program the motor data.

### 5.2 PPU unit



Fig. 13 PPU unit.
The programming and presentation unit (PPU) is a build-in operator panel with two light enitting diodes, three + four seven-segment LED-displays and a keyboard.

### 5.3 LED display

The two light emitting diodes indicates start/stop and running motor/machine. When a start command is given either from the PPU, through the serial interface (option) or through the remote control inputs, the start/stop-LED will be illuminated.

At a stop command the start/stop-LED will switch off. When the motor is running, the running-LED is flashing during ramp up and down and is illuminated continuously at full motor voltage.


Fig. 14 LED indication at different operation situation.

### 5.4 The Menu Structure

The menus are organised in a simple one level structure with the possibility to limit the number of menus that are reachable by setting the value in menu 007 to "oFF" (factory setting). With this setting only the basic menus $001,002,003,004,005,006$ and 007 can be reached.

This to simplify the setting when only voltage start/ stop ramps are used.

If menu 007 is in "on" and menu 008 "oFF" it is possible to reach all viewing menus and alarm lists as well.


Fig. 15 Memu structure.

### 5.5 The keys

The function of the keyboard are based on a few simple rules. At power up menu 001 is shown automatically. Use the "NEXT $\rightarrow$ " and "PREV $\leftarrow$ "keys to move between menus. To scroll through menu numbers, press and hold either the "NEXT $\rightarrow$ " or the "PREV $\leftarrow "$ key. The " + " and "-" keys are used to increase respectively decrease the value of setting. The value is flashing during setting. The "ENTER $\downarrow$ " key confirms the setting just made, and the value will go from flashing to stable. The "START/STOP" key is only used to start and stop the motor/machine.
The $\Omega$ and $\Omega$ keys are only used for JOG from the keyboard. Please note one has to select enable in menu 103 or 104 , see $\S 7.25$, page 61 .

Table 5 The keys

| Start/stop motor operation. | START |
| :--- | :--- |
| Display previous menu. | PREV |
| Display next menu. |  |
| Decrease value of setting. |  |
| Increase value of setting. |  |
| Confirm setting just made. |  |
| Alarm reset. |  |
| JOG Reverse |  |
| JOG Forward |  |

Table 6 Control modes

| Control mode |  | Start/Stop | JOG fwd/rev | Alarm reset | Setting of parameters |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | Parameter set with external selection Menu 061=0 |  |  | Parameter set with internal selection Menu 061=1-4 |
| Keyboard Menu 006=1 | Unlocked keyboard |  | Keyboard | Keyboard | Keyboard | - | Keyboard |
|  | Locked keyboard | ------------ | $\cdots$ | ------------- | ------------ | -- |
| Remote Menu 006=2 | Unlocked keyboard | Remote | Remote | Remote and keyboard | Remote | Keyboard |
|  | Locked keyboard | Remote | Remote | Remote | Remote | - |
| Serial comm. Menu 006=3 | Unlocked keyboard | Serial comm | Serial comm | Serial comm. and keyboard | $-$ | Serial comm |
|  | Locked keyboard | Serial comm | Serial comm | Serial comm | - | Serial comm |

## 6. INSTALLATION AND CONNECTION

Mounting, wiring and setting the device into operation must be carried out by trained personnel (electricians specialised in heavy current technology):

- In accordance with the local safety regulations of the electricity supply company.
- In accordance with DIN VDE 0100 for setting up heavy current plants.
Care must be taken to ensure that personnel do not come into contact with live circuit components.


WARNING! Never operate the soft starter with removed front cover.

### 6.1 Installation of the soft starter in a cabinet

When installing the soft starter:

- Ensure that the cabinet will be sufficiently ventilated, after the installation.
- Keep the minimum free space, see the tables on page 25.
- Ensure that air can flow freely from the bottom to the top.

NOTE! When Installing the soft starter, make sure it does not come into contact with live components. The heat generated must be dispersed via the cooling fins to prevent damage to the thyristors (free circulation of alr).

MSF-017 to MSF-835 soft starters are all delivered as enclosed versions with front opening. The units have bottom entry for cables etc. see Fig. 25 on page 29 and Fig. 27 on page 31. MSF-1000 and MSF-1400 are delivered as open chassis.

NOTE! The soft starter should be wired with shlelded control cable to fulfill EMC regulations acc. to § 1.5, page 6.

NOTE! For UL-approval use $75^{\circ} \mathrm{C}$ Copper wire only.
MSF-017 to MSF-250


Fig. 16 MSF-017 to MSF-250 dimensions.


Fig. 17 Hole pattern for MSF-017 to MSF-250 (backside view).


Fig. 18 Hole pattern for MSF-170 to MSF-250 with upper mounting bracket instead of DIN-rail.

## MSF-017 to MSF-250

Table 7 MSF-017 to MSF-250.

| MSF model | Class | Connection | Conv./ Fan | Dimension HxWxD (mm) | Hole dist. w1 (mm) | Hole dist. h1 (mm) | Diam./ screw | Weight (kg) |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| -017, -030 | IP 20 | Busbars | Convection | $320 \times 126 \times 260$ | 78.5 | 265 | 5.5/M5 | 6.7 |
| $\begin{aligned} & -045,-060 \\ & -075,-085 \end{aligned}$ | IP 20 | Busbars | Fan | $320 \times 126 \times 260$ | 78.5 | 265 | 5.5/M5 | 6.9 |
| -110, -145 | IP 20 | Busbars | Fan | $400 \times 176 \times 260$ | 128.5 | 345 | 5.5/M5 | 12.0 |
| -170, -210, -250 | IP 20 | Busbars | Fan | $500 \times 260 \times 260$ | 208.5 | 445 | 5.5/M5 | 20 |

Table 8 MSF-017 to MSF-250

| MSF <br> model | Minimum free space (mm): |  |  | Dimension Connection busbars $\mathbf{C u}$ | Tightening torque for bolt ( Nm ) |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | above 1) | below | at side |  | Cable | PE-cable | Supply and PE |
| -017, -030, -045 | 100 | 100 | 0 | 15x4 (M6), PE (M6) | 8 | 8 | 0.6 |
| -060, -075,-085 | 100 | 100 | 0 | $15 \times 4$ (M8), PE (M6) | 12 | 8 | 0.6 |
| -110,-145 | 100 | 100 | 0 | $20 \times 4$ (M10), PE (M8) | 20 | 12 | 0.6 |
| -170, -210, -250 | 100 | 100 | 0 | $30 \times 4$ (M10), PE (M8) | 20 | 12 | 0.6 |
| 1) Above: wall-soft starter or soft starter-soft starter |  |  |  |  |  |  |  |

## MSF-310 to MSF-1400

Table 9 MSF-310 to MSF-1400 see Fig. 20 on page 26.

| MSF model | Class | Connection | Conv./ Fan | Dimension $\mathrm{HxWxD}(\mathrm{mm})$ | Hole dist. w1 (mm) | Hole dist. h1 (mm) | Diam./ screw | Weight (kg) |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| -310 | IP 20 | Busbars | Fan | $532 \times 547 \times 278$ | 460 | 450 | 8.5/M8 | 42 |
| -370, -450 | IP 20 | Busbars | Fan | $532 \times 547 \times 278$ | 460 | 450 | 8.5/M8 | 46 |
| -570 | IP 20 | Busbars | Fan | $687 \times 640 \times 302$ | 550 | 600 | 8.5/M8 | 64 |
| -710 | IP 20 | Busbars | Fan | $687 \times 640 \times 302$ | 550 | 600 | 8.5/M8 | 78 |
| -835 | IP 20 | Busbars | Fan | $687 \times 640 \times 302$ | 550 | 600 | 8.5/M8 | 80 |
| -1000, -1400 | IPOO | Busbar | Fan | $900 \times 875 \times 336$ | Fig. 23 |  | 8.5/M8 | 175 |

Table 10 MSF- 310 to MSF- 1400.

| MSF <br> model | Minimum free space (mm): |  |  | Dimension Connection, busbars Al | Tightening torque for bolt ( Nm ) |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | above 1) | below | at side |  | Cable | PE-cable | Supply and PE |
| -310, -370, -450 | 100 | 100 | 0 | 40x8 (M12) | 50 | 12 | 0.6 |
| -570, -710, -835 | 100 | 100 | 0 | $40 \times 10$ (M12) | 50 | 12 | 0.6 |
| -1000, -1400 | 100 | 100 | 100 | $75 \times 10$ (M12) | 50 | 12 | 0.6 |
| 1) Above: Wall-soft starter or soft starter-soft starter |  |  |  |  |  |  |  |



Fig. 19 MSF - 310 to MSF -835.


Fig. 20 Hole pattern for screw attachment, MSF. 310 to MSF-835. Hole distance ( $n m$ ).

| MSF | e | f |
| :---: | :--- | :--- |
| -310 to -450 | 44 | 39 |
| -570 to -835 | 45.5 | 39 |

Observe that the two supplied mounting hooks (see $\$ 1.8$, page 7 and Fig. 2 on page 7 must be used for mounting the soft starter as upper support (only MSF310 to MSF-835).


Fig. 21 Busbar distances MSF -310 to MSF -835.

Table 11 Busbar distances

| MSF model | Dist. h1 <br> (mm) | Dist. w1 <br> (mm) | Dist. w2 <br> $(\mathbf{m m})$ | Dist. w3 <br> (mm) |
| :--- | :--- | :--- | :--- | :--- |
| -310 to -450 | 104 | 33 | 206 | 379 |
| -570 to -835 | 129 | 35 | 239.5 | 444 |
| $-1000-1400$ |  | 55 | 322.5 | 590.5 |



Fig. 22 MSF-1000 to - 1400


Fig. 23 Hole pattern busbar MSF - 1000 to - 1400.

### 6.2 Connections



Fig. 24 Connection of MSF-017 to MSF -085.

## Connection of MSF-017 to MSF-085

## Device connections

1. Protective earth, $\perp$ (PE), Mains supply, Motor
(on the right and left inside of the cabinet)
2. Protective earth, $\perp(\mathrm{PE})$, Control voltage
3. Control voltage connection $\mathbf{0 1}, 02$
4. Mains supply L1, L2, L3
5. Motor power supply T1, T2, T3
6. Current transformers (possible to mount outside for bypass see $\$ 7.12$, page 43 )
7. Mounting of EMC gland for control cables


Fig. 25 Connection of MSF-110 to MSF- 145.

## Connection of MSF-110 to MSF-145

## Device connections

1. Protective earth, $\perp$ (PE), Mains supply, Motor (on the left inside of the cabinet)
2. Protective earth $\stackrel{\perp}{\perp}(\mathrm{PE})$, Control voltage
3. Control voltage connection 01, 02
4. Mains supply L1, L2, L3
5. Motor power supply T1, T2, T3
6. Current transformers (possible to mount outside for bypass see $\S 7.12$, page 43)
7. Mounting of EMC gland for control cables


Fig. 26 Connection of $M S F-170$ to $M S F-250$

## Connection of MSF-170 to MSF-250

## Device connections

1. Protective earth, $\stackrel{\perp}{\perp}$ (PE), Mains supply, Motor (on the left inside of the cabinet)
2. Protective earth $\perp(\mathrm{PE})$, Control voltage
3. Control voltage connection 01, 02
4. Mains supply L1, L2, L3
5. Motor power supply T1, T2, T3
6. Current transformers (possible to mount outside for bypass see $\$ 7.12$, page 43)
7. Mounting of EMC gland for control cables


Fig. 27 Connection of MSF-170 to MSF-1400.

## Connection of MSF-310 to MSF-1400

## Device connections

1. Protective earth, $\stackrel{\perp}{=}$ (PE), Mains supply and Motor
2. Protective earth, $\perp$ (PE), Control voltage
3. Control voltage connection 01, $\mathbf{0 2}$
4. Mains supply L1, L2, L3
5. Motor power supply T1, T2, T3
6. Current transformers (possible to mount outside for bypass see $₫ 7.12$, page 43)
7. Mounting of EMC gland for control cables

### 6.3 Connection and setting on the PCB control card



Fig. 28 Connections on the PCB, control card.
Table 12 PCB Terminals

| Terminal | Function | Electrical characteristics |
| :---: | :---: | :---: |
| 01 | Supply voltage | $100-240$ VAC $\pm 10 \% / 380-500 \mathrm{VAC} \pm 10 \%$ |
| 02 |  |  |
| PE | Gnd | $\stackrel{1}{\square}$ |
| 11 | Digital inputs for start/stop and reset. | $0.3 \mathrm{~V} \rightarrow 0 ; 8.27 \mathrm{~V} \rightarrow 1 . \mathrm{Max} .37 \mathrm{~V}$ for 10 sec . Impedance to $0 \mathrm{VDC}: 2.2 \mathrm{k} \Omega$. |
| 12 |  |  |
| 13 | Supply/control voltage to PCB terminal 11 and 12, $10 \mathrm{k} \Omega$ potentiometer, etc. | +12 VDC $\pm 5 \%$. Max. current from +12 VDC: 50 mA . Short circuit proof. |
| 14 | Remote analogue input control, 0-10 V, 2-10 V, 0.20 mA and $4.20 \mathrm{~mA} /$ digital input. | Impedance to terminal 15 (0 VDC) voltage signal: $125 \mathrm{k} \Omega$, current signal: $100 \Omega$ |
| 15 | GND (common) | 0 VDC |
| 16 | Digital inputs for selection of parameter set. | $0.3 \mathrm{~V} \rightarrow 0$; 8-27 V $\rightarrow$ 1. Max. 37 V for 10 sec . Impedance to $0 \mathrm{VDC}: 2.2 \mathrm{k} \Omega$ |
| 17 |  |  |
| 18 | Supply/control voltage to PCB terminal 16 and 17, $10 \mathrm{k} \Omega$ potentiometer, etc. | $+12 \mathrm{VDC} \pm 5 \%$. Max. current from $+12 \mathrm{VDC}=50 \mathrm{~mA}$. Short circuit proof. |
| 19 | Remote analogue output control | Analogue Output contact: <br> $0-10 \mathrm{~V}, 2-10 \mathrm{~V}$; min load impedance $700 \Omega$ <br> 0.20 mA and 4.20 mA ; max load impedance $750 \Omega$ |
| 21 | Programmable relay K1. Factory setting is "Opera tion" indication by closing terminal 21-22. | 1-pole closing contact, 250 VAC 8 A or 24 VDC 8 A resistive, $250 \mathrm{VAC}, 3 \mathrm{~A}$ inductive. |
| 22 |  |  |
| 23 | Programmable relay K2. Factory setting is "Full voltage" indication by closing terminal 23-24. | 1-pole closing contact, 250 VAC 8 A or 24 VDC $8 A$ resistive, $250 \mathrm{VAC}, 3 \mathrm{~A}$ inductive. |
| 24 |  |  |
| 31 | Alarm relay K3, closed to 33 at alarm. | 1-pole change over contact, 250 VAC $8 A$ or 24 VDC 8 A resistive, $250 \mathrm{VAC}, 3 \mathrm{~A}$ inductive. |
| 32 | Alarm relay K3, opened at alarm. |  |
| 33 | Alarm relay K3, common terminal. |  |
| 69-70 | PTC Thermistor input | Alarm level $2.4 \mathrm{k} \Omega$ Switch back level $2.2 \mathrm{k} \Omega$. |
| 71-72* | Clickson thermistor | Controlling soft starter cooling fine temperature MSF-310-MSF-1400 |
| 7374* | NTC thermistor | Temperature measuring of soft starter cooling fine |
| 75 | Current transformer input, cable S1 (blue) | Connection of L1 or T1 phase current transformer |
| 76 | Current transformer input, cable S1 (blue) | Connection of L3, T3 phase (MSF 017 - MSF 250) or L2, T2 phase (MSF 310-MSF 1400) |
| 77 | Current transformer input, cable \$2 (brown) | Common connection for terminal 75 and 76 |
| 78* | Fan connection | 24 VDC |
| 79* | Fan connection | 0 VDC |

*Internal connection, no customer use.

### 6.4 Minimum wiring



Fig. 29 Wiring circuit, "Minimun wiring".
The figure above shows the "minimum wiring". See
$\S 6.1$, page 24 , for tightening torque for bolts etc.

1. Connect Protective Earth (PE) to earth screw marked $\stackrel{\perp}{\perp}(\mathrm{PE})$.
2. Connect the soft starter between the 3-phase mains supply and the motor. On the soft starter the mains side is marked L1, L2 and L3 and the motor side with T1, T2 and T3.
3. Connect the control voltage ( $100-240 \mathrm{VAC}$ ) for the control card at terminal 01 and 02 .
4. Connect relay K1 (terminals 21 and 22) to the control circuit.
5. Connect PCB terminal 12 and 13 ( PCB terminal 11-12 must be linked) to, e.g. a 2-position switch (on/oFF) or a PLC, etc., to obtain control of soft start/stop. (For start/stop command from keyboard menu 006 must be set to 01 ).
6. Ensure the installation complies with the appropriate local regulations.

NOTE! The soft starter should be wired with shlelded control cable to fulfill EMC regulations acc. to $\S 1.5$, page 6.

NOTE! If local regulations say that a mains contactor should be used, the K1 then controls It. Always use standard commercial, slow blow fuses, e.g. type gl, gG to protect the wiring and prevent short clrculting. To protect the thyristors against shortcircult currents, superfast semiconductor fuses can be used if preferred. The normal guarantee is valld even If superfast semiconductor fuses are not used. All signal inputs and outputs are galvanicaliy insulated from the mains supply.

### 6.5 Wiring examples

Fig. 30 gives an wiring example with the following functions.

- Analogue input control, see $\$ 7.7$, page 40
- Parameter set selection, see $\$ 7.20$, page 54
- Analogue output, see $\S 7.18$, page 52
- PTC input, see $\$ 7.21$, page 55

For more information see $\S 6.3$, page 32 .


Fig. 30 Analogue input control, parameter set, analogue output and PTC input.


Fig. 31 Forward/reverse wiring circuit.

## 7. FUNCTIONAL DESCRIPTION SET-UP MENU

This chapter describes all the parameters and functions in numerical order as they appear in the MSF. Table 13 gives an overview of the menus, see also Chapter 13. page 79 (set-up menu list).

Table 13 Set-up Menu overview

|  | Menu number | Parameter group |  | Menu numbers | See § |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Basic functions | 001-008 | Basic | Ramp up/down parameters | 001-005 | 7.1 |
|  |  |  | Start/Stop/Reset command | 006 | 7.2 |
|  |  |  | Menu Expansion | 007-008 | 7.3 |
| Extended functions | 011-199 | Voltage control dual ramp |  | 011-014 | 7.4 |
|  |  | Torque control parameters |  | 016-018 | 7.5 |
|  |  | Main functions |  | 020-025 | $7.6-7.10$ |
|  |  | Additional functions |  | 030-036 | 7.11-7.14 |
|  |  | Slow speed and Jog functions |  | $\begin{aligned} & 037-040,57-58, \\ & 103-104 \end{aligned}$ | $\begin{aligned} & 7.15,7.19 \\ & 7.25 \end{aligned}$ |
|  |  | Motor Data Setting |  | 041-046 | 7.16 |
|  |  | Outputs | Relays | 051-052 | 7.17 |
|  |  |  | Analogue output | 054-056 | 7.18 |
|  |  | Input | Digital input | 057-058 | 7.19 |
|  |  | Parameter set selection |  | 061 | 7.20 |
|  |  |  | Motor protection | 071-075 | 7.21 |
|  |  |  | Main protection | 081-088 | 7.22 |
|  |  |  | Application protection | 089-099 | 7.23 |
|  |  |  | Resume alarms | 101, 102 | 7.24 |
|  |  | Auto return menu |  | 105 | 7.26 |
|  |  | Factory defaults |  | 199 | 7.28 |
| View functions | 201-915 | Main view |  | 201-208 | 7.29 |
|  |  | RMS current per phase |  | 211-213 | 7.29 |
|  |  | RMS voltage per phase |  | 214-216 | 7.29 |
|  |  | Keyboard lock status |  | 221 | 7.30 |
|  |  | Alarm list |  | 901-915 | 7.31 |

### 7.1 Ramp up/down parameters



Fig. 32 Menu numbers for start/stop ramps, initial voltage at start and step down voltage at stop.

Determine the starting time for the motor/machine.
When setting the ramp times for starting and stopping, initial voltage at start and step down voltage at stop, proceed as follow:

## 001 :

|  |  | $\mathbf{3}$ |
| :--- | :--- | :--- |
|  | $\mathbf{0}$ | Setting the initial voltage at <br> start ramp 1 |
| Default: | $30 \%$ |  |
| Range: | $25-90 \% U_{n}$ |  |

Set the initial voltage. Normally the factory setting, $30 \%$ of $U_{n}$, is a suitable choice.


### 7.1.1 RMS current [005]



NOTE! This is the same read-out as function 201, see § 7.28, page 63 .

| $0\|0\| 3$ | 0 |  |
| :--- | :--- | :--- |
|  | 1 | 0 |
|  | 0 | Setting of step down voltage <br> stop ramp 1 |
| Default: | $100 \%$ |  |
| Range: | $100-40 \%$ of $U_{n}$ |  |
| Step down voltage at stop can be used to stop <br> smoothly. |  |  |

### 7.2 Start/stop/reset command

Start/stop of the motor and reset of alarm is done either from the keyboard, through the remote control inputs or through the serial interface (option). The remote control inputs start/stop/reset ( PCB terminals 11,12 and 13) can be connected for 2 -wire or 3 -wire control.


NOTE! A reset via the keyboard will not start or stop the motor.

## NOTE! Factory default setting is 2, remote control.

To start and stop from the keyboard, the "START/ STOP" key is used.

To reset from the keyboard, the "ENTER $\leftarrow /$ RESET" key is used. A reset can be given both when the motor is running and when the motor is stopped. A reset from the keyboard will not start or stop the motor.

### 7.2.1 2-wire start/stop with automatic reset at start



Closing PCB terminals 12 and 13 , and a jumper between terminal 11 and 12 , will give a start command. Opening the terminals will give a stop. If PCB terminals 12 and 13 is closed at power up a start command is given (automatic start at power up). When a start command is given there will automatically be a reset.

### 7.2.2 2-wire start/stop with separate reset



Closing PCB terminals 11,12 and 13 will give a start and opening the terminals 12 and 13 will give a stop. If PCB terminals 12 and 13 are closed at power up a start command is given (automatic start at power up). When PCB terminals 11 and 13 are opened and closed again a reset is given. A reset can be given both when the motor is running and stopped and doesn't affect the start/stop.

### 7.2.3 3-wire start/stop with automatic reset at start.



PCB terminal 12 and 13 are normally closed and PCB terminal 11 and 13 are normally open. A start command is given by momentarily closing PCB terminal 11 and 13. To stop, PCB terminal 12 and 13 are momentarily opened.

When a start command is given there will automatically be a reset. There will not be an automatic start at power up.

### 7.3 Menu expansion setting.

In order to use the viewing menus and/or the extended functions menu 007 must be set to "On", then one reach read out of the viewing menus 201915. To be able to set any extended functions in the menus 011-199 menu 008 must be set to "on" as well.


## $008{ }^{\circ}$

|  | $\mathbf{O}$ | $\mathbf{F}$ |
| :--- | :--- | :--- |
|  | $\mathbf{F}$ | Selecting of extended <br> functions |
| Default: | oFF |  |
| Range: | oFF, on |  |
| oFF | Only view function 201-915 are visi- <br> ble. |  |
| on | All the function menus are visible |  |

NOTE! Menu 007 must be "on".

### 7.4 Voltage control dual ramp

To achieve even smoother ramps at start and or stop, a dual ramp can be used.


Fig. 33 Menu numbers for dual voltage ramp at start/stop, initial woltage at start and step down-voltage at stop.

The settings are carried out by beginning with the settings in menus 001-004 and 007-008 and proceed with the following steps:


$\left.$| 0 1 3 <br> 0   |  |  |  |
| :--- | :--- | :--- | :--- |
|  |  | 4 | 0 | | Setting of step down voltage |
| :--- |
| in stop ramp 2 | \right\rvert\,


| 0 1 4 <br> 0   |
| :--- | :--- | :--- |
| Setting of stop ramp time 2    <br>  0 $F$ $F$ <br> Default: oFF   <br> Range: oFF, 2-120 sec   <br> oFF Stop ramp 2 disabled   <br> $\mathbf{1 - 6 0}$ Set the stop ramp 2 time. A dual <br> voltage stop ramp is active.   |

### 7.5 Torque control parameters

See also $\S 7.10$, page 42 and chapter 4. page 13 for more information on the Torque control setting.

| 0 | 1 | 6 | 0 |
| :--- | :--- | :--- | :--- |
|  |  |  |  |
|  |  | 1 | 0 |
|  |  | 1 | 0 |
| Default: | 10 |  |  |
| Range: | $0 \cdot 250 \%$ of Tn |  |  |
| Insert initial torque at start <br> shaft torque (Tn), see chapter 13. page 79. |  |  |  |



### 7.6 Current limit (Main Function)

The Current Limit function is used to limit the current drawn when starting ( $150-500 \%$ of In). This means that current limit is only achieved during set start-up time.

Two kinds of current limit starts are available.

- Voltage ramp with a limited current.

If current is below set current limit, this start will act exactly as a voltage ramp start.

- Current limit start.

The soft starter will control the current up to set current limit immediately at start, and keep it there until the start is completed or the set start-up time expires.
See Fig. 34 Current limit.
NOTE! Make sure that nominal motor current In menu 042 Is correctly inserted.

### 7.6.1 Voltage ramp with current limit

The settings are carried out in three steps:

1. Estimate starting-time for the motor/machine and select that time in menu 002 (see $\oint 7.1$, page 36 ).
2. Estimate the initial voltage and select this voltage in menu 001 (see $\S 7.1$, page 36).
3. Set the current limit to a suitable value e.g. $300 \%$ of In in menu 020.

| 0.210 |  |  | Voltage ramp with current limit at start |
| :---: | :---: | :---: | :---: |
| 0 | $F$ | $F$ |  |
| Default: |  | oFF |  |
| Range: |  | oFF, 150-500\% In |  |
| OFF |  | Voltage Ramp mode with current limit disabled. Voltage Ramp enabled. |  |
| 150-500 |  | $\begin{aligned} & \text { Cur } \\ & \text { moo } \end{aligned}$ | limit level in Voltage ramp |

NOTE! Only possible when Voltage Ramp mode is enabled.
Menus 021-025 must be "ofF".


Fig. 34 Current limit

### 7.6.2 Current limit

The settings are carried out in two steps:

1. Estimate starting time for the motor/machine and select that time in menu 002 (see $§ 7.1$, page 36 ).
2. Set the current limit to a suitable value e.g. $300 \%$ of In in menu 021.

| 0 2 1 <br> 0   |  |  |
| :--- | :--- | :--- |
|  | 0 | $F$ |
| Current limit at start |  |  |
| Default: | oFF |  |
| Range: | oFF, 150-500\% In |  |
| oFF | Current limit mode disabled. Voltage <br> Ramp enabled. |  |
| $\mathbf{1 5 0 - 5 0 0}$ | Current limit level in current limit <br> mode. |  |

NOTE! Only passlble when Voltage Ramp mode Is enabled. Menus 020, $022-025$ must be "oFF".

NOTE! Even though the current limit can be set as low as 150\% of the nominal motor current value, this minimum value cannot be used generally. Considerations must be glven to the starting torque and the motor before setting the approprlate current limit. "Real start time" can be longer or shorter than the set values depending on the load conditions. This applies to both current limit methods.


Fig. 35 Current limit
If the starting time is exceeded and the soft starter is still operating at current level, an alarm will be activated. It is possible to let the soft starter to either stop operation or to continue. Note that the current will rise uncontrolled if the operation continues (see $\$$ 7.24.2, page 61).

### 7.7 Pump control (Main Function)

By choosing pump control you will automatically get a stop ramp set to 15 sec . The optimising parameters for this main function are start and stop time; initial torque at start and end torque at start and stop. End torque at stop is used to let go of the pump when it's no longer producing pressure/flow, which can vary on different pumps. See Fig. 36.


Fig. 36 Pump control

## Pump application

The pump application is using Torque ramps for quadratic load. This gives lowest possible current and linear start and stop ramps. Related menus are 2,4 (see $§ 7.1$, page 36 ), 16,17 and 18 (see $\subseteq 7.5$, page 39 ).

| $0 \times 2 \mid 20$ |  |  | Setting of pump control |
| :---: | :---: | :---: | :---: |
| 0 | F | F |  |
| Default: |  | oFF |  |
| Range: |  | oFF, on |  |
| OFF |  |  | control disabled. Voltage enabled. |
| on |  | Pum | control application is ena |

NOTE! Only possible when Voltage Ramp mode Is enabled. Menu 020-021, 023-025 must be "oFF".

### 7.8 Analogue Input Control (Main Function)

Soft starting and soft stopping can also be controlled via the Analogue Input Control ( $0-10 \mathrm{~V}, 2-10 \mathrm{~V}, 0-20 \mathrm{~mA}$ and $4-20 \mathrm{~mA}$ ). This control makes it possible to connect optional ramp generators or regulators.

After the start command, the motor voltage is controlled through the remote analogue input.


WARNING! The remote analogue control may not be used for continuous speed regulation of standard motors. With this type of operation the increase In the temperature of the motor must be taken Into consideration.

To install the analogue input control, proceed by:

1. Connect the ramp generator or regulator to terminal $14(+)$ and $15(-)$.


Fig. 37 Wiring for analogue input.
2. Set Jumper J1 on the PCB control card to voltage (U) or current control (I) signal position, see Fig. 38 and Fig. 24 on page 28. Factory setting is voltage (U).


Fig. 38 Setting voltage or current for analogue input.

| 0 2 3 0 |
| :--- | :--- | :--- | :--- |
|  0 $F$ Selection of Analogue input <br> control <br> Default: oFF   <br> Range: oFF, 1, 2   <br> oFF Analogue input disabled. <br> Voltage Ramp enabled.   <br> $\mathbf{1}$  Analogue input is set for 0-10V/ <br> O-20mA control signal  <br> $\mathbf{2}$  Analogue input is set for 2-10V/ <br> 4-20mA control signal.  |

NOTE! Only possible when Voltage Ramp mode is enabled. Menu 020-022, 024, 025 must be "oFF"

### 7.9 Full voltage start, D.O.L. (Main Function)

The motor can be accelerated as if it was connected directly to the mains. For this type of operation:

Check whether the motor can accelerate the required load (D.O.L.-start, Direct On Line start). This function can be used even with shorted thyristors.

| 0 2 4 <br> 0   |  |  |
| :--- | :--- | :--- |
|  | O | F |
|  | Fetting of D.O.L start |  |
| Default: | oFF |  |
| Range: | oFF, on |  |
| oFF | D.O.L. start disabled. <br> Voltage Ramp enabled. |  |
| on | D.O.L. start enabled |  |

NOTE! Only possible when Voltage Ramp mode is enabled. Menu 020-023, 025 must be "oFF".


Fig. 39 Full voltage start.

### 7.10 Torque control (Main function)

This main function can be used to make a start according to a pre-defined torque reference curve. Two different load characteristics, linear and square, are possible to select.

At start/stop the torque controller will follow the selected characteristic.

A torque start/stop behaviour can be seen in Fig. 40.

A perfect start and stop with torque ramps have a good linearity of current. To optimise this, use the setting of initial torque (menu 16) and end torque (menu 18 ). See also $₫ 7.5$, page 39 .

## Example:

Default for initial torque is $10 \%$ so if starting a more heavy load this will result in a small current peak in beginning of ramp. By increasing this value to $30 /$ $70 \%$ the current peak will not appear.

The end torque is increased mainly if the application has a high inertial load, like planers, saws and centrifuges. A current peak will appear in the end of ramp because the load is pushing the speed more or less by itself. By increasing this level to $150-250 \%$ the current will be linear and low.


NOTE! Torque control mode is only possible when Voltage Ramp mode is enabled (menu 020-024 are "oFF").


Fig. 40 Torque control at start/stop.


Fig. 41 Current and speed in torque control.

### 7.11 Torque boost

The Torque Booster enables a high torque to be obtained by providing a high current during $0.1-2$ sec at start. This enables a soft start of the motor even if the break away torque is high at start. For example in crushing mills applications etc.

When the torque booster function has finished, starting continues according to the selected start mode.


Fig. 42 The principle of the Torque Booster when starting the motor in voltage ramp mode.

See $\int 4.6$, page 19 , which main function that can be used with the torque boost.

| O 310 |  |  | Torque boost active time |
| :---: | :---: | :---: | :---: |
| 0 | $F$ | $F$ |  |
| Default: |  | oFF |  |
| Range: |  | oFF, | 1-2 sec |
| oFF |  | Torq | boost disabled |
| 0.1-2.0 |  | Set | Torque boost time. |



NOTE! Check whether the motor can accelerate the load with "Torque booster", without any harmful mechanical stress.

### 7.12 Bypass

In cases of high ambient temperatures or other reason it may sometimes be necessary to use a by-pass contactor to minimize the power loss at nominal speed (see Technical Data). By using the built-in Full Voltage Relay function an external contactor can be used to Bypass the soft starter when operating at nominal speed.

Bypass contactor can also be used if soft stop is required. Normally a Bypass contactor is not necessary as the device is designed for continues running conditions, see Fig. 29 on page 33 for wiring example.

NOTE! If one like to use the alarm functions, the extended functlons or the viewing functions the 2-pcs current transformers must be mounted outside the soft start as shown in Flg. 44 and Fg. 45 on page 45 . For this purpose an optlonal extension cable for the current transformers is avallable. Code No 01-2020-00.


CAUTION! If the current transformers are not mounted as in Fg. 43 on page 44 and § 6.2, page 28, the alarm and viewing functions will not work. Do not forget to set menu 032 to ON , otherwise there will be an F12 alarm and at the stop command will be a freewheeling stop.

For further information see chapter 6.2 page 28 .


Fig. 43 Bypass wiring example MSF 310-1400.


Fig. 44 Current transformer position when Bypass MSF-017 to MSF-250.


Fig. 45 Current transformer position when Bypass MSF-310 to MSF-1400.

### 7.13 Power Factor Control

During operation, the soft starter continuously monitors the load on the motor. Particularly when idling or when only partially loaded, it is sometimes desirable to improve the power factor. If Power factor control (PFC) is selected, the soft starter reduces the motor voltage when the load is lower. Power consumption is reduced and the degree of efficiency improved.

| $0\|3\| 3$ |  |  |
| :--- | :--- | :--- | :--- |
|  | O | Setting of PFC |
|  | $F$ | $F$ |
| Default: | oFF |  |
| Range: | oFF, on |  |
| ofF | PFC disabled |  |
| on | PFC enabled. The Full voltage relay <br> function does not work. |  |

NOTE! If the PFC is used the EMC-directive is not fulfilled.

### 7.14 Brake functions

There are two built in braking methods for applications were the normal stop ramp is not enough.

## - Dynamic DC-brake

Increases the braking torque by decreasing speed.

- Soft brake

Gives a high torque at the start of the braking and then also increasing torque by decreasing speed.

In both methods the MSF detects when the motor is standing still, so rotating in wrong direction is avoided.

## Dynamic Vector Brake

- Possible to stop motors with high inertia loads from close to synchronous speed.
- At $70 \%$ of the nominal speed a DC-brake is activated until the motor is standing still or the selected Braking Time has expired (see menu 34, next page).
- No contactor needed.
- For extra safety, tbe soft starter has a digital input signal for monitoring standstill so that at real motor standstill will stop the output voltage immediately (see $\$ 7.19$, page 53 ).


## Soft brake

- Even very high inertia loads can be stopped
- The Soft brake is a controlled reversing of the motor as the MSF measures the speed during braking.
- Two contactors are needed which can be placed on the in- or output of the soft starter. On the input the first contactor is connected to relay K 1 which is also used as a mains contactor.
- At $30 \%$ of the nominal speed a DC-brake is activated until the motor is standing still or the selected Braking Time has expired (menu 34, next page).
- For extra safety, the soft starter has a digital input signal for monitoring standstill. So that the output voltage is stopped immediately (see menu 57-58, § 7.19 , page 53 ).

See Fig. 47 on page 47 for the following set-up sequence:

- Soft brake is activated if menu $36=2$ and menu 34 has a time selected (see next page).
- Menu 51 and 52 are automatically set to 5 and 4 to get the correct relay functions on K 1 and K 2 (see $\S$ 7.17, page 51).
- Relay K1 should be used to connect a contactor for supply L1, L2, L3 to MSF or motor.
- Relay K2 is used to connect phase shifting contactor to change L1, L2 and L3 to MSF or motor.
- At start K1 is activated and connects L1, L2, L3 then the motor starts. At stop K1 opens and disconnects L1, L2, and L3 and after 1s K2 connects witb the other phase sequence and the braking of the motor is active.

NOTEI Soft brake uses both programmable relays. For other functions, see also the function table in chapter 7. page 35.

NOTE! For several start/stops it is recommend to use the PTC Input.


WARNING! If the Soft Brake function has been selected once and after that the Bypass function is selected, then the relay functions on K1 and K2 remain in the Soft Brake functlonality. Therefore It Is necessary to change the relay functions in menu 51-52 manually to the Bypass functions (see $\$ 7.17$, page 51) or reset to default in menu 199 (see $\S 7.28$, page 63) and select the Bypass function agaln.


Torque | Softbrake |
| :--- |
| Dynamic DC |
| Nom. speed |
| 03-F121 |

Fig. 46 Braking time


| $0\|3\| 6\|l\|$ |  |  |
| :--- | :--- | :--- |
|  |  |  |
|  |  |  |
| Brake method |  |  |
|  |  | 1 |
| Default: | 1 |  |
| Range: | 1,2 |  |
| $\mathbf{1}$ | Dynamic vector brake, active |  |
| $\mathbf{2}$ | Soft brake active |  |



Fig. 47 Soft brake wiring example.

### 7.15 Slow speed and Jog functions

The soft starter is able to run the motor at a fixed slow speed for a limited period of time.

The slow speed will be about $14 \%$ of the full speed in the forward direction and $9 \%$ in the reverse direction.

The following functions are possible:

- Slow speed controlled by an external signal. The digital input is used to run at slow speed at a start or stop command for a selected number of pulses (edges) generated by an external sensor (photo cell, micro switch, etc.). See $\S 7.19$, page 53 for more instructions.
- Slow Speed during a selected time period.

The slow speed will be active after a stop command for a selected time period. See $\$ 7.19$, page 53 for more instructions.

- Slow Speed using the "JOG"-commands.

The slow Speed can be activated via the JOG keys on the keyboard or externally via the analogue input. See $\S 7.25$, page 61 for more instructions.

### 7.15.1 Slow speed controlled by an external signal.

With these setting it is possible to have an external pulse or edge signal controlling the time that the Slow Speed is active either after a Start command or a Stop command or at both commands. The following menu's are involved:

| Menu | Function | See page |
| :--- | :--- | :--- |
| 57 | Digital input selection | page 53 |
| 58 | Pulse selection | page 53 |
| 37 | Slow speed torque | page 49 |
| 38 | Slow speed time at start | page 49 |
| 39 | Slow speed time at stop | page 49 |
| 40 | DC-Brake at slow speed | page 49 |

Installation is as follows:

1. Set the analogue input selection for Slow Speed operation. Menu $57=2$. See $\S 7.19$, page 53 . See Fig. 37 on page 41 for a wiring example.
2. Select in menu 38 (see $\S 7.15 .2$, page 49 ) the Slow Speed at Start time. This time will now be the absolute maximum time for Slow Speed to be active after a start command, in case the external signal will not appear.
3. Select in menu 39 (see $\S 7.15 .2$, page 49 ) the Slow Speed at Stop time. This time will now be the absolute maximum time for Slow Speed to be active after a stop command, in case the external signal will not appear.
4. Select in menu 57 (see $\int 7.19$, page 53 ) the number of edges to be ignored by the Slow Speed input, before a start or stop is executed at slow speed. The edges are generated by an external sensor (photo cell, micro switch, etc.).

The Slow Speed torque (menu 37) and DC-Brake after Slow Speed (menu 40) can be selected if needed. (see $\S 7.15 .4$, page 49).

When the number of edges exceeds or the time expire, a start according to selected main function is made.

At stop, the motor will ramp down (if selected) and DC brake (if selected) before a slow speed forward at stop will begin. Slow speed will last as long as the number of edges on the external input is below parameter value in menu 036 and the max duration time doesn't expires. When the number of edges exceeds or the time expire, a stop is made.

In Fig. 48 on page 48 the selected number of edges are 4. It is recommended to select DC-brake (se $\S 7.14$, page 46) before a slow speed at stop if it is a high inertia load. See Fig. 29 on page 33 for wiring diagram. In case one use DC-brake, see $\mathbb{\$}$.15.4, page 49 .


Fig. 48 Slow speed controlled by an external signal.
This additional function can be used together with most of the main functions (see $₫ 4.6$, page 19 ).

| 03 | 0   <br>    <br>    | Slow speed torque |
| :--- | :--- | :--- |
|  |  |  |
| Default: | 10 |  |
| Range: | $10-100$ |  |
| Select the magnitude of the slow speed torque. |  |  |

### 7.15.2 Slow speed during a selected time

It is possible to have a slow speed in forward direction before a start and after a stop. The duration of the slow speed is selectable in menus 038 and 039.

It is reconmended to select DC brake (see $\$ 7.14$, page 46) before a slow speed at stop if it is a high inertia load. This slow speed function is possible in all control modes, keyboard, remote and serial communication.

| $038{ }_{0}^{0}$ |  |  | Slow speed time at start |
| :---: | :---: | :---: | :---: |
|  | F | F |  |
| Default: |  | OFF |  |
| Range: |  | OFF, 1-60 sec |  |
| ofF |  | Slow speed at start is disabled |  |
| 1.60 |  |  | w speed time at start. |




Fig. 49 Slow speed at stant/stop during a selected time.
The Slow speed torque (menu 37) and the DC-Brake after Slow speed (menu $40, \S 7.15 .4$, page 49) can be selected if needed.

### 7.15.3 Jog Functions

The Jog commands can be used to let the motor run at a Slow speed (forward or reverse) as long as the Jog command is active.

The Jog conmmands can be activated in 2 different ways:

- Jog keys

The Jog-Forward and Jog-reverse keys on the control panel. The keys can be progranmed separate for each function. See $\$ 7.25$, page 61 for more instructions

- External Jog command

The external conmand is given via terninal 14 at the digital input. Only 1 function (forward or reverse) can be programmed to the digital input at the time. See $\S 7.19$, page 53 for more instructions.

### 7.15.4 DC-brake after slow speed at stop [040]

A DC-brake after a slow speed at stop is possible to have, i.e. for a high inertia load or for a precise stop.

The current is controlled and the reference value for the normal DC-brake function is used (see § 7.15.4, page 49).
The duration for the DC-brake is possible to select.
This DC-brake function is not applied when the "JOG $\Omega$ " and "JOG $\Omega$ " keys are used.

| $O$ 4,0 0  <br>  DC-Brake at slow speed   <br>  0 $F$ $F$ <br> Default: oFF   <br> Range: oFF, 1-60   <br> oFF DC-brake after slow speed at stop <br> disabled.   <br> $\mathbf{1 - 6 0}$ DC-brake duration time after slow <br> speed at stop.   |
| :--- | :--- | :--- |

### 7.16 Motor data setting

The first step in the settings is to set menu 007 and 008 to "on" to be able to reach the menus 041-046 and enter the motor data.

NOTE! The default factory settings are for a standard 4-pole motor acc. to the nominal current and power of the soft starter. The soft starter will run even If no specific motor data is selected, but the performance will not be optimal.

| $0\|4\| 5$ | 0 |  |
| :--- | :--- | :--- |
| $\quad$ Nominal motor cos phi |  |  |
|  | 0.8 | 6 |
| Default: | 0.86 |  |
| Range: | $0.50-1.00$ |  |



Nominal motor voltage

| Default: | 400 V |
| :--- | :--- |
| Range: | $200-700 \mathrm{~V}$ |

Make sure the soft starters maximum voltage rating is suitable for chosen motor voltage.


NOTE! Now go back to menu 007, 008 and set it to "oFF" and then to menu 001.


### 7.17 Programmable relay K1 and K2

The soft starter has three built-in auxiliary relays, K3 (change over contacts), is always used as an alarm relay. The other two relays, K1 and K2 (closing contacts), are programmable.

K1 and K2 can be set to either "Operation", "Full Voltage" or "Pre-alarm" indication. If DC-brake is chosen the relay K2 will be dedicated to this function.


Fig. 50 Start/stop sequence and relay function "Operation" and "Full voltage".

| 0,51 | 0 |  |
| :--- | :--- | :--- |
|  |  |  |
|  | 1 |  |

### 7.18 Analogue output

The soft starter can present current, voltage and power on an analogue output terminal, for connection to a recording instrument or a PLC. The output can be configured in 4 different ways, $0-10 \mathrm{~V}$,
$2-10 \mathrm{~V}, 0-20 \mathrm{~mA}$ or $4-20 \mathrm{~mA}$. To install the instrument proceed as follows:

1. Connect the instrument to terminal $19(+)$ and 15 (-).


Fig. 51 Wiring for analogue output.
2. Set Jumper J2 on the PCB board to voltage ( U ) or current (I) signal position. Factory setting is voltage (U). See Fig. 52 on page 52 and Fig. 24 on page 28.

4. Choose a read-out value in menu 055

| $0\|5\| 5$ | 0 |  |
| :--- | :--- | :--- |
|  |  | 1 |
| $\quad$ Analogue output value |  |  |
|  |  | 1 |
| Default: | 1 |  |
| Range: | $1,2,3$ |  |
| $\mathbf{1}$ | RMS current, default range 0-5xin |  |
| $\mathbf{2}$ | Line input RMS voltage, default <br> range 0-720V |  |
| $\mathbf{3}$ | Output shaft power, default range <br> O-2xPn |  |

5. Set analogue output gain to adjust the range of chosen analogue output value in menu 056 .,


Example on settings:

| Set value | $\mathbf{I}_{\text {scale }}$ | $\mathbf{U}_{\text {scale }}$ | $\mathbf{P}_{\text {scale }}$ |
| :--- | :--- | :--- | :--- |
| $100 \%$ | $0-5 \times I_{n}$ | $0-720 \mathrm{~V}$ | $0-2 \times P_{\mathrm{n}}$ |
| $50 \%$ | $0-2.5 \times I_{n}$ | $0-360 \mathrm{~V}$ | $0-P_{\mathrm{n}}$ |

Fig. 52 Setting of current or voltage output.
3. Set the parameter in menu 054.

| 0 5 0 |
| :--- | :--- | :--- | :--- |
|  0 Analogue output <br> Default: oFF  <br> Range: oFF, 1, 2  <br> oFF Analogue ouput is disabled  <br> $\mathbf{1}$ Analogue output is set to <br> O-10V/0-20mA  <br> $\mathbf{2}$ Analogue output is set to <br> O-10V/4-20mA  |

### 7.19 Digital input selection

The analogue input can be used as a digital input. This is programmed in Menu 57. There are 4 different functions:

- Rotation sensor input for braking functions. See $\S 7.14$, page 46 .
- Slow speed external controlled. See $\S 7.15 .1$, page 48.
- Jog functions forward or reverse enabled. See $\S$ 7.25 , page 61 .

Fig. 53 shows how to set the input for voltage or current control, with jumper J1 the control board. The default setting for J 1 is voltage control.


Fig. 53 Setring of J1 for current or voltage control.
Fig. 54 shows a wiring example for the analogue input as it is used for digital input.


Fig. 54 Wiring for slow speed external input.
NOTE! If the Maln Function Analogue control Is programmed (see § 7.8, page 41) the analogue input can not be used for digltal slgnal input. The menu 57 Is then automatically set to OFF.

| 0 5 7 <br> 0   |  |  |  |
| :--- | :--- | :--- | :--- |
|  | 0 | F | F |
|  |  |  |  |
|  |  |  |  |
| Default: | oFF |  |  |
| Range: | oFF, 1-4 |  |  |
| $\mathbf{0 F F}$ | No digital input selection |  |  |
| $\mathbf{1}$ |  | Rotation sensor for brake functions |  |
| $\mathbf{2}$ | Slow speed function |  |  |
| $\mathbf{3}$ | Jog forward command |  |  |
| $\mathbf{4}$ | Jog reverse command |  |  |

NOTE! Jog forward, reverse has to be enabled, see § 7.25, page 61.

Depending on the selection made in menu 57, menu 58 is used to program the number of the edges. The edges can be generated by an external sensor (photo cell, micro switch etc.).


### 7.20 Parameter Set

Parameter Set, an important function which can be handy when using one soft starter to switch in and start different motors, or working under variable load conditions. For example; starting and stopping conveyor belts with different weight on the goods from time to time.

For sets of parameters can be controlled either from the keyboard, the external control inputs or the serial interface (option). Up to 51 different parameters can be set for each Parameter Set.


Fig. 55 Parameter overview
When 'Parameter set' in menu 061 is set to 0 (external selection), only parameters in menu 006 (Control mode) and 061 (Parameter set) can be changed. All other parameters are not allowed to change.

It is possible to change parameter set at stop and at full voltage running.



Fig. 56 Connection of external control inputs.

| Parameter Set | PS1 (16-18) | PS2 (17-18) |
| :---: | :---: | :---: |
| 1 | Open | Open |
| 2 | Closed | Open |
| 3 | Open | Closed |
| 4 | Closed | Closed |

### 7.21 Motor protection, overload (F2 alarm)

In many cases it is convenient to have a complete starter. The soft starter have a possibility to use either an input PTC signal from the motor, an internal thermal model of the motor for thermal protection or both together at the same time. Slight overload for long time and several overloads of short duration will be detected with both methods.

| 0 7 1 0 <br> 0    |  |  |
| :--- | :--- | :--- |
|  |  | $n$ |

NOTE! Open terminals will glve an F2 alarm immedlately. Make sure the PTC is always connected or the terminals are shorted.

NOTE! The internal motor thermal protection will still generate an alarm if it is not selected oFF.


NOTE! If 'Bypass' is used check that the current transformers are placed and connected correctly (see Flg. 43 on page 44).


CAUTION! Used thermal capacity is set to 0 If the control board loses its supply (terminal 01 and 02). This means that the internal thermal model starts with a 'cold' motor, which perhaps in reality is not the case. This means that the motor can be overheated.


Fig. 57 The thermal curve


Read-out of the used thermal capacity. If menu 072 'Internal motor thermal protection' is selected oFF, the capacity is shown as if the default class 10 was selected.

| 0 7 4 |  |  |
| :--- | :--- | :--- | :--- |
|  0 | Starts per hour limitation |  |
| Default: | oFF |  |
| Range: | oFF, 1-99/hour |  |
| oFF | Starts per hour limitation is disabled. |  |
| $1-99$ |  | Sets the start per hour limitation <br> alarm. If the selected number is <br> exceeded, alarm F11 occurs. |

## $07{ }^{\circ}{ }^{\circ}$

| $\mathbf{O}$ | F | Locked rotor alarm |
| :--- | :--- | :--- |
| Default: | oFF |  |
| Range: | oFF, 1.0-10.0 sec |  |
| oFF | Locked rotor alarm is disabled |  |
| $\mathbf{1 . 0 - 1 0 . 0}$ | An F5 alarm is given when the rotor <br> locks. The alarm is active during <br> starting and running. |  |

### 7.22 Mains protection




L123 is the direct phase sequence.
L321 is the reverse phase sequence.

| $088{ }_{0}^{\circ}$ |  |  | Phase reversal alarm |
| :---: | :---: | :---: | :---: |
| 0 | F | F |  |
| Default: |  | OFF |  |
| Range: |  | OFF, on |  |
| OFF |  | Phase reversal alarm is disabled |  |
| on |  | Sets the phase reversal Alarm. <br> - Switch on the power supply first. <br> The phase sequence is stored as the correct sequence. <br> - Sets the menu 088 to "on". <br> - Any reversal of phase sequence will cause alarm F16. |  |

NOTE! The actual phase sequence can be viewed in menu 87.

### 7.23 Application protection (load monitor)

### 7.23.1 Load monitor max and min/protection (F6 and F7 alarms)

MSF has a built in load monitor based on the output shaftpower. This is a unique and important function which enables protection of machines and processes driven by the motor connected to the soft starter. Both a Min and Max limit is possible to select.

In combination with the pre-alarm function, see $\$ 7.23 .2$, page 58 , this create a powerful protection. An auto set function is also included for an automatic setting of the alarm limits. A start-up delay time can be selected to avoid undesired alarms at start-up, see Fig. 58 on page 60.

NOTE! The load monitor alarms are all disabled during a stop ramp.

| $0\|8\|$ 0  <br>    <br>   Auto set power limits <br>   0 <br> Default: no  <br> Range: no, YES  <br> no Auto set is disabled  <br> YES Auto set is activated if ENTER is <br> pressed.  |
| :--- | :--- | :--- |

## $0900_{\circ}^{\circ}$



Output shaftpower in \%

| Default: | - |
| :--- | :--- |
| Range: | $0-200 \%$ |

Measured output shaftpower in \% of nominal motor power.

NOTE! System must be in full voltage running before an auto set is permitted.

The actual power is regarded as $1.00 \times \mathrm{xPact}$.
The set levels are:

$$
\begin{array}{ll}
\text { Power max alarm limit[092]: } & 1.15 \times \mathrm{xP} \text { actual } \\
\text { Power max pre-alarm limit[094]: } & 1.10 \mathrm{xP} \text { actual } \\
\text { Power min pre-alarm limit[096]: } & 0.90 \mathrm{xP} \text { actual } \\
\text { Power min alarm limit[098]: } & 0.85 \mathrm{xP} \text { actual }
\end{array}
$$

A successful auto set shows a message 'Set' for 3 s and if something goes wrong a message 'no' will be showed.


| Default: | 10 sec |
| :--- | :--- |
| Range: | $1-250 \mathrm{sec}$ |

From start command during selected delay time, all power load monitor alarms and pre-alarms are disabled.


Insert limit in \% of nominal motor power. The actual power in \% of nominal motor power, could be read out in menu 090. If output shaft power exceeds selected limit, an F6-alarm occurs after the response delay time. The 'Auto set' function in menu 089, affect this limit even if the alarm is set "oFF" in menu 093. This is a category 1 alarm.

| $0 \mid 9$ 3  <br>  0 Response delay max alarm <br>  R  <br> Refault: oFF  <br> Range: oFF, 0.1-25.0 sec  <br> oFF Max Alarm is disabled.  <br> $\mathbf{0 . 1 - 2 5 . 0}$ Sets the response delay of the Max <br> Alarm level.  |
| :--- | :--- | :--- |

### 7.23.2 Pre-alarm

It could be useful to know if the load is changing towards a load alarm limit. It is possible to insert both a Max and Min pre-alarm limit based on the motor output shaft power. If the load exceeds one of these limits, a pre-alarm condition occurs.

It should be noted that it is not normal alarms. They will not be inserted in the alarm list, not activating the alarm relay output, not displayed on the display and they will not stop operation. But it is possible to activate relay K 1 or K 2 if a pre-alarm condition occurs. To have pre-alarm status on any of these relays, select value 3 in menu 051 or 052 (see $§ 7.17$, page 51 ).

A start-up delay time can be selected in menu 091 to avoid undesired pre-alarms at start-up. Note that this time is also shared with power Max and Min alarms.

NOTE! The pre-alarm status Is always avallable on the serlal communication.


Insert limit in \% of nominal motor power. The actual power in \% of nominal motor power, could be read out in menu 090. If output shaft power exceeds selected limit, a pre-alarm occurs after the response delay time. The 'Auto set' function in menu 089, affect selected limit even if the pre-alarm is set "oFF" in menu 095.

| 0.95 | 0 |  |
| :--- | :--- | :--- |
|  | 0 | F |
|  | F | Max pre-alarm response <br> delay |
| Default: | oFF |  |
| Range: | oFF, 0.1-25.0 sec |  |
| oFF | Max Pre-Alarm is disabled. |  |
| $\mathbf{0 . 1 - 2 5 . 0}$ | Sets the response delay of the Max <br> Pre-Alarm level. |  |






|  | O | F |
| :--- | :--- | :--- |
| $\quad$ Min alarm response delay |  |  |
| Default: | oFF |  |
| Range: | oFF, 0.1-25.0 sec |  |
| oFF | Min Alarm is disabled |  |
| $\mathbf{0 . 1 - 2 5 . 0}$ | Sets the response delay of the Min <br> Alarm level. The Min alarm is disa- <br> bled during a stop ramp down. |  |



### 7.24 Resume alarms

### 7.24.1 Phase input failure F1

## - Multiple phase failure.

Shorter failure than 100 ms is ignored. If failure duration time is between 100 ms and 2 s , operation is temporary stopped and a soft start is made if the failure disappears before 2 s. If failure duration time is longer than 2 s , an F1 alarm is given in cat. 2.

- Single phase failure.

During start up (acceleration) the behaviour is like multiple phase failure below. When full voltage running there is a possibility to select the behaviour.

| 1 0 1 Run at single phase loss <br>   $n$ 0 |  |
| :--- | :--- | :--- | :--- |
| Default: | no |
| Range: | no, YES |
| no | Soft starter trips if a single phase <br> loss is detected. Alarm F1 (category <br> 2) will appear after 2 sec. |
| YES | Soft starter continues to run after a <br> single phase loss. <br> - Alarm F1 appears after 2 sec. <br> - If the loose phase is reconnect the <br> alarm is reset automatically. <br> - If running on 2 phases, a stop com- <br> mand will give a Direct on line stop <br> (freewheel) |

### 7.24.2 Run at current limit time-out F4

In modes 'Current limit at start' and 'Voltage ramp with current limit at start' an alarm is activated if still operating at current limit level when selected ramp time exceeds. If an alarm occurs there is a possibility to select the behaviour.


### 7.25 Slow speed with JOG

Slow speed with "JOG" is possible from the "JOG" keys, but also from terminals, see menu 57 page 53 and serial comm. The "JOG" is ignored if the soft starter is running. The slow speed "JOG" function has to be enabled for both forward and reverse directions in menus 103 and 104 , see below.

## NOTE! The enable functions is for all control modes.

| $1\|0\| 3$ 0  <br>  JOG forward enable  <br>  $O$ $F$ |  |
| :--- | :--- | :--- | :--- |
| Default: | oFF |
| Range: | oFF, on |
| oFF | JOG forward disabled |
| on | JOG forward enabled |




Fig. 59 The 2 Jog keys.

### 7.26 Automatic return menu

Often it is desirable to have a specific menu on the display during operation, i.e. RMS current or power consumption. The Automatic return menu function gives the possibility to select any menu in the menu system.

The menu selected will come up on the display after 60 sec . if no keyboard activity. The alarm messages (F1-F16) have a priority over menu 105 (as they have for all menus).


### 7.27 Communication option, related 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 'Keyboard control' mode. See $\$ 7.2$, page 37.

| 1 1 0 <br> 0   |  |
| :--- | :--- | :--- |
|   Serial comm unit address  <br>    1 |  |
| Default: | 1 |
| Range: | $1-247$ |
| This parameter will select the unit address. |  |


| 1 12 |
| :--- | :--- | :--- |
|    <br>   Serial comm baudrate <br>   9.6 <br> Default: 9.6  <br> Range: $2.4,4.8,9.6,19.2,38.4$ kBaud  <br> This parameter will select the baudrate.   |


| 113 |  |  |
| :--- | :--- | :--- |
|  |  | 0 |
|  |  | 0 |

## Serial comm. broken alarm

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 soft starter 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.

| 11,4 |  |  |
| :--- | :--- | :--- |
|  |  |  |
|  |  | Serial comm. contact <br> interrupted |
| Default: | 1 |  |
| Range: | ofF, 1, 2 |  |
| This parameter will control the behaviour in the soft <br> starter when the serial comm. is interrupted. <br> oFF No alarm and continue operation. <br> 1 | Alarm and stop operation. |  |
| 2 | Alarm and continue operation. |  |

### 7.28 Reset to factory setting [199]

When selecting reset to factory settings:

- All parameters in all parameter sets will have default factory settings.
- Menu 001 will appear on the display.
- Note that the alarm list, the power consumption and the operation time will not have default settings.

| 199 ${ }_{0}^{\circ}$ |  |  | Reset to factory settings |
| :---: | :---: | :---: | :---: |
|  | n | 0 |  |
| Default: |  | no |  |
| Range: |  | no, YES |  |
| no |  | No reset |  |
| YES |  | Reset all functions to the factory defaults incl. all 4 Parameter Sets. |  |

NOTE! Reset to factory settings is not allowed at run.

### 7.29 View operation

## General

The soft start includes as standard a numerous metering functions which eliminates the need of additional transducers and meters.

## Measured values

- Current RMS 3-phase current and per phase
- Voltage RMS 3-phase voltage and per phase
- Output shaft power / torque $\mathrm{kW} / \mathrm{Nm}$
- Power factor
- Power consumption in kWh
- Operation time in hours


## Viewing of the measured values

After setting motor data and extended functions one can set menu 008 in oFF and will then automatically move to menu 201, the first menu viewing the measured values and thus eliminate to scroll through menu 011 to menu 199.


NOTE! This is the same read-out as menu 005 see $\$ 7.1 .1$, page 36.


NOTE! The power factor vlewing will not work at bypass even If the current transformers are mounted outside the soft start.



Operation time is calculated when the soft starter is in RUN mode. After 9999 hours the display will show two values.

| Example: 12467 hours shows | 1 | 1 sec |
| :--- | :--- | :--- |
|  | 2467 | 5 sec |



### 7.30 Keyboard lock

The keyboard can be locked to prohibit operation and parameter setting by an unauthorised. Lock keyboard by pressing both keys "NEXT $\rightarrow$ " and "ENTER $\square^{\prime \prime}$ for at least 2 sec . The message '- Loc' will display when locked. To unlock keyboard press the same 2 keys "NEXT $\rightarrow$ " and "ENTER $\longleftarrow$ " for at least 2 sec. The message 'unlo' will display when unlocked.

In locked mode it is possible to view all parameters and read-out, but it is forbidden to set parameters and to operate the soft starter from the keyboard.

The message '-Loc' will display if trying to set a parameter or operate the soft starter in locked mode.

The key lock status can be read out in menu 221 .

| 2 2 1$\quad$ Locked keyboard info |  |  |
| :--- | :--- | :--- |
|  |  | $n$ |
|  | 0 |  |
| Default: | no |  |
| Range: | no, YES |  |
| no | Keyboard is not locked |  |
| YES | Keyboard is locked |  |

### 7.31 Alarm list

The alarm list is generated automatically. It shows the latest 15 alarms (F1 - F16). The alarm list can be useful when tracing a failure in the soft starter or its control circuit. Press key "NEXT $\rightarrow$ " or "PREV $\leftarrow$ " to reach the alarm list in menus 901-915 (menu 007 has to be ON ).


## 8. PROTECTION AND ALARM

The soft starter is equipped with a protection system for the motor, the machine and for the soft starter itself.
Three categories of alarm are available:

## Category 1

Alarm that stops the motor and need a separate reset before a new start can be accepted.

## Category 2

Alarm that stops the motor and accepts a new start command without any separate reset.

## Category 3

Alarm that continues to run the motor.
All alarm, except pre-alarm, will activate the alarm relay output K3, flash a red fault number on the display and it will also be placed in the alarm list. As long as the alarm is active, the display is locked in the alarm indication.

The relay output K3 can be used in the control circuit for actions needed when alarm occurs.

If more than one alarm is active, it is the last alarm that is presented on the display.

### 8.1 Alarm description

### 8.1.1 Alarm with stop and requiring a separate reset

Operation will stop for a category 1 alarm. A separate reset is needed before a new start conmand is accepted. It is possible to reset from keyboard (pushing "ENTER/RESET") regardless of selected control mode. It is also possible to reset the alarm from the actual control mode (i.e. if control mode is serial communication, a reset is possible to do from serial communication).

A reset is accepted first when the alarm source goes back to normal.

When a reset is made, the alarm relay output K 3 is deactivated, the alarm indication on the display disappear and the original menu shows.

After a reset is made the system is ready for a new start command.

### 8.1.2 Alarm with stop and requiring only a new start command

Operation will stop for a category 2 alarm. A restart can be done and at the same time the alarm relay output K3 is deactivated, the alarm indication on the display disappear and the original menu shows.

It is still possible to reset the alarm in the same way as for category 1 alarms (see 8.1.1), if a start is not required at the time.

### 8.1.3 Alarm with continue run

Operation will continue run for a category 3 alarm. Some different reset behaviour is possible (see remarks for the specific alarms in $\$ 8.2$, page 67 ).

- Automatic reser when the alarm source goes back to normal.
- Automatic reset when a stop command is given.
- Manual reset during run.

When the reset occurs, the alarm relay output K3 is deactivated, the alarm indication on the display disappear and the original menu shows.

### 8.2 Alarm overview

| Display indication | Protective function | Alarm category | Remark |
| :---: | :---: | :---: | :---: |
| F1 | Phase input failure. | Cat 3. Run with auto reset. | Single phase failure when full voltage running if menu 101 'Run at phase loss' = YES. If the fault phase comes back, an automatic reset is made. |
|  |  | Cat 2. Stop with reset in start. | Multiple phase failure or single phase failure when not full voltage running or if menu 101 ' Run at phase loss' = no. |
| F2 | Motor protection, overload. | Cat 1. Stop with manual reset. | If menu 071 'Motor PTC input' $=$ YES, cool down the motor. <br> If menu 071 'Motor PTC input' = no, the internal model has to 'cool' down. |
| F3 | Soft start overheated | Cat 1. Stop with manual reset. | If not cooled down, a reset will not be accepted. |
| F4 | Full speed not reached at set current limit and start time. | If menu 102 'Run at current limit time-out' $=$ no. <br> Cat 2. Stop with reset in start. | The current limit start is not completed. |
|  |  | If menu 102 'Run at current limit time-out' = YES. <br> Cat 3. Run with manual reset. | When start time expired, a 6 sec ramp is used to reach full voltage, without control of the current. Reset the alarm with either a manual reset or a stop command. |
| F5 | Locked rotor. | Cat 1. Stop with manual reset. | Motor and/or machine protection. |
| F6 | Above max power limit. | Cat 1. Stop with manual reset. | Machine protection. |
| F7 | Below min power limit. | Cat 1. Stop with manual reset. | Machine protection. |
| F8 | Voltage unbalance. | Cat 2. Stop with reset in start. | Motor protection. |
| F9 | Over voltage. | Cat 2. Stop with reset in start. | Motor protection. |
| F10 | Under voltage. | Cat 2. Stop with reset in start. | Motor protection. |
| F11 | Starts / hour exceeded. | Cat 2. Stop with reset in start. | Motor and/or machine protection. |
| F12 | Shorted thyristor. | Cat 3. Run with manual reset. | When stop command comes, the stop will be a 'Direct On Line' stop, and the soft starter will be resetted. After this fault it is possible to start only in 'Direct On Line' mode. One or more thyristors probably damaged. |
| F13 | Open thyristor. | Cat 1. Stop with manual reset. | One or more thyristors probably damaged. |
| F14 | Motor terminal open. | Cat 1. Stop with manual reset. | Motor not correctly connected. |
| F15 | Serial communication broken. | If menu 114 Serial comm. contact broken =1. Cat 2. Stop with reset in start. | Serial communication broken will stop operation. Run from keyboard if necessary. |
|  |  | If menu 114 Serial comm. contact broken $=2$. Cat 3 . Run with auto reset. | Serial communication broken will not stop operation. Stop from keyboard if necessary. |
| F16 | Phase reversal alarm. | Cat 1. Stop with manual reset. | Incorrect phase order on main voltage input. |

9. TROUBLESHOOTING

### 9.1 Fault, cause and solution

| Observation | Fault indication | Cause | Solution |
| :---: | :---: | :---: | :---: |
| The display is not illuminated. | None | No control voltage. | Switch on the control voltage. |
| The motor does not run. | F1 (Phase input failure) | Fuse defective. | Renew the fuse. |
|  |  | No mains supply. | Switch the main supply on. |
|  | F2 <br> (Motor protection, overload) | Perhaps PTC connection. Perhaps incorrect nominal motor current inserted (menu 042). | Check the PTC input if PTC protection is used. <br> If internal protection is used, perhaps an other class could be used (menu 072). <br> Cool down the motor and make a reset. |
|  | F3 (Soft start overheated) | Ambient temperature to high. soft starter duty cycle exceeded. Perhaps fan failure. | Check ventilation of cabinet. Check the size of the cabinet. Clean the cooling fins. If the fan(s) is not working correct, contact your local MSF sales outlet. |
|  | F4 <br> (Full speed not reached at set current limit and start time) | Current limit parameters are perhaps not matched to the load and motor. | Increase the starting time and/or the current limit level. |
|  | F5 (Locked rotor) | Something stuck in the machine or perhaps motor bearing failure. | Check the machine and motor bearings. Perhaps the alarm delay time can be set longer (menu 075). |
|  | F6 <br> (Above max power limit) | Overload | Over load. Check the machine. Perhaps the alarm delay time can be set longer (menu 093). |
|  | F7 <br> (Below min power limit) | Underioad | Under load. Check the machine. Perhaps the alarm delay time can be set longer (menu 099). |
|  | F8 <br> (Voltage unbalance) | Main supply voltage unbalance. | Check mains supply. |
|  | $\begin{aligned} & \text { F9 } \\ & \text { (Over voltage) } \end{aligned}$ | Main supply over voltage. | Check mains supply. |
|  | $\begin{aligned} & \text { F10 } \\ & \text { (Under voltage) } \end{aligned}$ | Main supply under voltage. | Check mains supply. |
|  | F11 <br> (Starts / hour exceeded) | Number of starts exceeded according to menu 074. | Wait and make a new start. Perhaps the number of starts / hour could be increased in menu 074. |
|  | F13 (Open thyristor) | Perhaps a damaged thyristor. | Make a reset and a restart. If the same alarm appears immediately, contact your local MSF sales outlet. |
|  | F14 <br> (Motor terminal open) | Open motor contact, cable or motor winding. | If the fault is not found, reset the alarm and inspect the alarm list. If alarm F12 is found, a thyristor is probably shorted. <br> Make a restart. If alarm F14 appears immediately, contact your local MSF sales outlet. |


| Observation | Fault indication | Cause | Solution |
| :---: | :---: | :---: | :---: |
| The motor does not run. | F15 <br> (Serial communication broken) | Serial communication broken. | Make a reset and try to establish contact. Check contacts, cables and option board. <br> Verify <br> - System address (menu 111). <br> - Baudrate (menu 112). <br> - Parity (menu 113). <br> If the fault is not found, run the motor with keyboard control if urgent (set menu 006 to " 1 "). See also manual for serial communica tion. |
|  | $\begin{aligned} & \text { F16 } \\ & \text { (Phase reversal) } \end{aligned}$ | Incorrect phase sequence on main supply. | Switch L2 and L3 input phases. |
|  | - . - | Start command comes perhaps from incorrect control source. (I.e. start from keyboard when remote control is selected). | Give start command from correct source (menu 006). |
|  | -Loc | System in keyboard lock. | Unlock keyboard by pressing the keys 'NEXT' and 'ENTER' for at least 3 sec . |
| The motor is running but an alarm is given. | F1 <br> (Phase input failure) | Failure in one phase. Perhaps fuse defective. | Check fuses and mains supply. Deselect 'Run at single phase input failure' in menu 101, if stop is desired at single phase loss. |
|  | F4 <br> (Full speed not reached at set current limit and start time) | Current limit parameters are perhaps not matched to the load and motor. | Increase the starting time and/or the current limit level. Deselect 'Run at current limit timeout' in menu 102, if stop is desired at current limit time-out. |
|  | F12 <br> (Shorted thyristor) | Perhaps a damaged thyristor. | When stop command is given, a free wheel stop is made. Make a reset and a restart. If alarm F14 appears immediately, contact your local MSF sales outlet. <br> If it is urgent to start the motor, set soft starter in 'Direct On Line' (menu 024). It is possible to start in this mode. |
|  |  | By pass contactor is used but menu 032 'Bypass' is not set to "on". | Set menu 032 'Bypass' to "on". |
|  | F15 <br> (Serial communication broken) | Serial communication broken. | Make a reset and try to establish contact. Check contacts, cables and option board. Verify <br> - System address (menu 111). <br> - Baudrate (menu 112). <br> - Parity (menu 113). <br> If the fault is not found, run the motor with keyboard control if urgent, see also manual for serial communication. |


| Observation | Fault indication | Cause | Solution |
| :---: | :---: | :---: | :---: |
| The motor jerks etc. | When starting, motor reaches full speed but it jerks or vibrates. | If 'Torque control' or 'Pump control' is selected, it is necessary to input motor data into the system. | Input nominal motor data in menus 041-046. Select the proper load characteristic in menu 025. <br> Select a correct initial- and end torque at start in menus 016 and 017. If 'Bypass' is selected, check that the current transformers are correct connected. |
|  |  | Starting time too short. | Increase starting time. |
|  |  | Starting voltage incorrectly set. | Adjust starting voltage. |
|  |  | Motor too small in relation to rated current of soft starter. | Use a smaller model of the soft starter. |
|  |  | Motor too large in relation to load of soft starter. | Use larger model of soft starter. |
|  |  | Starting voltage not set correctly | Readjust the start ramp. |
|  |  |  | Select the current limit function. |
|  | Starting or stopping time too long, soft does not work. | Ramp times not set correctly. | Readjust the start and/or stop ramp time. |
|  |  | Motor too large or too small in relation to load. | Change to another motor size. |
| The monitor func. tion does not work. | No alarm or pre-alarm | It is necessary to input nominal motor data for this function. Incorrect alarm levels. | Input nominal motor data in menus 041-046. Adjust alarm levels in menus 091-099. If 'Bypass' is selected, check that the current transformers are correct connected. |
| Unexplainable alarm. | F5, F6, F7, F8, F9, F10 | Alarm delay time is to short. | Adjust the response delay times for the alarms in menus 075, 082. 084, 086, 093 and 099. |
| The system seems locked in an alarm. | F2 <br> (Motor protection, overload) | PTC input terminal could be open. <br> Motor could still be to warm. If internal motor protection is used, the cooling in the internal model take some time. | PTC input terminal should be short circuit if not used. Wait untif motor PTC gives an OK (not overheated) signal. Wait until the internal cooling is done. Try to reset the alarm after a while. |
|  | F3 <br> (Soft start overheated) | Ambient temperature to high. Perhaps fan failure. | Check that cables from power part are connected in terminals 073, 074, 071 and 072. MSF-017 to MSF-145 should have a short circuit between 071 and 072 . Check also that the fan(s) is rotating. |
| Parameter will not be accepted. | - - - | If the menu number is one of 020-025, only one can bee selected. <br> In other words only one main mode is possible at a time. | Deselect the other main mode before selecting the new one. |
|  |  | If menu 061, 'Parameter set' is set to "O", the system is in a remote parameter selection mode. It is now impossible to change most of the parameters. | Set the menu 061, 'Parameter set' to a value between "1" - "4" and then it is possible to change any parameter. |
|  |  | During acceleration, decelera tion, slow speed, DC brake and Power factor control mode, it is impossible to change parameters. | Set parameters during stop or full voltage running. |
|  |  | If control source is serial comm., it is impossible to change parameters from keyboard and vice versa. | Change parameters from the actual control source. |
|  |  | Some menus include only read out values and not parameters. | Read-out values can not be altered. In table 13, page 35, read-out menus has '-' in the factory setting column. |
|  | -Loc | Keyboard is locked. | Unlock keyboard by pressing the keys 'NEXT' and 'ENTER' for at least 3 sec . |

## 10. MAINTENANCE

In general the soft starter is maintenance free. There are however some things which should be checked regularly. Especially if the surroundings are dusty the unit should be cleaned regularly.

WARNING! Do not touch parts inside the enclosure of the unit when the control and motor voltage is
switched on.

## Regular maintenance

- Check that nothing in the soft starter has been damaged by vibration (loose screws or connections).
- Check external wiring, connections and control signals. Tighten terminal screws and busbar boles if necessary.
- Check that PCB boards, thyristors and cooling fin are free from dust. Clean with compressed air if necessary. Make sure the PCB boards and thyristors are undamaged.
- Check for signs of overheating (changes in colour on PCB boards, oxidation of solder points etc.). Check that the temperature is within permissible limits.
- Check that the cooling fan/s permit free air flow. Clean any external air filters if necessary.

In the event of fault or if a fault cannot be cured by using the fault-tracing table in chapter 9. page 68.

## 11. OPTIONS

The following option are available. Please contact your supplier for more detailed information.

### 11.1 Serial communication

For serial communication the MODBUS RTU (RS232/RS485) option card is available order number: 01-1733-00.


Fig. 60 Option RS232/485

### 11.2 Field bus systems

Various option cards are available for the following bus systems:

- PROFIBUS DP order number: 01-1734-01
- Device NET, order number:

01-1736-01

- LONWORKS:

01-1737-01

- FIP IO:

01-1738-01

- INTERBUS-S:

01-1735-01
Each system has his own card. The option is delivered with an instruction manual containing the all details for the set-up of the card and the protocol for programming.


Fig. 61 Option Profibus

### 11.3 External PPU.

The external PPU option is used to move the PPU (keyboard) from the soft starter to the front of a panel door or control cabinet.

The maximum distance between the soft starter and the external PPU is 3 m .
The option can be factory mounted (01-2138-01) or it can be built in later (01-2138-00). For both versions instruction/data sheet are available.


Fig. 62 Shows an example of the External PPU after it has been built in.

### 11.3.1 Cable kit for external current transformers

This kit is used for the bypass function, to connect the external current transformers more easy. order number: 01-2020-00.


Fig. 63 Cable kit

### 11.4 Terminal clamp

Data: Single cables, Cu or Al

Cables
MSF type Cu Cable
Bolt for connection to busbar
Dimensions in mm
Order No. single
Data: Parallel cables, Cu or Al
Cables
MSF type and Cu Cable
Bolt for connection to busbar
Dimensions in mm
Order No. parallel
$95-300 \mathrm{~mm}^{2}$
310
M10
$33 \times 84 \times 47 \mathrm{~mm}$ 9350
$2 \times 95-300 \mathrm{~mm}^{2}$
310 to -835
M10
35x87x65
9351


Fig. 64 The terminal clamp.

## 12. TECHNICAL DATA

| 3x200-525 V 50/60 Hz Model | MSF-017 |  | MSF-030 |  | MSF-045 |  | MSF-060 |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Soft starter rating according to AC35a, see chapter 4. page 13 | $\begin{array}{\|c\|} \hline 5.0-30: 50-10 \\ \text { heavy } \end{array}$ | $\left\|\begin{array}{c} 3.0-30: 50-10 \\ \text { normal/light } \end{array}\right\|$ | $\begin{array}{\|c\|} \hline \text { 5.0-30:50-10 } \\ \text { heavy } \end{array}$ | $\begin{array}{\|l\|} \hline \text { 3.0-30:50-10 } \\ \text { normal/light } \end{array}$ | $\begin{gathered} \text { 5.0-30:50-10 } \\ \text { heavy } \end{gathered}$ | $\begin{array}{\|l\|} \text { 3.0-30:50-10 } \\ \text { normal/light } \end{array}$ | $\begin{gathered} \text { 5.0-30:50-10 } \\ \text { heavy } \end{gathered}$ | $\begin{array}{\|l\|l\|} \text { 3.0-30:50-10 } \\ \text { normal/light } \end{array}$ |
| Rated current of soft starter (A) | 17 | 22 | 30 | 37 | 45 | 60 | 60 | 72 |
| Recommended motor size ( kW ) for 400 V | 7.5 | 11 | 15 | 18.5 | 22 | 30 | 30 | 37 |
| Recommended motor size ( kW ) for 525 V | 11 | 15 | 18.5 | 22 | 30 | 37 | 37 | 45 |
| Order number: supply voltage ( $100-240 \mathrm{~V}$ ) | 01-1301-01 |  | 01-1302-01 |  | 01-1303-01 |  | 01.1304-01 |  |
| Order number: supply voltage ( $380-500 \mathrm{~V}$ ) | 01-1301-02 |  | 01-1302-02 |  | 01-1303-02 |  | 01-1304-02 |  |
| 3x200-690V 50/60Hz Model | MSF-017 |  | MSF-030 |  | MSF045 |  | MSF-060 |  |
| Rated current of soft starter (A) | 17 | 22 | 30 | 37 | 45 | 60 | 60 | 72 |
| Motor power for 690V | 15 | 18.5 | 22 | 30 | 37 | 55 | 55 | 75* |
| Order number: supply voltage (100-240V) | 01-1321-01 |  | 01-1322-01 |  | 01-1323-01 |  | 01-1324-01 |  |
| Order number: supply voltage ( $380-500 \mathrm{~V}$ ) | 01-1321-02 |  | 01-1322-02 |  | 01-1323-02 |  | 01-1324-02 |  |
| Electrical Data |  |  |  |  |  |  |  |  |
| Recommended wiring fuse (A) 1) | 25/50 | 32 | 35/80 | 50 | 50/125 | 80 | 63/160 | 100 |
| Semi-conductor fuses, if required | 80 A |  | 125 A |  | 160 A |  | 200 A |  |
| Power loss at rated motor load (W) | 50 | 70 | 90 | 120 | 140 | 180 | 180 | 215 |
| Power consumption control card | 20 VA |  | 20 VA |  | 25 VA |  | 25 VA |  |
| Mechanical Data |  |  |  |  |  |  |  |  |
| Dimensions in mm HxW×D | $320 \times 126 \times 260$ |  | $320 \times 126 \times 260$ |  | 320x126x 260 |  | $320 \times 126 \times 260$ |  |
| Mounting position (Vertical/Horizontal) | Vertical |  | Vertical |  | Vert. or Horiz. |  | Vert. or Horiz. |  |
| Weight (kg) | 6.7 |  | 6.7 |  | 6.9 |  | 6.9 |  |
| Connection busbars Cu , (bolt) | 15×4 (M6) |  | 15x4 (M6) |  | 15×4 (M6) |  | 15x4 (M8) |  |
| Cooling system | Convection |  | Convection |  | Fan |  | Fan |  |
| General Electrical Data |  |  |  |  |  |  |  |  |
| Number of fully controlled phases | 3 |  |  |  |  |  |  |  |
| Voltage tolerance control | Controt +/-10\% |  |  |  |  |  |  |  |
| Voltage tolerance motor | Motor $200-525+/ \cdot 10 \% / 200-690+5 \%,-10 \%$ |  |  |  |  |  |  |  |
| Recommended fuse for control card (A) | Max 10 A |  |  |  |  |  |  |  |
| Frequency | $50 / 60 \mathrm{~Hz}$ |  |  |  |  |  |  |  |
| Frequency tolerance | +/-10\% |  |  |  |  |  |  |  |
| Relay contacts | $3 \times 8 \mathrm{~A}, 250 \mathrm{~V}$ resistive load, 3 A 250 VAC inductive ( $\mathrm{PF}=0.4$ ) |  |  |  |  |  |  |  |
| Type of protection/Insulation |  |  |  |  |  |  |  |  |
| Type of casing protection | IP 20 |  |  |  |  |  |  |  |
| Other General Data |  |  |  |  |  |  |  |  |
| Ambient temperatures |  |  |  |  |  |  |  |  |
| In operation | $0.40{ }^{\circ} \mathrm{C}$ |  |  |  |  |  |  |  |
| Max.e.g. at $80 \%$ IN | $50^{\circ} \mathrm{C}$ |  |  |  |  |  |  |  |
| In storage | $(-25)-(+70){ }^{\circ} \mathrm{C}$ |  |  |  |  |  |  |  |
| Relative air humidity | 95\%, non-condensing |  |  |  |  |  |  |  |
| Max. altitude without derating | (See separate: Technical information 151) 1000 m |  |  |  |  |  |  |  |
| Norms/Standards, Conform to: | IEC 947-4-2, EN 292. EN 60204-1, UL508 |  |  |  |  |  |  |  |
| EMC, Emission | EN 50081-2, (EN 50081-1 with bypass contactor) |  |  |  |  |  |  |  |
| EMC, Immunity | EN 50082-2 |  |  |  |  |  |  |  |
| 1) Recommended wiring fuses for: $\begin{aligned} & \text { Heavy (first column): ramp/direct start } \\ & \text { Normal/ Ught (second column): ramp start }\end{aligned}$ |  |  |  |  |  |  |  |  |
| NOTEI Short clrcuit withstand MSF017-060 5000 rms A when used with K5 or RK5 fuses. |  |  |  |  |  |  |  |  |

* 2-pole motor

| 3x200-525 V 50/60 Hz Model | MSF-075 |  | MSF-085 |  | MSF-110 |  | MSF-145 |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Soft starter rating according to AC35a, see chapter 4. page 13 | $\begin{gathered} \text { 5.0-30:50-10 } \\ \text { heavy } \end{gathered}$ | $\begin{array}{\|l\|} \text { 3.0-30:50-10 } \\ \text { normal/light } \end{array}$ | $\begin{array}{\|c\|} \hline 5.0-30: 50-10 \\ \text { heavy } \end{array}$ | $\left\|\begin{array}{c} \text { 3.0-30:50-10 } \\ \text { normal/light } \end{array}\right\|$ | $\begin{gathered} 5.0-30: 50-10 \\ \text { heavy } \end{gathered}$ | $\left\|\begin{array}{c} \text { 3.0-30:50-10 } \\ \text { normal/light } \end{array}\right\|$ | $\begin{gathered} 5.0-30: 50-10 \\ \text { heavy } \end{gathered}$ | $\begin{aligned} & \text { 3.0-30:50-10 } \\ & \text { normal/light } \end{aligned}$ |
| Rated current of soft starter (A) | 75 | 85 | 85 | 96 | 110 | 134 | 145 | 156 |
| Recommended motor size (kW) for 400 V | 37 | 45 | 45 | 55* | 55 | 75 | 75 |  |
| Recommended motor size (kW) for 525 V | 45 | 55 | 55 | 75* | 75 | 90 | 90 | 110 |
| Order number for supply voltage ( $100-240 \mathrm{~V}$ ) | 01-1305-01 |  | 01.1306-01 |  | 01-1307-01 |  | 01-1308-01 |  |
| Order number for supply voltage ( $380-550 \mathrm{~V}$ ) | 01-1305-02 |  | 01-1306-02 |  | 01-1307-02 |  | 01-1308-02 |  |
| 3x200-690 V 50/60 Hz Model | MSF-075 |  | MSF-085 |  | MSF-110 |  | MSF-145 |  |
| Rated current of soft starter (A) | 75 | 85 | 85 | 90 | 110 | 134 | 145 | 156 |
| Motor power for 690V | 55 | 75 | 75 | 90 | 90 | 110 | 132 | 160* |
| Order number for supply voltage ( $100-240 \mathrm{~V}$ ) | 01-1325-01 |  | 01-1326-01 |  | 01-1327-01 |  | 01-1328-01 |  |
| Order number for supply voltage ( $380-550 \mathrm{~V}$ ) | 01-1325-02 |  | 01-1326-02 |  | 01-1327-02 |  | 01-1328-02 |  |
| Electrical Data |  |  |  |  |  |  |  |  |
| Recommended wiring fuse ( $A$ ) 1) | 80/200 | 100 | 100/250 | 125 | 125/315 | 180 | 160/400 | 200 |
| Semi-conductor fuses, if required | 250 A |  | 315 A |  | 350 A |  | 450 A |  |
| Power loss at rated motor load (W) | 230 | 260 | 260 | 290 | 330 | 400 | 440 | 470 |
| Power consumption control card | 25 VA |  | 25 VA |  | 25 VA |  | 25 VA |  |
| Mechanical Data |  |  |  |  |  |  |  |  |
| Dimensions in mm HxW×D | 320×126× 260 |  | $320 \times 126 \times 260$ |  | 400×176×260 |  | 400×176×260 |  |
| Mounting position (Vertical/Horizontal) | Vert. or Horiz. |  | Vert. or Horiz. |  | Vert. or Horiz. |  | Vert. or Horiz. |  |
| Weight (kg) | 6.9 |  | 6.9 |  | 12 |  | 12 |  |
| Connection, busbars Cu. (bolt) | 15x4 (M8) |  | 15×4 (M8) |  | 20x 4 (M10) |  | 20×4 (M10) |  |
| Cooling system | Fan |  | Fan |  | Fan |  | Fan |  |
| General Electrical Data |  |  |  |  |  |  |  |  |
| Number of fully controlled phases | 3 |  |  |  |  |  |  |  |
| Voltage tolerance control | Control $+/ \cdot 10 \%$ |  |  |  |  |  |  |  |
| Voltage tolerance motor | Motor 200-525 +/-10\%/200-690 + 5\%, -10\% |  |  |  |  |  |  |  |
| Recommended fuse for control card (A) | Max 10 A |  |  |  |  |  |  |  |
| Frequency | $50 / 60 \mathrm{~Hz}$ |  |  |  |  |  |  |  |
| Frequency tolerance | +/.10\% |  |  |  |  |  |  |  |
| Relay contacts | $8 \mathrm{~A}, 250 \mathrm{~V}$ resistive load, $3 \mathrm{~A}, 250 \mathrm{~V}$ inductive load ( $P \mathrm{~F}=0.4$ ) |  |  |  |  |  |  |  |
| Type of protection/insulation |  |  |  |  |  |  |  |  |
| Type of casing protection | $\text { IP } 20$ |  |  |  |  |  |  |  |
| Other General Data |  |  |  |  |  |  |  |  |
| Ambient temperatures In operation | $0.40^{\circ} \mathrm{C}$ |  |  |  |  |  |  |  |
| Max.e.g. at $80 \% I_{N}$ | $50^{\circ} \mathrm{C}$ |  |  |  |  |  |  |  |
| In storage | $(-25) \cdot(+70)^{\circ} \mathrm{C}$ |  |  |  |  |  |  |  |
| Relative air humidity | 95\%, non-condensing |  |  |  |  |  |  |  |
| Max. altitude without derating | (See separate: Technical information 151) 1000 m |  |  |  |  |  |  |  |
| Norms/Standards, Conform to: | IEC 947-4-2, EN 292. EN 60204-1, UL508 |  |  |  |  |  |  |  |
| EMC, Emission | EN 50081-2, (EN 50081-1 with bypass contactor) |  |  |  |  |  |  |  |
| EMC, Immunity | EN 50082-2 |  |  |  |  |  |  |  |
| 1) Recommended wiring fuses for: $\quad \begin{aligned} & \text { Heavy (first column): ramp/direct start } \\ & \text { Normal/Light (second column): ramp start }\end{aligned}$ |  |  |  |  |  |  |  |  |
| NOTEI Short circuit withstand MSF075-145 10000 mms A when used with K5 or RK5 fuses. |  |  |  |  |  |  |  |  |

* 2-pole motor

| 3x200-525 V 50/60 Hz Model | MSF-170 |  | MSF-210 |  | MSF-250 |  | MSF310 |  | MSF370 |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Soft starter rating according to AC35a, see chapter 4. page 13 | $\begin{aligned} & \text { 5.0-30: } \\ & \text { 50-10 } \\ & \text { heavy } \end{aligned}$ | $\begin{array}{\|c\|} \text { 3.0-30: } \\ 50-10 \\ \text { normal/light } \end{array}$ | $\begin{aligned} & \text { 5.0-30: } \\ & \text { 50-10 } \\ & \text { heavy } \end{aligned}$ | $\begin{array}{\|c\|} \hline 3.0-30: \\ 50-10 \\ \text { normal/light } \end{array}$ | $\begin{aligned} & \text { 5.0-30: } \\ & 50-10 \\ & \text { heavy } \end{aligned}$ | $\begin{array}{\|c\|} \hline 3.0-30: \\ 50-10 \\ \text { normal/light } \\ \hline \end{array}$ | $\begin{aligned} & \text { 5.0-30: } \\ & \text { 50-10 } \\ & \text { he avy } \end{aligned}$ | $\begin{gathered} \text { 3.0-30: } \\ \text { 50-10 } \\ \text { normal/light } \end{gathered}$ | $\begin{aligned} & \text { 5.0-30: } \\ & \text { 50-10 } \\ & \text { heavy } \end{aligned}$ | $\begin{array}{\|c\|} \hline \text { 3.0-30: } \\ \text { 50-10 } \\ \text { normal/light } \end{array}$ |
| Rated current of soft starter (A) | 170 | 210 | 210 | 250 | 250 | 262 | 310 | 370 | 370 | 450 |
| Recommended motor size ( kW ) for 400 V | 90 | 110 | 110 | 132 | 132 | 160* | 160 | 200 | 200 | 250 |
| Recommended motor size (kW) for 525 V | 110 | 132 | 132 | 160 | 160 | 200* | 200 | 250 | 250 | 315 |
| Order no. for supply voltage (100.240V) | 01-1309-11 |  | 01-1310-11 |  | 01-1311-11 |  | 01-1312-01 |  | 01-1313-01 |  |
| Order no. for supply voltage ( $380-550 \mathrm{~V}$ ) | 01-1309-12 |  | 01-1310-12 |  | 01-1311-12 |  | 01-1312-02 |  | 01-1313-02 |  |
| $3 \times 200-690$ V 50/60 Hz Model | MSF-170 |  | MSF-210 |  | MSF-250 |  | MSF310 |  | MSF-370 |  |
| Rated current of soft starter ( A ) | 170 | 210 | 210 | 250 | 250 | 262 | 310 | 370 | 370 | 450 |
| Motor power for 690 V | 160 | 200 | 200 | 250 | 250 | 250 | 315 | 355 | 355 | 400 |
| Order no. for supply voltage (100-240V) | 01-1329-01 |  | 01-1330-01 |  | 01-1331-01 |  | 01-1332-01 |  | 01-1333-01 |  |
| Order no. for supply voltage (380-550V) | 01-1329-02 |  | 01-1330-02 |  | 01-1331-02 |  | 01-1332-02 |  | 01-1333-02 |  |
| Electrical Data |  |  |  |  |  |  |  |  |  |  |
| Recommended wiring fuse (A) 1) | 200/400 | 200 | 250/400 | 315 | 250/500 | 315 | 315/630 | 400 | 400/800 | 500 |
| Semi-conductor fuses, if required | 700 A |  | 700 A |  | 700 A |  | 800 A |  | 1000 A |  |
| Power loss at rated motor load (W) | 510 | 630 | 630 | 750 |  | 50 W | 930 | 1100 | 1100 | 1535 |
| Power consumption control card | 35 VA |  | 35 VA |  | 35 VA |  | 35 VA |  | 35 VA |  |
| Mechanical Data |  |  |  |  |  |  |  |  |  |  |
| Dimensions mm HxW×D incl. brackets | 500x 260×260 |  | $500 \times 260 \times 260$ |  | $500 \times 260 \times 260$ |  | $532 \times 547 \times 278$ |  | $532 \times 547 \times 278$ |  |
| Mounting position (Vertical/Horizontal) | Vert. or Horiz. |  | Vert. or Horiz. |  | Vert. or Horiz. |  | Vert. or Horiz. |  | Vert. or Horiz. |  |
| Weight (kg) | 20 |  | 20 |  | 20 |  | 42 |  | 46 |  |
| Connection, Busbars Al/Cu (bolt) | $30 \times 4$ (M10) |  | $30 \times 4$ (M10) |  | $30 \times 4$ (M10) |  | $40 \times 8$ (M12) |  | 40×8 (M12) |  |
| Cooling system | Fan |  | Fan |  | Fan |  | Fan |  | Fan |  |
| General Electrical Data |  |  |  |  |  |  |  |  |  |  |
| Number of fully controlled phases | 3 |  |  |  |  |  |  |  |  |  |
| Voltage tolerance control | Control $+/-10 \%$ |  |  |  |  |  |  |  |  |  |
| Voltage tolerance motor | Motor $200-525+/ \cdot 10 \% / 200-690+5 \%,-10 \%$ |  |  |  |  |  |  |  |  |  |
| Recommended fuse for control card (A) | Max 10 A |  |  |  |  |  |  |  |  |  |
| Frequency | $50 / 60 \mathrm{~Hz}$ |  |  |  |  |  |  |  |  |  |
| Frequency tolerance | +/-10\% |  |  |  |  |  |  |  |  |  |
| Relay contacts | $8 \mathrm{~A}, 250 \mathrm{~V}$ resistive load, 3A, 250 V inductive load ( $\mathrm{PF}=0.4$ ) |  |  |  |  |  |  |  |  |  |
| Type of protection/insulation |  |  |  |  |  |  |  |  |  |  |
| Type of casing protection | IP 20 |  |  |  |  |  |  |  |  |  |
| Other General Data |  |  |  |  |  |  |  |  |  |  |
| Ambient temperatures In operation | 0. $40^{\circ} \mathrm{C}$ |  |  |  |  |  |  |  |  |  |
| Max.e.g. at $80 \% I_{N}$ | $50^{\circ} \mathrm{C}$ |  |  |  |  |  |  |  |  |  |
| In storage | $(-25) \cdot(+70)^{\circ} \mathrm{C}$ |  |  |  |  |  |  |  |  |  |
| Relative air humidity | 95\%, non-condensing |  |  |  |  |  |  |  |  |  |
| Max. altitude without derating | (See separate: Technical information 151) 1000 m |  |  |  |  |  |  |  |  |  |
| Norms/Standards, Conform to: | IEC 947-4-2, EN 292, EN 60204-1, (UL508, only MSF-170 to MSF-250) |  |  |  |  |  |  |  |  |  |
| EMC, Emission | EN 50081-2, (EN 50081-1 with bypass contactor) |  |  |  |  |  |  |  |  |  |
| EMC, Immunity | EN 50082-2 |  |  |  |  |  |  |  |  |  |
| 1) Recommended wiring fuses for: Heavy (first column): ramp/direct start <br> Normal/Lght (second column): ramp start |  |  |  |  |  |  |  |  |  |  |
| NOTE! Short circuit withstand MSF170-250 18000 mms A when used with K5 or RK5 fuses. |  |  |  |  |  |  |  |  |  |  |

* 2-pole motor

| 3x200-525V 50/60Hz Model | MSF-450 |  | MSF-570 |  | MSF-710 |  | MSF-835 |  | MSF-1000 |  | MSF-1400 |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Soft starter rating according to AC35a, see chapter 4. page 13 | $\begin{aligned} & \text { 5.0.30: } \\ & \text { 50-10 } \\ & \text { heavy } \end{aligned}$ | $\begin{gathered} \text { 3.0-30: } \\ 50-10 \\ \text { normal/ } \\ \text { lleht } \end{gathered}$ | $\begin{aligned} & \text { 5.0.30: } \\ & \text { 50-10 } \\ & \text { heavy } \end{aligned}$ | $\begin{gathered} 3.0-30 ; \\ 50-10 \end{gathered}$ normal/ <br> light | $\begin{aligned} & \text { 5.0.30: } \\ & \text { 50-10 } \\ & \text { heavy } \end{aligned}$ | $\begin{gathered} \text { 3.0-30: } \\ \text { 50-10 } \\ \text { normal/ } \\ \text { light } \end{gathered}$ | $\begin{aligned} & 5.0-30: \\ & 50-10 \\ & \text { heavy } \end{aligned}$ | 3.0-30: <br> 50-10 <br> normal/ light | $\begin{aligned} & \text { 5.0.30: } \\ & \text { 50-10 } \\ & \text { heavy } \end{aligned}$ | $\begin{gathered} \text { 3.0-30: } \\ 50-10 \end{gathered}$ normal/ light | $\begin{aligned} & \text { 5.0-30: } \\ & \text { 50-10 } \\ & \text { heavy } \end{aligned}$ | $\begin{gathered} \text { 3.0-30: } \\ \text { 50-10 } \\ \text { norma!/ } \\ \text { llyht } \end{gathered}$ |
| Rated current of soft starter (A) | 450 | 549 | 570 | 710 | 710 | 835 | 835 | 960 | 1000 | 1125 | 1400 | 1650 |
| Recommended motor size (kW) for 400 V | 250 | 315 | 315 | 400 | 400 | 450 | 450 | 560 | 560 | 630 | 800 | 930 |
| Recommended motor size (kW) for 525 V | 315 | 400 | 400 | 500 | 500 | 560 | 600 | 630 | 660 | 710 | 1000 | 1250 |
| Order no. for supply voltage ( $100-240 \mathrm{~V}$ ) | 01-1341-01 |  | 01-1315-01 |  | 01-1316-01 |  | 01-1317-01 |  | 01-1318-01 |  | 01.1319-01 |  |
| Order no. for supply voltage ( 380.550 V ) | 01-1314-02 |  | 01-1315-02 |  | 01-1316-02 |  | 01-1317-02 |  | 01-1318-02 |  | 01.1319-02 |  |
| $3 \times 200-690 \mathrm{~V} 50 / 60 \mathrm{~Hz}$ Model | MSF-450 |  | MSF-570 |  | MSF-710 |  | MSF-835 |  | MSF-1000 |  | MSF-1400 |  |
| Rated current of soft starter ( A ) | 450 | 549 | 570 | 640 | 710 | 835 | 835 | 880 | 1000 | 1125 | 1400 | 1524 |
| Motor power for 690 V | 400 | 560 | 560 | 630 | 710 | 800 | 800 |  | 1000 | 1120 | 1400 | 1600 |
| Order no. for supply volt age (100-240V) | 01-1334-01 |  | 01-1335-01 |  | 01-1336-01 |  | 01-1337-01 |  | 01-1338-01 |  | 01-1339-01 |  |
| Order no. for supply voltage ( $380-550 \mathrm{~V}$ ) | 01-1334-02 |  | 01-1335-02 |  | 01-1336-02 |  | 01-1337-02 |  | 01-1338-02 |  | 01-1339-02 |  |
| Electrical Data |  |  |  |  |  |  |  |  |  |  |  |  |
| Recommended wiring fuse (A 1) | 500/1 k | 630 | 630/1 k | 800 | 800/1 k | 1 k | $1 \mathrm{k} / 1.2 \mathrm{k}$ | 1 k | 1k/1.4 k | 1.2 k | 1.4 k/1.8 k | 1.8 k |
| Semi-conductor fuses, if required | 1250 A |  | 1250 A |  | 1800 A |  | 2500 A |  | 3200 A |  | 4000 A |  |
| Power loss at rated motor load (W) | 1400 | 1730 | 1700 | 2100 | 2100 | 2500 | 2500 | 2875 | 3000 | 3375 | 4200 | 4950 |
| Power consumption control card | 35 VA |  | 35 VA |  | 35 VA |  | 35 VA |  | 35 VA |  | 35 VA |  |
| Mechanical Data |  |  |  |  |  |  |  |  |  |  |  |  |
| Dimensions mm H $\times W \times$ D incl. brackets | $532 \times 547 \times 278$ |  | 687×640×302 |  | $687 \times 640 \times 302$ |  | $687 \times 640 \times 302$ |  | $900 \times 875 \times 336$ |  | 900×875×336 |  |
| Mounting position (Vertical/Horizontal) | Vert. or Horiz. |  | Vert. or Horiz. |  | Vert. or Horiz. |  | Vert. or Horiz. |  | Vert. or Horiz. |  | Vert. or Horiz. |  |
| Weight (kg) | 46 |  | 64 |  | 78 |  | 80 |  | $175$ |  | 175 |  |
| Connection, Busbars Al (bolt) | 40x8 (M12) |  | 40×10 (M12) |  | 40×10 (M12) |  | 40×10(M12) |  | 75×10(M12) |  | 75×10 (M12) |  |
| Cooling system | Fan |  | Fan |  | Fan |  | Fan |  | Fan |  | Fan |  |
| General Electrical Data |  |  |  |  |  |  |  |  |  |  |  |  |
| Number of fully controlled phases | 3 |  |  |  |  |  |  |  |  |  |  |  |
| voltage tolerance control | Control +/-10\% |  |  |  |  |  |  |  |  |  |  |  |
| Voltage tolerance motor | Motor 200-525 +/. 10\%/200-690 + 5\%, -10\% |  |  |  |  |  |  |  |  |  |  |  |
| Recommended fuse for control card (A) | Max 10 A |  |  |  |  |  |  |  |  |  |  |  |
| Frequency | $50 / 60 \mathrm{~Hz}$ |  |  |  |  |  |  |  |  |  |  |  |
| Frequency tolerance | +/-10\% |  |  |  |  |  |  |  |  |  |  |  |
| Relay contacts | $8 \mathrm{~A}, 250 \mathrm{~V}$ resistive load, $3 \mathrm{~A}, 250 \mathrm{~V}$ inductive load ( $\mathrm{PF}=0.4$ ) |  |  |  |  |  |  |  |  |  |  |  |
| Type of protection/Insulation |  |  |  |  |  |  |  |  |  |  |  |  |
| Type of casing protection | IP 20 |  |  |  |  |  |  |  | IPOO |  |  |  |
| Other General Data |  |  |  |  |  |  |  |  |  |  |  |  |
| Ambient temperatures In operation | $0.40{ }^{\circ} \mathrm{C}$ |  |  |  |  |  |  |  |  |  |  |  |
| Max.e.g. at $80 \% \mathrm{I}_{\mathrm{N}}$ | $50^{\circ} \mathrm{C}$ |  |  |  |  |  |  |  |  |  |  |  |
| In storage | $(-25) \cdot(+70)^{\circ} \mathrm{C}$ |  |  |  |  |  |  |  |  |  |  |  |
| Relative air humidity | 95\%, non-condensing |  |  |  |  |  |  |  |  |  |  |  |
| Max. altitude without derating | (See separate: Technical information 151) 1000 m |  |  |  |  |  |  |  |  |  |  |  |
| Norms/Standards, Conform to: | IEC 947-4-2, EN 292, EN 60204-1 |  |  |  |  |  |  |  |  |  |  |  |
| EMC, Emission | EN 50081-2. (EN 50081-1 with bypass contactor) |  |  |  |  |  |  |  |  |  |  |  |
| EMC, Immunity | EN 50082-2 |  |  |  |  |  |  |  |  |  |  |  |
| 1) Recommended wiring fuses for: | Heavy (first column): ramp/direct start Normal/Ught (second column): ramp start |  |  |  |  |  |  |  |  |  |  |  |

## Semi-conductor fuses

Always use standard commercial fuses to protect the wiring and prevent short circuiting. To protect the thyristors against short-circuit currents, superfast semiconductor fuses can be used if preferred (e.g. Bussmann type FWP or similar, see table below).

The normal guarantee is valid even if superfast semiconductor fuses are not used.

| Type | A | FWP Bussmann fuse |
| :---: | :---: | :---: |
|  | I ${ }^{2} \mathbf{t}$ (fuse) $\times \mathbf{1 0 0 0}$ |  |
| MSF-017 | 80 | 2.4 |
| MSF-030 | 125 | 7.3 |
| MSF-045 | 150 | 11.7 |
| MSF-060 | 200 | 22 |
| MSF-075 | 250 | 42.5 |
| MSF-085 | 300 | 71.2 |
| MSF-110 | 350 | 95.6 |
| MSF-145 | 450 | 137 |
| MSF-170B | 700 | 300 |
| MSF-210B | 700 | 300 |
| MSF-250B | 800 | 450 |
| MSF-310 | 800 | 450 |
| MSF-370 | 1000 | 600 |
| MSF-450 | 1200 | 2100 |
| MSF-570 | 1400 | 2700 |
| MSF-710 | 1800 | 5300 |
| MSF-835 | 2000 |  |
| MSF-1000 | 2500 |  |
| MSF-1400 | 3500 |  |

## 13. SET-UP MENU LIST

| Menu number | Function/Parameter | Range | Par.set | Factory setting | Value | Page |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 001 | Initial voltage at start | 25-90\% of U | 1-4 | 30 |  | page 36 |
| 002 | Start time ramp 1 | $1-60 \mathrm{sec}$ | 1-4 | 10 |  | page 36 |
| 003 | Step down voltage at stop | 100-40\% U | 1-4 | 100 |  | page 36 |
| 004 | Stop time ramp 1 | oFF, 2-120 sec | 1-4 | OFF |  | page 36 |
| 005 | Current | 0.0-9999 Amp | - | $\cdots$ |  | page 36 |
| 006 | Control mode | 1, 2, 3 | 1-4 | 2 |  | page 37 |
| 007 | Extended functions \& metering | OFF, on | --- | ofF |  | page 38 |
|  |  |  |  |  |  |  |
| 008 | Extended functions | oFF, on | - | OFF |  | page 38 |
|  |  |  |  |  |  |  |
| 011 | Initial voltage start ramp 2 | 30.90\% U | 1-4 | 90 |  | page 38 |
| 012 | Start time ramp 2 | oFF, 1-60 sec | 1.4 | OFF |  | page 38 |
| 013 | Step down voltage stop ramp 2 | $100 \cdot 40 \%$ U | 1-4 | 40 |  | page 38 |
| 014 | Stop time ramp 2 | oFF, 2-120 sec | 1-4 | oFF |  | page 38 |
|  |  |  |  |  |  |  |
| 016 | Initial torque at start | 0-250\% Tn | 1-4 | 10 |  | page 39 |
| 017 | End torque at start | 50-250\% Tn | 1-4 | 150 |  | page 39 |
| 018 | End torque at stop | 0-100\% Tn | 1-4 | 0 |  | page 39 |
| 020 | Voltage ramp with current limit at start | oFF, $150-500 \% \mathrm{I}_{\mathrm{n}}$ | 1-4 | oFF |  | page 39 |
| 021 | Current limit at start | oFF, $150-500 \% I_{n}$ | 1-4 | oFF |  | page 40 |
| 022 | Pump control | oFF, on | 1.4 | OFF |  | page 40 |
| 023 | Remote analogue control | oFF, 1, 2 | 1 - 4 | OFF |  | page 41 |
| 024 | Full voitage start D.O.L | OFF, on | 1-4 | OFF |  | page 41 |
| 025 | Torque control | OFF, 1, 2 | 1-4 | oFF |  | page 42 |
|  |  |  |  |  |  |  |
| 030 | Torque boost active time | OFF, 0.1-2.0 sec | 1-4 | oFF |  | page 43 |
| 031 | Torque boost current limit | $300-700 \% \mathrm{In}$ | 1-4 | 300 |  | page 43 |
| 032 | Bypass | oFF, on | 1.4 | oFF |  | page 43 |
| 033 | Power Factor Control PFC | oFF, on | 1.4 | oFF |  | page 46 |
| 034 | Brake active time | oFF, 1-120 sec | 1.4 | ofF |  | page 47 |
| 035 | Braking strength | 100-500\% | 1.4 | 100 |  | page 47 |
|  |  |  |  |  |  |  |
| 036 | Braking methods | 1, 2 | 1-4 | 1 |  | page 47 |
| 037 | Slow speed torque | 10-100 | 1.4 | 10 |  | page 49 |
| 038 | Slow speed time at start | oFF, $1-60 \mathrm{sec}$ | 1.4 | ofF |  | page 49 |
| 039 | Slow speed time at stop | oFF, 1-60 sec | 1.4 | OFF |  | page 49 |
| 040 | DC-Brake at slow speed | oFF, 1-60 sec | 1 - 4 | oFF |  | page 49 |
|  |  |  |  |  |  |  |
| 041 | Nominal motor voltage | $200 \cdot 700 \mathrm{~V}$ | 1-4 | 400 |  | page 50 |
| 042 | Nominal motor current | $\begin{gathered} 25-150 \% I_{\text {nsoft }} \text { in } \\ \text { Amp } \end{gathered}$ | 1-4 | $I_{\text {nsoft }}$ in Amp |  | page 50 |
| 043 | Nominal motor power | $\begin{gathered} 25-300 \% \text { of } P_{\text {nsoft }} \text { in } \\ k W \end{gathered}$ | 1.4 | $\mathrm{P}_{\text {nsoft }}$ in kW |  | page 50 |
| 044 | Nominal speed | 500-3600 rpm | 1.4 | $\mathrm{N}_{\text {nsoft }}$ in rpm |  | page 50 |
| 045 | Nominal power factor | $0.50 \cdot 1.00$ | 1 - 4 | 0.86 |  | page 50 |
| 046 | Nominal frequency | $50,60 \mathrm{~Hz}$ | $\square$ | 50 |  | page 50 |


| Menu number | Function/Parameter | Range | Par.set | Factory setting | Value | Page |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| . |  |  |  |  |  |  |
| 051 | Programmable relay K1 | 1, 2, 3, (4), 5 |  | 1 |  | page 51 |
| 052 | Programmable relay K2 | 1, 2, 3, 4, 5 | $\cdots$ | 2 |  | page 51 |
|  |  |  |  |  |  |  |
| 054 | A nalogue output | oFF, 1, 2 | 1-4 | oFF |  | page 52 |
| 055 | Analogue output value | 1, 2, 3 | 1-4 | 1 |  | page 52 |
| 056 | Scaling analogue output | 5-150\% | 1-4 | 100 |  | page 52 |
| 057 | Digital input selection | oFF, 1, 2, 3, 4 | 1-4 | OFF |  | page 53 |
| 058 | Digital input pulses | 1-100 | 1-4 | 1 |  | page 53 |
|  |  |  |  |  |  |  |
| 061 | Parameter set | 0, 1, 2, 3, 4 | - | 1 |  | page 54 |
|  |  |  |  |  |  |  |
| 071 | Motor PTC input | no, YES | - | no |  | page 55 |
| 072 | Internal motor thermal protection class | oFF, $2 \cdot 40 \mathrm{sec}$ | $\cdots$ | 10 |  | page 55 |
| 073 | Used thermal capacity | 0-150\% | - | - |  | page 55 |
| 074 | Starts per hour limitation | oFF, 1-99/hour | 1-4 | oFF |  | page 55 |
| 075 | Locked rotor alarm | oFF, 1.0-10.0 sec | 1-4 | oFF |  | page 55 |
|  |  |  |  |  |  |  |
| 081 | Voltage unbalance alarm | 2-25\% Un | 1-4 | 10 |  | page 56 |
| 082 | Response delay voltage unbalance alarm | oFF, 1-60 sec | 1-4 | oFF |  | page 56 |
| 083 | Over voltage alarm | 100-150\% Un | 1-4 | 115 |  | page 56 |
| 084 | Response delay over voltage alarm | oFF, 1-60 sec | 1-4 | oFF |  | page 56 |
| 085 | Under voltage alarm | 75-100\% Un | 1-4 | 85 |  | page 57 |
| 086 | Response delay under voltage alarm | OFF, 1-60 sec | 1-4 | oFF |  | page 57 |
| 087 | Phase sequence | L123, L321 | $\cdots$ | - |  | page 57 |
| 088 | Phase reversal alarm | oFF, on | ------- | oFF |  | page 57 |
|  |  |  |  |  |  |  |
| 089 | Auto set power limits | no, YES | --- | no |  | page 57 |
| 090 | Output shaft power | 0.0-200.0\% Pn | ----- | - |  | page 57 |
| 091 | Start delay power limits | 1-250 sec | 1-4 | 10 |  | page 58 |
| 092 | Max power alarm limit | 5-200\% Pn | 1-4 | 115 |  | page 58 |
| 093 | Max alarm response delay | oFF, 0.1-25.0 sec | 1-4 | oFF |  | page 58 |
| 094 | Max power pre-alarm limit | 5-200\% Pn | 1.4 | 110 |  | page 58 |
| 095 | Max pre-alarm response delay | oFF, 0.1 .25 .0 sec | 1-4 | oFF |  | page 58 |
| 096 | Min pre-alarm power limit | 5-200\% Pn | 1.4 | 90 |  | page 58 |
| 097 | Min pre-alarm response delay | oFF, 0.1-25.0 sec | 1-4 | oFF |  | page 59 |
| 098 | Min power alarm limit | 5-200\%Pn | 1-4 | 85 |  | page 59 |
| 099 | Min alarm response delay | oFF, $0.1-25.0 \mathrm{sec}$ | 1-4 | oFF |  | page 59 |
|  |  |  |  |  |  |  |
| 101 | Run at single phase input failure | no, YES | 1-4 | no |  | page 61 |
| 102 | Run at current limit time-out | no, YES | 1-4 | no |  | page 61 |
|  |  |  |  |  |  |  |
| 103 | Jog forward enable | oFF, on | 1-4 | oFF |  | page 61 |
| 104 | Jog reverse enable | oFF, on | 1-4 | oFF |  | page 61 |
|  |  |  |  |  |  |  |
| 105 | Automatic return menu | oFF, 1-999 | - | oFF |  | page 62 |
|  |  |  |  |  |  |  |
| 111 | Serial comm. unit address | 1-247 | $\cdots$ | 1 |  | page 62 |
| 112 | Serial comm. baudrate | 2.4 - 38.4 kBaud | ------- | 9.6 |  | page 62 |


| Menu number | Function/Parameter | Range | Par.set | Factory setting | Value | Page |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 113 | Serial comm. parity | 0, 1 | $\underline{-}$ | 0 |  | page 62 |
| 114 | Serial comm. contact broken | oFF, 1, 2 | - | 1 |  | page 62 |
| 199 | Reset to factory settings | no, YES | --------- | no |  | page 63 |
| 201 | Current | 0.0-9999 Amp | - | ------- |  | page 63 |
| 202 | Line main voltage | 0.720 V | -- | - |  | page 63 |
| 203 | Output shaft power | -9999-9999 kW | - | - |  | page 63 |
| 204 | Power factor | 0.00-1.00 | - | $\cdots$ |  | page 63 |
| 205 | Power consumption | 0.000-2000 MWh | - | - |  | page 63 |
| 206 | Reset power consumption | no, YES | $\cdots$ | no |  | page 64 |
| 207 | Shaft torque | -9999-9999 Nm | $\underline{\square}$ | - |  | page 64 |
| 208 | Operation time | Hours | $\cdots$ | - |  | page 64 |
|  |  |  |  |  |  |  |
| 211 | Current phase L1 | 0.0.9999 Amp | ------- | - |  | page 64 |
| 212 | Current phase L2 | 0.0-9999 Amp | -------- | $\cdots$ |  | page 64 |
| 213 | Current phase L3 | 0.0-9999 Amp | ------- | - |  | page 64 |
|  |  |  |  |  |  |  |
| 214 | Line main voltage L1-L2 | 0.720 V | ----- | - |  | page 64 |
| 215 | Line main voltage L1-L3 | 0.720 V | - | -- |  | page 64 |
| 216 | Line main voltage L2 L3 | 0.720 V | - | - |  | page 64 |
|  |  |  |  |  |  |  |
| 221 | Locked keyboard info | no, YES | - | no |  | page 65 |
|  |  |  |  |  |  |  |
| 901 | Alarm list, Latest error | F1-F16 | --- | ----- |  | page 65 |
| 902-915 | Alarm list, Older error in chronological order | F1-F16 | - | ----- |  | page 65 |

Explanation of units:
U Input line voltage
Un Nominal motor voltage.
In Nominal motor current.
Pn Nominal motor power.
$\mathrm{Nn} \quad$ Nominal motor speed.
Tn Nominal shaft torque.
Insoft Nominal current soft starter.
Pnsoft Nominal power soft starter.
Nnsoft Nominal speed soft starter.
Calculation shaft torque

$$
\tau_{n}=\frac{P_{n}}{\left(\frac{N_{n}}{60} \times 2 \pi\right)}
$$

NOTE! The six main functions for motor control, menus 020-025, can only be selected one at a time.

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## REPRESENTATION

ADL Co.
P.O. Box 47

125040 MOSCOW
Russia
Tel. 00007-095268 7423
Fax 00007-095268 0348
rouslan@adlserv.aha.ru
Airtronik drives
Alte Landstrasse 384
CH-8708 Männendor $f / 2 \mathrm{H}$
Schweiz
Tel. +41 19207406
Fax. +41 19203689
airtronik_ch@hotmail.com
AUTOMATECH Sp.zo.o
ul. Ry'zowa 84
PL-O2482 OPACZ-KOLONIA
Poland
Tel. 0048-22-723 0662
Fax 0048-22-7230606
b.kolodziejczyk@automatech.it.pl

Cyclect Holdings Pte Ltd
33 Tuas View Crescent
Singapore 637654
Singapore
Phone: +65 2656833
Fax: +65 2640897
info@cyclect.com.sg
Elpro Drive, S. R. 0
ul. Miru 3
CZ 73961 TRINEC
Tjeckien Republic
Tel. 00420W 659434661
Fax 00420W 659325864
agorgol@elprocz.cz
Emotron AB
Box 22225
SE-250 24 HELSINGBORG
Sweden
Tel. +4642169900
Fax +4642169949
infoeemotron.com
Emotron Antriebssysteme GmbH
Goethestrasse 6
38855 WERNIGERODE

## Germany

Tel. 0049-3943 92050
Fax 0049-3943 92055
info@emotron-as.de
Emotron B.V.
P.0. Box 132

5531 NX BLADEL
Holland
Tel. 0031-497389222
Fax 0031-497 386275
infoeemotron.nl
Emotron EHFISA
Aribau 229
ES-08021 BARCELONA

## Spain

Tel. 0034932091499
Fax 0034-93 2091245
emotron@emotron.es
Emotron Inc
3440 Granite Circle
TOLEDO, OH 43617
USA
Tel. 001- (419) 841-7774
Fax 001- (419) 843-5816
paul.hackett@usa-emotron.com

Emsby
27 Rodwell Street
QUE - 4108 ARCHERFIELD
Australia
Tel. 0061-7 32742566
Fax 0061-73274 2387
dkirkegaard@emsby.com
Energopro GM
52321 Chicherin St
220029 Minsk
Belarus
Tel:+375 172394079, +375 172394218,
+375 172345293
Fax: +375 172394949
energopro@tut.by
Esquire Engineering sdn bhd
13. JIn Jurutera U1/23, Seksyen U1

Hicom-Glenmarie Industrial Park
40000 Shah Alam SELANGOR
Malaysia
Tel. $0060-35191958$
Fax 0060 35191960
barry_h@tm.net.my
HEDTEC OY
P.O.B 110

SF-00201 HELSINGFORS
Finland
Tel. 00358-9682881
Fax 00358-9674918
kaj.nyberg@hedengren.fi
Ingeniōr Ivar Pettersen AS
Postboks 166
N3001 DRAMMEN
Norway
Tel. 0047-32 212121
Fax 0047-32 212199
lars.hennum@pettersen.no
Jolly Electrical Prt Ltd
S-09, "ARIES" Complex,
87, Sampatrao Colony,
B.P.C Road,

Vadodara390 007
India
Tel: +91-265 233 4634/231 0990
Fax: +91-265 2335492
jolly@wilnetonline.net
K.K. E-FI

2-18-4 Hagoromocho
1900021 Tachakawa
J- TOKYO
Japan
Tel. 0081. 425288820
Fax 0081. 425288821
sato.hiroyukigelf.co.jp
MAS for Eng. \& Trad
From Tahreer St
12, a-Abee Emáma St.
DOKKI GIZA
Egypt
Tel. 0020-23357947
Fax 0020-23357948
Mohamad Eid Kari
Marjeh-square,Euphorat st. Dagestani
Bld. 1st. FI. POB 31203
DAMASKUS
Syria
Tel. 00963-11 2223867
Fax 00963-11 2245425

Pardis International
Golbarg W. Kerman
S. Rahmati E. No. 202

TEHERAN
Iran
Tel. 0098-217838571
Fax 0098-217838571
mehraban@irtp.com
SAEG Controls S.A.C.
Av. 6 de Agosto 1137
Jesus Maria - LIMA
Peru
Tel: +51 13320049
Fax: +51 13320606
fkatayama@saeg.com
Saftronics (PTY) LTD
27 Heronmere Road
POBox 38045
2016 BOOYSENS
South Africa
Tel. 0027-114341345
Fax 0027-114341359
rann@pixie.co.za
TENSON Engineering Ltd
Room 908, Nan Fung Commercial Center
19 LAM LOK St
KOWLOON BAY
Hong Kong
Tel. +85227580878
Fax +852 27595335
sammy@tenson.com.hk
Variadores S.A.
Avenida 37 (Ciudad de Quito) \# 82-05
Bogota, D.C. Colombia
Tel: +5716357288
Fax: +5716113872
ventas@variadores.com.co
WELLFORD CHILE S.A.
ENCALA 103645
Madrid No 1602 - Santiago
SANTIAGO
Chile
Tel. 0056-2556 2655
Fax 0056-2 5563528
encala@hotmail.com
Voltampere s.a.
2nd kIm Lagada-Redina
GR-57200 THESSALONIKI
Greece
Tel. $0030-39426188$
Fax 0030-394 26189
automation@voltampere.gr

Emotron AB
Mörsaregatan 12
SE-250 24 Helsingborg, Sweden
Tel: +46 42169900
Fax: +46 42169949
E-mail: info@emotron.com


Fig. 1 Standard uiring.

ig. 2 Connections on the $P C B$, control card.

Table 1 PCB Terminak

| Terminal | Function | Evectrical characteristics |
| :---: | :---: | :---: |
| 01 | Supply voltage | $\begin{aligned} & 100-240 \mathrm{VAC} \pm 10 \% / 380-500 \mathrm{VAC} \\ & \pm 10 \% \end{aligned}$ |
| 02 |  |  |
| PE | Gnd | $\stackrel{1}{-}$ |
| 11 | Digital inpuis for stert/siop ano resei. | O.3V-> C:8.27 V $\rightarrow$ i. Max. 37 V for 10 sec . <br> Impedance to $0 \mathrm{VDC}: 2.2 \mathrm{kS}$. |
| 12 |  |  |
| 15 | Supply/control voltage to PCE terminal 11 anc $12.10 \mathrm{k} \Omega$ potentiometer. eic. | $+12 \mathrm{VDC} \pm 5 \%$. Max. current from $\div 12$ VDG: 50 mk . Shori circuit prooi. |
| 14 | Remote analogut input control. 6.104 .2 .10 V .02 m , and 4.20 mA./digitel input. | Impedance to termina! $15(0 \mathrm{VOC})$ voltage signat: 125 kr current sigy nat: 100 S! |
| 15 | GND (common) | O VDC |
| 16 | Digital inputs for selectior, of parameler set. | (C.3V->0: 8-27V-31. Man. 37V for 10s. Impedance to $0 \mathrm{VDC:} 2.2 \mathrm{kS}$ |
| 17 |  |  |
| 18 | Supaly/control voltage 10 PCE terminal 16 and 17. 10 K.ry potertiometer: etc. | $\div 12$ VDC $\div 5 \%$. Ma;. current trom, +12 VDC $=50 \mathrm{~mA}$. Shori circuii prooi. |
| 19 | Remote analogue outpul control | A nalogue Output contact: Q-10V. 2.10V: min load impedance $700 \Omega 0.20 \mathrm{~mA}$ and 4.20 mA :max load impedance $750 \Omega$ |
| 21 | Programmable relay K1. Factory setting is "Operation" indication by closing terminal 21 - 22. | 1-pole closing contact. 250 VAC 8 A or 24 VDC 8 A resistive, 250 VAC, 3A inductive. |
| 22 |  |  |
| 23 | Programmable relay K2. Factory setting is "Full voltage" indication by closing terminal $23-24$. | 1-pole closing contact, 250 VAC 8 A or 24 VDC 8 A resistive, 250 VAC, $3 A$ inductive. |
| 24 |  |  |
| 31 | Alarm relay K 3 , closed to 33 at alarm. | 1-pole change over contact, 250 VAC $8 A$ or 24 VDC $8 A$ resistive, 250 VAC, 3 A inductive. |
| 32 | Alarm relay K3, opened at alarm. |  |
| 33 | Alarm relay K3. common terminal |  |
| 69.70 | PTC Thermistor input | Alarm level $2.4 \mathrm{k} \Omega$ Switch back level $2.2 \mathrm{k} \Omega$. |
| 71-72* | Clickson thermistor | Controlling soft starter cooling fine temperature MSF-170-MSF-835 |
| 73-74* | NTC thermistor | Temperature measuring of soft starter cooling fine |
| 75 | Current transiormer input. cable S1 (blue) | Connection of $L 1$ or $T 1$ phase current transformer |
| 76 | Current transformer input, cable S1 (blue) | Connection of L3. T3 phase (MSF 017. MSF 250) or L2, T2 phase (MSF 310-MSF 1400) |
| 77 | Current transtormer input. cable S2 (brown) | Common connection for terminal 75 and 76 |
| 78* | Fan comection | 24 VDC |
| 79* | Fan connection | 0 VDC |

$\star$ Internal connection, no customer use.

ig. 3 Merwu structure.

| Menu nt. | Function/Parameter | Range ${ }^{\text {P }}$ | Pas. Fa <br> set se | Factory <br> setting | Page |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 001 In | Initial voltage at start | 25-90\% of U 1 | 1.4 | 30 pa | page 36 |
| 002 St | Start time ramp I | 1.605 1 | 1.4 | 10 p | page 36 |
| 003 St | Step down voltage at stop | $100.40 \%$ U 1 | 1.4 | 100 pa | page 36 |
| 004 | Stop time ramp 1 | OFF. $2 \cdot 120 \mathrm{~s}$ 1 | 1.4 | OFF p | ge 36 |
| 005 C | Cufrent | 0.0 .9999 mm - | - |  | рөge 35 |
| 006 | Control mode | 1. 2.3 1.4 | 1.4 | 2 p | page 37 |
| 007 E | Extenced functions \& metering | ofF. On - | - | OFF | page 38 |
| 008 E | Extended functions | ofF. Or, | - | OFF | page 38 |
|  |  |  |  |  |  |
| 011 In | Initial voltage stari ramp 2 | 30.90\% U 1 | 1.4 ! | 90 | page 38 |
| 012 | Stari time ramp 2 | OFF, I-60 | 1.4 | off | page 38 |
| 013 | Stef down voliage stoframp 2 | 100.40\% U | 1.4 | 40 | pags 38 |
| 014 | Stop time ramp 2 | OFF, $2 \cdot 120 \leq 1$ | 1.4 | OFF | Page 381 |
| 016 | Initial torque ai stari | 0.250\% Tn 1 | 1.4 | 10 | page 39 |
| 017 | End torque at stari | 50-250\% Tn 1 | 1-4 | 150 | E 39 |
| 018 | End torque ai stop | 0.100\%. Tn | 1.4 | 0 | page 39 |
| 020 | Voltage ramp with current limit at start | $\begin{aligned} & \text { OFF. } 150 \text {. } \\ & 500 \% I_{n} \end{aligned}$ | 1.4 | ofF | page 39 |
| 021 | Current limit at start | $\begin{aligned} & \text { ofF, } 150 \text {. } \\ & 500 \% i_{n} \end{aligned}$ | 1.4 | off | page 40 |
| 022 | Pump control | off, on | 1.4 | OFF | page 40 |
| 023 | Remote analogue control | off. 1, 2 | 1.4 | OFF | page 41 |
| 024 | Full voltage start D.O.L | OFF, on | 1.4 | OFF | page 41 |
| 025 | Torque control | ofF, 1, 2 | 1.4 | ofF | page 42 |
|  | . |  |  |  |  |
| 030 | Torque boost active time | OFF. O.1-2.0.5 | 1.4 | off | page 43 |
| 031 | Torque boosst current 'limit | 300:.700\%! | 1.4 | 300 | paga 43 |
| 032 | Bypass | ofF, on | 1.4 | OFF: | page 43 |
| 033 | Power Factor Control PFC | OFF, on | 1.4 | OFF | page 46 |
| 034 | Braking time | OFF, 1.120 s | 1.4 | OFF | page 47 |
| 035 | Braking strength | 100-500\% | 1.4 | 100 | page 47 |
| 036 | Braking methods | 1, 2 | 1.4 | 1 | page 47 |
| 037 | Slow speed torque | 10-100 | 1.4 | 10 | page 49 |
| 038 | Slow speed time' at start | ofF, 1-60 s | 1-4 | ofF | page 49 |
| 039 | Slow speed time at stop | ofF, 1-60 s | 1.4 | ofF | page 49 |
| 040 | DC-Brake at slow speed | OFF, 1.60 s | 1.4 | OFF | page 49 |
| 041 | Nominal motor voltage | 200-700 V | 1-4 | 400 | page 50 |
| 042 | Nominal motor current | 25-150\% $i_{\text {nsoft }}$ in Amp | 1.4 | $I_{\text {nseft }}$ in Amp | page 50 |
| 043 | Nominal motor power | $\begin{aligned} & 25-300 \% \text { of } \\ & P_{\text {nsot }} \text { in } \mathrm{kW} \end{aligned}$ | 1-4 | $P_{n \text { sot }} \text { in }$ | 7 page 50 |
| 044 | Nominal speed | $500 \cdot 3600 \mathrm{rpm}$ | 1.4 | $\mathrm{N}_{\text {nsoth }}$ in rpm | page 50 |
| 045 | Nominal power factor | 0.50-1.00 | 1.4 | - 0.86 | page 50 |
| 046 | Nominal frequency | $50,60 \mathrm{~Hz}$ |  | 50 | page 50 |
|  |  |  |  |  |  |
| 051 | 1 Programmable relay K1 | 1, 2, 3, (4). 5 |  | 1 | page 51 |
| 052 | 2 Programmable relay K2 | 1, 2, 3, 4, 5 | - | 2 | page 51 |
|  | $\square$ |  |  |  |  |
| 054 | 4 Analogue output | ofF, 1, 2 | 1-4 | 4 OFF | page 52 |
| 055 | 5 Analogue output value | 1, 2, 3 | 1.4 | - 4 | page 52 |
| 056 | 5 Scaling analogue output | 5-150\% | 1.4 | 4100 | page 52 |
| 057 | 7. Digital input selection | OFF, 1, 2, 3, 4 | 41.4 | 4 OFF | page 53 |
| 058 | 8 Digital input putses | 1-100 | 1.4 | 4 | page 53 |
|  |  |  |  |  |  |
| 061 | 1 Parameter set | 0.1.2.3.4 |  | 1 | page 54 |
|  |  |  |  |  |  |
| 071 | $1{ }^{1}$ Motor PTC input | no, YES | - | no | page 55 |
| 072 | 2 Internal motor thermal pro- | OFF, 2.40 sec | c | 10 | page 55 |
| $\begin{array}{\|l\|} \hline 073 \\ \hline 074 \\ \hline \end{array}$ | 3 Used thermal capacity | 0-150\% | - | - | page 55 |
|  | $4{ }^{4}$ Starts per hour limitation | OFF, 1-99/hour | Ir 1 1-4 | 4 OFF | page 55 |


| Menu nt. | Function/Parameter | Range | Par. set | Factory setting | Page |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 075 L0 | Locked rotor alarm | OFF: 1.0.10.0 s | 1.4 | OFF | page 55 |
| 081 | Voltage unbalance alarm | 2. $25 \% \mathrm{U}_{\text {n }}$ | 1.4 | 10 | page 56 |
| 082 ( $\begin{aligned} & \text { Re } \\ & \text { un }\end{aligned}$ | Response delay voltage unbalance atarm | OFF. 1. 60 sec | 1.4 | ofF | page 56 |
| 083 O | Over voltage alarm | $100 \cdot 150 \% U_{n}$ | 1.4 | 115 | page 56 |
| 084R <br> vo | Response delay over voltag $\epsilon$ alarm | OFF. i-60 sec | I. 4 | OFF | page 56 |
| 085 U | Under voltage alarm | $75.100 \% \mathrm{U}_{\mathrm{r}_{1}}$ | I. 4 | 85 | page 57 |
| 086 ${ }^{0} \begin{aligned} & \text { K } \\ & \text { V }\end{aligned}$ | Response deiay under vottage alarm | oFF, I. 60 sec | 1.4 | of: | Page 57 |
| $00^{-1}$ | Phase sequence | L123. L321 |  | - | \|page 57 |
| O88 P | Phase reversal alarmi | OFF. Ori |  | OFF | page 57 |
| 08S ${ }^{08}$ | Auto sei power limits | nc. Y C E | - | ne | page 57 |
| 090 0 <br> 09  | Ouipui shatil power | \|0.0.200.0\% Fn |  |  | page 57 |
| 0915 | Start delay power limits | I. 2501 sec | 1.4 | 20 | page 58\| |
| 092 M | Max. powe: alarm limit | E-200\% Pri | 1.4 | 115 | Page 58\| |
| 093 M | Ma.: alarm response delay | ofF. 0.1 .25 .11 s | 1.4 | off | page 58 |
| 094 | Max powet ors-alarm limit | $5 \cdot 200 \%$ Pn | I. 4 | 110 | page 58 |
| 095 | Mar. pre-ziarm response delay | off. 0.1-25.0 s | 1.4 | off | page 58 |
| 096 | Min pre-alarm power limit | $5.200 \% \mathrm{Pn}$ | 1.4 | 90 | page 58 |
| 097 ${ }^{\text {M }}$ | Min pre-alarm response delay | OFF, 0.1-25.0 s | 1.4 | ofF | page 59 |
| 098 | Min power alarm limin | 5.200\%Fn | I. 4 | 85 | page 59 |
| 099 | Min alarm response delay | OFF, 0.1-25.0 s | 1.4 | DFF | page 59 |
| 101 | Run at single phase input failure | no. YES | 1.4 | no | page 61 |
| 102 | Run at current limit time-out | no. YES | 1.4 | no | page 61 |
| 103 | Jog forward enable | ofF. on | 1.4 | OFF | page 61 |
| 104 | jog reverse enable | off, on | 1.4 | OFF | page 61 |
| 105 | Automatic return menu | OFF, 1-999 |  | off | page 62 |
|  |  |  |  |  |  |
| 111 | Serial comm. unit address | 1. 247 |  | 1 | page 62 |
| 112 | Serial comm. baudrate | $\begin{gathered} 2.4-38.4 \\ \text { kBaud } \end{gathered}$ |  | 9.6 | page 62 |
| 113 | Serial comm. panty | 0.1 |  | 0 | page 62 |
| 114 | Serial comm. contact broken | त OFF, 1, 2 |  | 1 | page 62 |
|  |  |  |  |  |  |
| 199 | Reset to tactory settings | no, YES |  | no | page 63 |
|  |  |  |  |  |  |
| 201 | Curremt | 0.0 .9999 Amp |  |  | page 63 |
| 202 | Line main voltage | 0.720 V |  |  | page 63 |
| 203 | Output shaft power | -9999-9999 kW |  |  | page 63 |
| 204 | Power factor | $0.00 \cdot 1.00$ |  |  | page 63 |
| 205 | Power consumption | $\begin{gathered} 0.000-2000 \\ \mathrm{MWh} \end{gathered}$ | - | - | page 63 |
| 206 | Reset power consumption | no, YES |  | no | page 64 |
| 207 | Shatt torque | -9999-9999Nm |  |  | page 64 |
| 208 | Operation time | Hours |  |  | page 64 |
|  |  |  |  |  |  |
| 211 | Current phase L1 | $0.0 \cdot 9999 \mathrm{Amp}$ |  |  | page 64 |
| 212 | Current phase L2 | 0.0 .9999 AmD |  |  | page 64 |
| 213 | Curremt phase L3 | 0.0 .9999 Amp |  |  | page 64 |
| 214 | 4 Line main voltage L1-L2 | 0.720 V |  |  | page 64 |
| 215 | Line main voltage L1-13 | 0.720 V |  |  | page 64 |
| 216 | - Line main voitage L2 - L3 | 0.720 V |  |  | page 64 |
|  |  |  |  |  |  |
| 221 | 1 Locked keyboard info | no, YES | - | no | page 65 |
|  |  |  |  |  |  |
| 901 | 1 Alarm list, Latest error | F1. F16 |  |  | page 65 |
| $902$ | Alarm list, Older error in chronological order | F1. F16 | - | - | page 65 |

## PARAMETER SET LIST-MSF



|  |  | Factory setting | Parameter Sets |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  | 1 | 2 | 3 | 4 |
| 071 | Motar PTC input | no |  | common for all paramerer sets |  |  |
| 072 | Internal motor thermal protection class | 10 |  |  |  |  |
| 073 | Used thermal capacity | - | -- | - | - | - |
| 074 | Starts per hour limitation | OFF |  |  |  |  |
| 075 | Locked rotor alarm | off |  |  |  |  |
|  |  |  |  |  |  |  |
| 081 | Valtage unbalance alarm | 10 |  |  |  |  |
| 082 | Response felay voltaje unbalance alarm | OFF |  |  |  |  |
| 082 | Oiver voltage alarmi | 115 |  |  |  |  |
| 083 | Presponse delay over voltage alarm, | OFF |  |  |  |  |
| 085 | Under voluage alarm | 85 |  |  |  |  |
| 08 E | Response delay under voliage alarm | OFF |  |  |  |  |
| 1087 | Phast seouense | - |  |  |  |  |
| 088 | Phase reversal alarmi | OFF |  | Commoritor all oarameter sets |  |  |
|  |  |  |  |  |  |  |
| 085 | Aute sei power limits | nc |  | Commoritiot all oarameter sets |  |  |
| 090 | Output shati power | - |  |  |  |  |
| 091 | Start delay power limits | 10 |  |  |  |  |
| 092 | Max power atarm limit. | 115 |  |  |  |  |
| 093 | Max alarm response delay | OFF |  |  |  |  |
| 094 | Max power pre-aiarm limit | 110 |  |  |  |  |
| 095 | May pre-alarm response delay | OFF |  |  |  |  |
| 096 | Min pre-alarm power limit | 90 |  |  |  |  |
| 097 | Min prealarm response delay | OFF |  |  |  |  |
| 098 | Min power alarm limit | 85 |  |  |  |  |
| 099 | Min alarm response delay | off |  |  |  |  |
|  |  |  |  |  |  |  |
| 101 | Run at single phase input failure | по |  |  |  |  |
| 102 | Run al current limit timeout | no |  |  |  |  |
|  |  |  |  |  |  |  |
| 103 | Jog forward enable | OFF |  |  |  |  |
| 104 | jog reverse enable | OFF |  |  |  |  |
|  |  |  |  |  |  |  |
| 105 | A unomatic return meniu | OFF |  | Common for all parameter sets |  |  |
|  |  |  |  |  |  |  |
| 111 | Serial comm. unit adoress | 1 |  | Common for all parameter sets |  |  |
| 112 | Serial comm. baudrste | 9.6 |  | Common for all parameter sets |  |  |
| 113 | Serial comm. parity | 0 |  | Common for all parameter sets |  |  |
| 114 | Serial comm. contact brokern | 1 |  | Common tor ali parameter sets |  |  |
|  |  |  |  |  |  |  |
| 199 | Reset to factory settings | no |  | Common for all parameter sets |  |  |
|  |  |  |  |  |  |  |
| 201 | Current * | - | - | - | -- | -- |
| 202 | Line main voltage | - | - | $\square$ | - | - |
| 203 | Output shafl power | - | - | - - | -- | - |
| 204 | Power factor | - | - | - | - | $\cdots$ |
| 205 | Power consumplion | - | $\square$ | - | - | - |
| 206 | Reset power consumption | no |  | Common for all parameter sets |  |  |
| 207 | Shaft torque | - | - | - | - | $\square$ |
| 208 | Operation time | $\square$ | $\square$ | $\square$ | $\square$ | - |
|  |  |  |  |  |  |  |
| 211 | Currerit phase L1 | - | $\square$ | $\square$ | - | - |
| 212 | Current phase L2 | $\square$ | - - | - | - | - |
| 213 | Current phase L3 | - | $\underline{\square}$ | $\square$ | $\cdots$ | $\square$ |
|  |  |  |  |  |  |  |
| 214 | Line main voitage L - L 2 | - | - | $\square$ | - | - |
| 215 | Line main voltage $\square$ - 13 | - | - | $\square$ | - | - |
| 216 | Line main voltage L2-L3 | $\square$ | $\square$ | $\square$ | - | - |
|  |  |  |  |  |  |  |
| 221 | Locked keyboard info | no | $\underline{-}$ | $\square$ | $\square$ | --- |

## A.-...

# MODEL G306-GRAPHIC COLOR LCD OPERATOR INTERFACE TERMINAL WITH QVGA DISPLAY AND TOUCHSCREEN 



- CONFIGURED USING CRIMSON SOFTWARE (VERSION 2.0 OR LATER)
- UP TO 5 PSS-232/422/485 COMMUNICATIONS PORTS (2 RS-232 AND 1 RS-422/485 ON BOARD: 1 RS-232 ANO 1 PS $422 / 485$ ON OPTIONAL COMMUNICATIONS CARD)
- 10 BASE T/100 BASE-TX ETHERNET PORT TO NETWORK UNITS AND HOST WES PAGES
- USE PORT TO DOWNLOAD THE UINTT'S COIVFIGURATIONFROMA A

PC ORFOR DATA. TRANSFERS TO A PG

- UNIT'S CONFIGURATION IS STORED IN NON-VOLATILE MEMORY (4 MEYTE FLASH)
- COMPACTFLASH SOCKET TO INCREASE MEMORY CAPACITY
- 5.7-INCH STN PASSIVE MATRIX 256 COLOR QVGA $320 \times 240$
- COMPACTFLASH $H^{\text {ex }}$ SOCKET TO INCREASE MEMORY CAPACIT
- 5.7-INCH STN PASSIVE MATRIX 256 COLOR QVGA $320 \times 240$

PIXEL LCD

- 5-BUTTON KEYPAD FOR ON-SCREEN MENUS
- THREE FRONT PANEL LED INDICATORS
- POWER UNIT FROM 24 VDC $\pm 20 \%$ SUPPLY
- RESISTIVE ANALOG TOUCHSCREEN (2 RS-232 AND 1 RS-422/485 ON BOARD: 1 RS-232 AND 1


## GENERAL DESCRIPTION

The G306 Operator Interface Terminal combines unique capabilities normally expected from high-end units with a very affordable price. It is built around a high performance core with integrated functionality. This core allows the G306 to perform many fil the nomal features of the Paradigm range of Operator Interfaces while improving and adding new features.

The G306 is able to communicate with many different types of hardware using higb-speed RS232/422/485 communications ports and Ethernet 10 Base T/100 Base-TX communications. In addition, the G306 features USB for fast downloads of configuration files and access to trending and data logging. A Compactflash socket is provided so that Flasb cards can be used to collect your rending and data logging information as well as to store larger configuration files.

In addition to accessing and controlling of external resources, the G306 allows a user to easily view and enter information. Users can enter data through the touchscreen and/or front panel 5 -button keypad.

## - "FETY SUMMARY

11 safety related regulations, local codes and instructions that appear in the manual or on equipment must be observed to cosure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

Do not use the controller to directly command motors, valves, or other actuators not equipped with safeguards. To do so can be potentially harmful to persons or equipment in the event of a fault to the controller.


The protective conductor terminal is bonded to conductive parts of the equipment for safety purposes and must be connected to an extemal protective carthing system.
WARNING - EXPLOSION HAZARD - SUBSTITUTION OF COMPONENTS MAY IMPAIR SUITABILITY FOR CLASS I. DIVISION 2/CLASS II, DIVISION 2/CLASS III, DIVISION 2


CAUTION: Risk Of Danger.
Read complete instructions prior to installation and operation of the unit.

## CONTENTS OF PACKAGE

- G306 Operator Interface.
- Panel gasket.
- Template for panel cutout.
- Hardware packet for mounting unit into panel.
- Terminal block for connecting power.


## ORDERING INFORMATION

| MODEL NO. | DESCRIPTION | PART NUMBER |
| :---: | :---: | :---: |
| G306 | Operator interface for indoor applications, textured finish with embossed keys | G306C000 |
| G3CF | 64 MB CompactFlash Card ${ }^{5}$ | G3CF064M |
|  | 256 MB CompactFlash Card ${ }^{5}$ | G3CF256M |
|  | 512 MB CompactFlash Card ${ }^{5}$ | G3CF512M |
| G3RS | RS232/485 Optional Communications Cards | G3RS0000 |
| G3CN | CANopen Optional Communications Cards | G3CN0000 |
| PSDR7 | DIN Rail Power Supply | PSDR7000 |
| SFCRM2 | Crimson $2.0^{2}$ | SFCRM200 |
| CBL | RS-232 Programming Cable | CBLPROGO |
|  | USB Cable | CBLUSB00 |
|  | Communications Cables ${ }^{1}$ | CBLxxxxx |
| DR | Dilv Rail Mountable Adapter Products ${ }^{3}$ | DRxuxxxx |
|  | Replacement Battery ${ }^{4}$ | BAL 3R004 |
| G3FILM | Protective Films | G3FJLM06 |

$1^{\text {' Contact your Red Lion distributor or visit our website for }}$ complete selection.
${ }^{2}$ Use this part number to purchase Crimson on CD with a printed manual, USB cable, and RS-232 cable. Otherwisc, download for free from www.redlion.net.
${ }^{3}$ Red Lion offers RJ niodular jack adapters. Refer to the DR literature for complete details.
${ }^{4}$ Battery type is lithium coin type CR2025
${ }^{5}$ Industrial grade two million write cycles.

[^0]
## PECIFICATIONS

OWER REQUIREMENTS:
Must use Class 2 or SELV rated power supply.
Power connection via removable three position termina! block.
upply Voltage: $\quad+24$ VDC $\doteq 20 \%$
ypical Power: $\& W$
laximum Power?: 14 W
lores:

1. Typical power with $\div 3 \mathrm{VDC}, R S 232 / 485$ communications. Etheme commmicarions. CompactFlasin cardinsialled. and displa al full bighmess.
2. Maximum power indicares the mos! power thai can be drenw from the G306. Refer io "Power Supph Requivements" under "hnsalling anc Powering the G306."
$\therefore$ The G306's circuit commor is no: comnecred to the enclosure of the unii. See "Comnecing io Earth, Ground'" in the section "Installing and Powering the G300.
3. Read "Power Suppiy: Requiremens" in the section "Installing and Powering the G306" for additionai power suppiy infomarion
3ATTERY: Lithium coin cell. Typical lifetime of 10 years.
$\therefore$ CD DISPLAI:

| SIZE | 5.7 -inch |
| :--- | :---: |
| TYPE | STN |
| COLORS | 256 |
| PIXELS | $320 \times 240$ |
| BRIGHTNESS | $165 \mathrm{~cd} / \mathrm{m}^{2}$ |
| BACKLIGHT* | $20,000 \mathrm{HR} \mathrm{TYP}$ |

ifetime at room temperarure. Refer to "Display" in "Software/Nnit Operation"
5-KEY KEYPAD: for on-screed menus.
TOUCHSCREEN: Resistive analog.
MEMORY:
On Bōard User Memory: 4 Mbyte of non-volatile Flash memory.
Memory Card: CompactFlash Type II slot for Type I and Type II CompactFlash cards.
COMMUNICATIONS:
USB Port: Adheres to USB specification 1.1. Device only using Type.B connection.

WARNING - DO NOT CONNECT OR DISCONNECT CABLES WHILE POWER IS APPLIED UNLESS AREA IS KNOWN TO BE NON-HAZARDOUS. USB PORT IS FOR SYSTEM SET-UP AND DIAGNOSTICS AND IS NOT INTENDED FOR PERMANENT CONNECTION.

Serial Ports: Format and Baud Rates for each port are individually software programmable up to 115,200 baud.
PGM Port: RS232 port via RJI2.
COMMS Ports: RS422/485 port via RJ45, and RS232 port via RJ12.
DH485 TXEN: Transmit enable; open collector, $\mathrm{V}_{\mathrm{OH}}=15 \mathrm{VDC}$,
$V_{\mathrm{OL}}=0.5 \mathrm{~V} @ 25 \mathrm{~mA} \max$.
Note: For additional information on the communications or signal common and connections to earth ground please see the "Connecting to
Earth Ground" in the section "Installing and Powering the G306."
Ethernet Port: 10 BASE-T / 100 BASE-TX
RJ45 jack is wired as a NIC (Network Interface Card).
Isolation from Ethernet network to G3 operator interface: 1500 Vms
8. ENVIRONMENTAL CONDITIONS:

Operating Temperature Range: $01050^{\circ} \mathrm{C}$
Storage Temperature Range: - $201070^{\circ} \mathrm{C}$
Operating and Storage Humidity: $80 \%$ maximum relative humidity inoncondensing) from $01050^{\circ} \mathrm{C}$.
Vibration: Operational 5 to $8 \mathrm{~Hz}, 0.8^{\prime \prime}(p-p), 8$ to 500 Hz : in X. Y, $Z$ direction: duration: 1 hour, $\Sigma \mathrm{g}$.
Shock: Operational $40 \mathrm{~g}, 9 \mathrm{msec}$ int 3 directions.
Altitude: Up to 2000 meters.
9. CERTIFICATIONS AND COMPLIANCES:

SAFETY
UL Recognized Component File $\pi$ E179259: UL61010-1: CSA 22.2 No. $61010-1$ Recognized to U.S and Canadian requirements under the Component Recognition Program of Underuriters Laboratones, Inc.
 CSA 22.2 No. 213-M1987.
LISTED by Und. Lab. Inc. to U.S. arıd Canadian safery standards
Type 4 X Enclosure rating (Face only), UL50
IECEE CB Scheme Test Certificaic \#US/9737/UL,
CB Scheme Test Repori \#E179259-V01-S04
Issued by Underwriters Laboratories Inc.
IEC 61010-1, EN 6/010-1: Safery requirements for electrical equipmeni for measurement, control, and laboratory use, Pari 1.
IP6ó Enclosure rating (Face only), IEC 529
ELECTROMAGNETIC COMPATIBILITY
Emissions and Immunity to EN 61326: Electrical Equipment for Measurement, Control and Laboratory use.

## Immunity to lndustrialidacations:

| Electrostatic discharge | EN 61000-4-2 | Criterion A |
| :---: | :---: | :---: |
|  |  | 4 kV contact discharge |
|  |  | 8 kV air discharge |
| Electromagnetic RF fields | EN 61000-4-3 | Criterion A |
|  |  | $10 \mathrm{~V} / \mathrm{m}$ |
| Fast transients (burst) | EN 61000-4-4 | Criterion A |
|  |  | 2 kV power |
|  |  | 1 kV sigual |
| Surge | EN 61000-4-5 | Criterion A |
|  |  | $1 \mathrm{kV} \mathrm{L-L}$, |
|  |  | 2 kV L\&N-E power |
| RF conducted interference | EN 61000-46 | Criterion A |
|  |  | $3 \mathrm{~V} / \mathrm{mms}$ |
| Emissions: |  |  |
| Emissions | EN 55011 | Class A |

Note:
I. Criterion A: Normal operation withim specified limits.
10. CONSTRUCTION: Steel rear metal enclosure with NEMA 4X/[P66 aluminum front plate for indoor use only when correctly fitted with the gasket provided Installation Category II, Pollution Degret 2.
11. MOUNTING REQUIREMENTS: Maximum panel chickness is $0.25^{\prime \prime}$ ( 6.3 $\mathrm{mm})$. For NEMA 4X/IP66 scaling, a steel panel with a minimum thickness of $0.125^{\prime \prime}(3.17 \mathrm{~mm})$ is recommended.
Maximum Mounting Stud Torque: 17 incli-pounds ( $1.92 \mathrm{~N}-\mathrm{m}$ )
12. WEIGHT: 3.0 lbs ( 1.36 Kg )

## DIMENSIONS In inches (mm)



# Installing and Powering the G306 

## MOUNTING INSTRUCTIONS

This operator interface is designed for through-panel mounting. A panel cut-
liagram and a template are provided. Care should be taken to remove any wui inaterial from the mounting cut-out to prevent that material from falling inte the operator interface during installation. A gasket is provided to enable sealing to NEMA. 4X/P66 specification. Install the ten kep nuts provided and tighter evenly for uniform gasket compression.

Note: Tighening the hep mus bevond a maximum of thinci-poimds 11.92 N $m$ may cause damage to the from panel.


ALL NONINCENDIVE CIRCUITS MUST BE WIRED USING DIVISION 2 WIRING METHODS AS SPECIFIED IN ARTICLE 501 4. (b), 502-4 (b), AND 503-3 (b) OF THE NATIONAL ELECTRICAL CODE, NFPA 70 FOR INSTALLATION WITHIN THE UNITED STATES, OR AS SPECIFIED IN SECTION 19-152 OF CANADIAN ELECTRICAL CODE FOR INSTALLATION IN CANADA.

## CONNECTING TO EARTH GROUND



The protective conductor terminal is bonded to conducrive parts of the equipment for safery purposes and must be connected to an external protective earthing system.

Each G306 has a chassis ground terminal on the back of the unit. Your unit should be connected to earth ground (protective earth).

The chassis ground is not connected to signal common of the unit. Maintaining isolation between earth ground and signal common is not required to operate your unit. But, other equipment comnected to this unit may require isolation berween signal common and earth ground. To maimain isolation benveen signal common and earth ground care mus: be aken when connections are made to the unit. For example, a power supply with isolation berween its signal common and earth ground must be used. Also, plugging in a USB cable may connect signal common and earth ground.'

1. USB's shield may be connected to carth ground at the hosi. USB:s shicio in tum may also be comnecred to signal common.

## POWER SUPPLY REQUIREMENTS

The G306 requires a 24 V $D C$ power supply Your unit may draw considerably less than the maximum rated power depending upon the options being used. As additional fearures are used your uilis will draw increasing ainounts of power. ltems that could cause increases in current are additional communications. optional communications card, CompactFlesh card. and other feanures. programmed through Crimson.

In any case, it is very imporant that the power supply is moumed corectly if the unit is to operate reliably. Please take care to observe the foliowing points:

- The power supply musi be mounted close to the unie, with usualiy noi more than 6 feet $(1.8 \mathrm{~m})$ of cable between the supply and the operator inierface. Ideally, the shortest length possible should be used.
- The wire used to connect the operator interface's power supply should be at least 22 -gage wire. If a longer cable run is used, a heavier gage wire should be used. The routing of the cable should be kept away from large contactors, invertcrs, and other devices which may gencrate significant electercal noise.
- A power supply with a Class 2 or SELV rating is to be used. A Class? or SELV power supply provides isolation to accessible circuits from hazardous voltage levels generated by a mains power supply due to single faults. SELV is an acronym for "safety extra-low voltage." Safety extra-low volrage circuits shall exhibit voltages safe to touch both under normal operating conditions and after a single fault, such as a breakdown of a layer of basic insulation or after the failure of a single component has occurred.

COMMUNICATING WITH THE G306

## CONFIGURING A G306

The G306 is configured using Crimson software. Crimson is available as a free download from Red Lion's website, or it can be purchased on CD. Updates to Crimson for new features and drivers are posted on the website as they become available. By configuring the G306 using the latest version of Crimson, you are assured that your unit has the most up to date feature set. Crimson software can configure the G306 through the RS232 PGM por, USB port, or CompactFlash.
he USB port is connected using a standard USB cable with a Type B
nector. The driver needed to use the USB port will be installed with Crimson.
The RS232 PGM port uses a programming cable made by Red Lion to connect to the DB9 COM port of your computer. If you choose to make your own cable, use the "G306 Port Pin Out Diagram" for wiring information.
The CompactFlash can be used to program a G3 by placing a configuration file and finmware on the CompactFlash card. The card is then insented into the target G3 and powered. Refer to the Crimson literaure for more information on the proper names and locations of the files.

## USB, DATA TRANSFERS FROM THE COMPACTFLASH CARD



WARNING - DO NOT CONNECT OR DISCONNECT CABLES WHILE POWER IS APPLIED UNLESS AREA IS KNOWN TO BE NON-HAZARDOUS. USB PORT IS FOR SYSTEM SET-UP AND DIAGNOSTICS AND IS NOT INTENDED FOR PERMANENT CONNECTION.
In order to transfer data from the CompactFlash card via the USB port, a driver must be installed on your computer. This driver is installed with Crimson and is located in the folder C:IProgram FilestRed Lion Controls\Crinson 2.ODevicel after Crimson is installed. This may have already been accomplished if your G306 was configured using the USB port.

Once the driver is installed, connect the G306 to your PC with a USB cable, and
ow "Mounting the CompactFlash" instructions in the Crimson 2 user manual.

## CABLES AND DRIVERS

Red Lion has a wide range of cables and drivers for use with many different communication types. A list of these drivers and cables along with pin outs is available from Red Lion's website. New cables and drivers are added on a regular basis. If making your own cable, refer to the "G30ó Port Pin Outs" for wining information.

## ETHERNET COMMUNICATIONS

Ethemet communications can be established at cither 10 BASE-T or 100 BASE-TX. The G306 unit's RJ45 jack is wired as a NIC (Network Interface Card). For example, when wining to a hub or switch use a straight-through cable, but when connecting to another NIC usc a crossover cable.

The Etherner connector contains two LEDs. A yellow LED in the upper right, and a bi-color green/amber LED in the upper left. The LEDs represent the following statuscs:

| LED COLOR | DESCRIPTION |
| :--- | :--- |
| YELLOW solid | Link established. |
| YELLOW flashing | Data being transferred. |
| GREEN | 10 BASE-T Communications |
| AMBER | 100 BASE-TX Communications |

On the rear of each unit is a unique 12 -digit MAC address and a block for marking the unit with an IP address. Refer to the Crimson manual and Red Lion's website for additional information on Ethernet communications
he G306 has two RS232 ports. There is the PGM port and the COMMS port. rough only one of these ports can be used for programming, both pors can ised for communications with a PLC.
he RSS 32 ports can be used for either master or slave protocols with any 16 configuration.
:xamples of RS232 communications could involve another Red Lion product . PC. By using a cable with RJI2 ends on it, and a twist in the cable, RS232 imunications with another $G 3$ product or the Modular Controller can be tblished Red Lion pan numbers for cables with a twist in them are LPROGO ${ }^{\prime}$ : CBLRLCO ${ }^{-}$- or CBLRCO2 ${ }^{3}$.

G3 RS232 to a PC

| Connections |  |  |  |
| :---: | :---: | :---: | :---: |
| G3: RJJ12 | Name | PC: DB9 | Name |
| 4 | Columi | 1 | DCE |
| - 5 | . ${ }^{\text {Tx}}$. | 2 | P: |
| 2 | Rx | 3 | Tx. |
|  | N/C | 4 | OTR |
| 3 | COM | 5 | GND |
|  | N/C | 6 | DSR |
| 1 | CTS | 7 | RTS |
| $\epsilon$ | RT.S | 8 | CTS |
|  | N/C | 9 | RI |

CONNECTING $A$ GJOE OPERATOR INTERFACE TO AN ICM5

${ }^{1}$ CBLPROG0 can also be used to communicate with either a PC or an ICM5.
${ }^{2}$ DB9 adapter not included, 1 foot long.
${ }^{3}$ DB9 adapter not included, 10 feet long.


## RS422/485 COMMS PORT

The G306 has one RS422/485 port. This pon can be configured to act as either RS422 or RS485.


All Red Lion devices comnect $A$ to $A$ and $B$ to B. except for Paradigm devices. Refer to unnutredlion.net for additional information.

## Examples of RS485 2-Wire Connections

G3 to Red Lion RJ11 (CBLRLC00) DLC, IAMS, ITMS, PAXCDC4C

| Connections |  |  |  |
| :---: | :---: | :---: | :---: |
| G3: RJ45 | Name | RLC: RJ11 | Name |
| 5 | TxEN | 2 | TxEN |
| 6 | COM | 3 | COM |
| 1 | TxB | 5 | B- |
| 2 | TXA | 4 | A+ |

G3 to Modular Controller (CBLRLC05)

| Connections |  |  |  |
| :---: | :---: | :---: | :---: |
| G3 | Name | Modular Controller | Name |
| 1,4 | T×B | 1,4 | T×B |
| 4,1 | R×B | 4,1 | R×B |
| 2,3 | T×A | 2,3 | T×A |
| 3,2 | R×A | 3,2 | R×A |
| 5 | TxEN | 5 | TXEN |
| 6 | COM | 6 | COM |
| 7 | T×B | 7 | T×B |
| 8 | T×A | 8 | TXA |

## DH485 COMMUNICATIONS

The G306's RS422/485 COMMS pon can also be used for Allen Bradley DH485 communications.

W/ARNING: DO NOT use a standard DH485 cable to connect this port to Allen Bradley equipment. A cable and wing diagram are available from Red Lion.

G3 to AB SLC 500 (CBLAB003)

| Connections |  |  |  |
| :---: | :---: | :---: | :---: |
| F.JAE: PLC | Name | RJas: A-E | Name |
| 1 | TXE | 1 | 1. |
| 2 | TxA. | 2 | E |
| 3,8 | RxA | . | 24 V |
| 4.7 | PxE | $\cdot$ | COMMIN: |
| 5 | TXEN | 5 | TXEN |
| 6 | COMM | 4 | SHIELD |
| 4.7 | TxE | . | COMM |
| 3.8 | TXA | - | 24 V |

## oftware/ Unit Operation

## IMSON SOFTWARE

imson software is available as a free download from Red Lion's website or I be purchased on a CD, see "Ordering Information" for pan number. The version of the sofrware is always available from the website, and updating copy is free.

## SPLAY

uis operator interface uses a liquid crystal display (LCD) for displaying text צraphics. The display utilizes a cold cathode fluorescent rube (CCFI) for ing the display. The CCFL rubes can be dimmed for low ligh conditions. uese CCFL rubes have a limited lifetime. Backlighi lifetime is based upon amount of time the display is oumed on at full intensing. Tuming the light off when the display is not in use can extend the lifecime of your light. This can be accomplished through the Crimson: sofrware when iguring your unit.

## ONT PANEL LEDS

here are threc front panel LEDs. Shown below: is the default status of -EDs

| ED | Indication |
| :---: | :---: |
|  |  |
| FLASHING | Unit is in the boot loader, no valid configuration is loaded.' |
| STEADY | Unit is powered and running an application. |
|  |  |
| OFF | No CompactFlash card is present. |
| STEADY | Valid CompactFlash card present. |
| FLASHING RAPIDLY | CompactFlash card being checked. |
| -LICKERING | Unit is writing to the CompactFlash, either because it is storing data, or because the PC connected via the USB pori has locked the drive. ${ }^{2}$ |
| FLASHING SLOWLY | incorrectly formatted CompactFlash card present. |
|  |  |
| FLASHING | A tag is in an alarm state. |
| STEADY | Valid configuration is loaded and there are no alams present. |

1. The operator interface is shipped without a configuration. After downloading a configuration, if the light remains in the flashing state continuously, try cycling power. If the LED still continues to flash, try downloading a configuration again.
?. Do not turn off power to the unit while this light is flickering. The unit writes data in two minute intervals. Later Microsoft operating systems will not lock the drive unless they need to write data; Windows 98 may lock the drive any time it is mounted, thereby interfering with logging. Refer to "Mounting the CompactFlash" in the Crimson 2 Uscr Manual.

## TOUCHSCREEN

This operator interface utilizes a resistive analog touchscreen for user input. The unit will only produce an audible tone (beep) when a touch on an active touchscreen cell is sensed. The touchscreen is fully functional as soon as the operator interface is initialized. and can be operared with gloved hands.

## KEYPAD

The G306 keypad consists of five keys that can be used for on-screen menus.

## TROUBLESHOOTING YOUR G306

If for any reason you bave trouble operating: connecting: or simply have questions conceming your new G30G. contact Red ion's techmical suppon. For contact information. refer to the back page of the bulleim for phone sne fax numbers.

EMAIL: rechsupponturedion.nci
Web Sire: htre:/hwrur.edlion.ner

## BATTERY \& TIME KEEPING



WARNING - EXPLOSION HAZARD - THE AREA MUST EE KNOWN TO BE NON-HAZARDOUS BEFORE SERVICING REPLACING THE UNIT AND BEFORE INSTALLING OR REMOVING I/O WIRING AND BATTERY.


WARINING - EXPLOSION HAZARD - DO NOT DISCONNECT EQUIPMENT UNLESS POWER HAS BEEN DISCONNECTED AND THE AREF. IS KNOWN TO BE NON-HAZARDOUS.

A banery is used to keep time when the unit is without power. Typical accuracy of the G306 time keeping is less than one minute per month drifi. The battery of a G306 unit does not affect the unit's memory, all contigurations and date is stored in non-volatile memory.

CAUTION: RISK OF ELECTRUC SHOCK
The inverter board, attached to the mounting plate, suppiies the high voltage to operate the backlight. Touching the invener board may result in injury to personnei.


CAUTION: The circuit board contains static sensitive components. Before handling the operator interface withou the rear cover artached. discharge static charges from your body by touching a grounded bare metal object. Ideally: handle the operator interface at a static controlled clean workstation. Also, do not touch the surface areas of the circuit board. Dirt, oil, or other contaminants may adversely affect circuit operation.
: change the battery of a G306, remove power, cabling, and then the rear cover of the unit. To remove the cover, remove the four screws designated by the arrows on the rear of the unit. Then, by lifting the top side, hinge the cover, thus providing clearance for the connectors on the bottom side of the PCB as shown in the illustration below. Install in the reverse manner:


Remove the old battery" from the holder and replace with the new batrery. Replace the rear cover, cables, and re-apply power. Using Crimson or the unit's keypad, enter the correct time and dare.

* Please nore that the old banerve musi be disposed of in a manner thai complies with your local waste regularions. Also, the banery must not be disposed of in ine, or in a mamer whereby: it may be damaged and its contents come imo contaci with human shitr.

The bartery used bu ihe G306 is alithium nepe CRi02j.


OPTIONAL FEATURES ANB ACCESSORIES

## PTIONAL COMMUNICATION CARD

Led Lion offers optional communication cards for fieldbus communications. se communication cards will allow your G306 to communjcate with many he popular fieldbus protocols.
led Lion is also offering a communications card for additional RS232 and $122 / 485$ communications Visit Red Lion's website for information and ilability of these cards.

## USTOM LOGO

Each G3 operator interface has an embossed area containing the Red Liot o. Red Lion can provide custom logos to apply to this area. Conraci. your tributor for additional informatiors and pricing.


## COMPACTFLASH SOCKET

CompactFlash socket is a Type II socket that can accept eitheI Type 1 or II cards. Use cards with a minimum of 4 Mbytes with the G306's CompactFlash sockei. Cards are available at mosi computer and office supply retailers.

CompactFlash can be used for configuration cransfers, largei configurations data logging. and trending.

the CompactFlash card while
power is applied. Refer to
"From Panel LEDs."
Information stored on a CompactFlash card by a $G 306$ can be read by a card reader attached to a PC. This information is stored in IBM (Windows ${ }^{\text {® }}$ ) PC compatible FAT 16 file format.

## NOTE

For reliable operation in all of our products. Red Lion recommends the use of SanDisk ${ }^{81}$ and Simple Tech brands of CompactFlast cards.

Industrial grade versions that provide up to two million write/erase cycles minimum are available from Red Lion.

## LIMITED WARRANTY

The Company warrants the products it manufactures against defects in materials and workmanship for a period limited to two years from the date of shipment, provided the products have been stored, handied, installed, and used under proper conditions The Company's liability under this limited warranty shall extend only to the repair or replacement of a defective product at The Company s option. The Company disclaims all liability for any affirmation, promise or representation with respecr to the products The customer agrees to hold Red Lion Controls hamless from, defend, and indemnify RLC against damages, claims, and expenses arising out of subsequent sales of RLC products or products containing components manufactured by RLC and based upon personal injuries, deaths, properry damage. lost profits, and other mamers which Buyer, its employees. or sub-conracrors are o may be to any extent liabie, inciuding without limitation penalties imposed by the Consumer Product Safery Act (P.L. 92-573) and liability imposed upon any person pursuant to the Magnuson-Moss Warmanty Act (P.L. 93-637), as now in effect or as amended hereafier.

No warranties expressed or implied are creared with respect to The Company's products except those expressly connained herein The Customer acknowledges the disclaimers and limitations contained herein and relies on no other warranties or affinmations.
Red Lion Controls
go Willow Springs Circle
fork PA 17402
rel +1 (717) $767-6511$
-ax $+1(717) 764-0839$

Red Lion Controls BV
Basicweg 11b
NL - 3821 BR Amersfoort
Tel +31 (0) 334723225
Fax +31 (0) 334893793

Red Lion Controls AF
31, Kaki Bukit Road 3, \#06-04/05 TechLink Singapore 417818 Tel $+656744-6613$ Fax +65 6743-3360

## TC-900DR USER GUIDE


41 Aster Avenue Carrum Downs 3201 Australia Tel: 61397750505 Fax: 61397750606 www.trio.com.au

## GENERAL

The Trio DataCom TC-900DR is a full duplex 900 MHz Radio featuring a fully integrated $4800 / 9600 \mathrm{bps}$ data radio modem and antenna diplexer. Configuration of the unit is fully programmable, with parameters held in non volatile memory (NVRAM). All configuration parameters are accessible using the TC-DRPROG installation package, consisting of a programming lead, manual and sottware which will run on a PC under Windows 95/98/NT. It is essential that each unit is programmed to suit individual requirements prior to operation. For detailed information refer to the TC-900DR Handbook.

## DATA CONNECTION

The data connection is via a DB9 connector labeled 'Port A' (shown below), which is wired as a DCE.
¥r Serial "Port A" Pin Assignment. EXTERNAL VIEW OF `PORT A

NOTE: Pin 6 and pin 9 provide a dual function which depends on the mode that the TC-900DR is operating in.


## User Serial "Port B" Pin Assignment.

$t B$ can be used as a secondary data steam (:...Uependent of Port A) once configured by the programmer. Port $B$ also has one connection that may be of use for installation. This connection (Pin 9) is Receive Signal Strength Indicator (RSSI) output. $0-5 \mathrm{~V}$ where 1.5 V typically indicates -110 dBm and every 0.5 V increase indicates an improvement of $>10 \mathrm{dBm}$.
EXTERNAL VIEW OF`PORT B'


TE: Port B Pin 9 output has a high impedance of around 50 K OHMS and loading will decrease accuracy of the RSSI measurement.

## POWER CONNECTIONS

The power required is 13.8 VDC nominal, at $600 \mathrm{~mA}(T x)$ nominal. If the POWER LED indicator is not illuminated once power is applied, check the internal $\uparrow$ Amp fuse fitted within the unit.

POWER CONNECTOR TOP PIN BOTTOM PIN

## AUXILIARY CONNECTOR

PIN ASSIGNMENT
Ext. view
+VE SUPPLY (13.8vdc of socket

The auxiliary connector is primarily for use with the optional audio handset. The connections to this auxiliary 6 pin RJ11 connector are as follows:

| PIN NUMBER |  | FUNCTION <br> 1 |
| :--- | :--- | :--- |
|  | $8 V O L S$ |  |
| 2 | AUDIO OUT |  |
| 3 | GROUND socket view |  |

The optional audio handset is recommended as an aid in checking installations for radio path viability. This audio handset will only function when fitted prior to applying power to the unit.

The modem upon power up will check the presence of the handset and will inhibit data being transmitted so that voice communications can be established.
Once the path tests have been conducted the audio handsets MUST be REMOVED and the unit powered up with the handset removed before data communication can commence.

## USER INDICATIONS

The TC-900DR provides 4 LED's that show status information to the user - POWER, RXSIG, SYNC, and TXMIT indications.

The POWER is indicated by a green LED and simply signifies that power has been applied to the unit.
The RXSIG LED (yellow) indicates the level of RSSI signal from the radio IF strip, compared to a threshold level set in the configuration data programmed by the user. If the signal is above the threshold, then the LED indicator is turned on.
In all operation modes except "Programmer mode", the SYNC LED (yellow) indicates when the modem has detected a valid data stream. The SYNC LED is activated, when the modem detects a valid HDLC flag sequence, and remains active until an invalid sequence of seven or more consecutive "1" bits is detected.
The SYNC LED will not be tumed on if the RSSI signal strength (as indicated by the RXSIG LED) is below the minimum threshold. This prevents false SYNC detection from noise.

The TXMIT LED (red) indicator is connected directly to the modem's PTT output transistor. Whenever the radio is transmitting, this TXMIT LED indicator will be on.

## SPECIAL MODES OF OPERATION

Part of the power-up/reset initialisation phase of the TC-900DR are tests to determine if the modem should enter one of 3 "special operation" modes. In these modes the TC-900DR won't operate in its standard run mode

- Programmer mode
- Bit error rate test mode.
- Handset mode.

These modes are only entered if the required setup conditions are present at power up. An error mode of operation can also be entered into, if during normal operation, an error condition occurs

## PROGRAMMER MODE

CABLE - Pins 2, 3, 4, 5 straight through with Pin 6 on the DB9 connector of Port A: connected to pin 5 . When the modem is powered up with this fitted, the controller senses this and attempts to enter "Programmer mode" and the "SYNC" LED will flash approx. once per second. (Noie; the TC-DRPROG programming software and lead has the required connections). Failure to supply the correct password in time, will cause the modem to abandon the "Programmer mode" attempt, and go on with it's normal power-up procedure.

## BIT ERROR RATE TEST MODE

Pin 9 of the DB 9 connector of Port A , is normally the Ring Indicate output line. However, if this pin is driven positive (connecting it to pin 6 [DSR] and pin 7 [RTS]), then the modem's data transmitter and receiver will enter the BER test mode. This will activate the RF transmitter, and generate a scrambled bit pattern which should be decoded at a receiver as a constant logic " 1 " level in the unscrambled data. Any errors in the decoded bitstream, will be " 0 ", and the receiver portion of the modem in this mode, will activate the SYNC LED every time it sees a "0" bit.
Note: As the TC-900DR is full duplex this test can operate in both directions simultaneously.
Every error bit detected, will activate the SYNC LED. For error rates of 1 in $10^{3}$ and above, the SYNC LED will be ON most of the time. A 1 in $10^{4}$ error rate will show the SYNC LED active for approximately $10 \%$ of the time. This function provides a crude indication of Bit Error Rate for installation purposes. Note: Error count messages ( $\mathrm{ET}: \mathrm{XXXX}$ ) for every 10,000 bits are presented to Port A for the user. If pin 9 ceases to be driven positive, then the BER Test mode is terminated, and the modem restarts it's initialisation phase.

## HANDSET MODE

The modem tests for the presence of a handset plugged into the handset auxiliary port at power up. If a handset is plugged in, the modem will not generate a data stream. However, it will continue to indicate received RF signal strength. The handset has a PTT button, and this signal is connected across the modem's PTT output. Thus the handset PTT switch will not activate the TXMIT LED. It is essential to remove the handset from the unit and reapply power to the unit in order to return to normal operation.

## ERROR INDICATION MODES

There are 3 error conditions that cause the RXSIG \& SYNC LEDs to be used for error indications and not their normal purpose. Two are fatal conditions, that cause the modem to restart after the duration of the error indication phase.

## TRANSMIT POWER LOW

While the modem activates the radio transmiter, it periodically checks the transmit power. If the power measurement is less than a threshold set in the non-volatile memory, then the RXSIG and SYNC LEDs are made to alternate, approximately 4 times per second. The TXMIT LED will also be on during this process. This indication condition will persist for the duration of the transmission. As soon as the transmission is discontinued, the error indication will cease, and the two LEDS revert to their normal function. Factory set to 100 milliWatts

## NVRAM READ ERROR

The DFM4-9DR modem accesses the nor-volatile memory as part of it's initialisation phase, to read programming configuration data. If the communication protocol with, the device is violaied, or the non-volatile memory CRC checksum is found to $b \in$ incorrect, then the modem indicates this by flashing the RXSIG and SYNC LEDs iwice alternately. That is, one LED operates ON and OFF twice, then the other. $A$ total of five cycles of this occurs, then the modem restarts initialisation.

## SYNTHESISER LOCK DETECT ERROR

If at any time during normal operation, BER mode, or handset mode, the TBB206 frequency synthesiser indicates an out of lock condition, the modem enters an error indication mode for a short time before restarting.
One LED is turned ON ( 0 ), the LEDs are swapped, then both tumed OFF ( $\bullet$ ). Then the latter LED ON again, swap LEDS, and then OFF. This will give the appearance of a sweeping motion between the LEDs. The following table shows all error condition displays.

| Tx PWR Ert |  | NVRAM Et |  | SYNTH Err |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
| RXSIG | SYNC | RXSIG | SYNC | RXSIG | SYNC |
| 0 | - | 0 | - | 0 | - |
| - | 0 | - | - | - | 0 |
| 0 | - | 0 | - | - | - |
| - | 0 | - | - | - | 0 |
| 0 | - | - | 0 | 0 | - |
| - | 0 | - | - | - | $\bullet$ |
| 0 | - | $\bullet$ | 0 |  | repeat |
| - | 0 | - | - |  |  |
| continue |  |  | repeat |  |  |

## MOUNTING AND ANTENNA CONNECTION

The TC-900DR should be mounted in a cool, dry, vibration free environment, whilst providing easy access to screws and connections. There are 4 mounting holes on the unit. The antenna should be an external yagi antenna but can be a ground independent dipole mounted via a feeder to the antenna connector (SMA type) for short range applications. However the whole radio modem should be clear of the associated data equipment to prevent mutual interference.

## ASSEMBLY OF POWER LEAD

A small plastic bag containing a molex connector (M5557-2R) and two pins (M5556-TL) is provided in the packing box.

The pins are designed to take 18-24 (AWG) wire size with insulation range $1.3 \cdot 3.10 \mathrm{~mm}$.

Please take care when crimping the pins.
09/03

Operating Instructions
Waterpilot FMX167
Level probe


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## 1. Safety instructions

### 1.1 Designated use

The Waterpilot FMX167 is a hydrostatic pressure sensor for measuring the level of fresh water, wastewater and seawater. Versions with a Pt 100 resistance thermometer can detect temperature at the same time. The optional temperature transmitter converts the Pt 100 signal into a $4 \ldots 20 \mathrm{~mA}$ signal.
The manufacturer shall not accept any liability for damage arising from improper use or if the device is used for purposes for which it was not intended.

### 1.2 Installation, commissioning and operation

The Waterpilot FMX167 and the temperature transmitter TMT181 (optional) are designed as failsafe to the state of the art and comply with prevailing regulations and EC directives. If the devices are not used properly or for purposes for which they were not intended, they may become hazards arising from the particular application, e.g. product overflow through incorrect installation or adjustment. For these reasons, only trained personnel authorised by the plant operator may install, connect electrically, commission, operate and maintain the measuring system. Trained personnel must have read and understood these Operating Instructions and heed the instructions. Any changes and repairs to the devices may only be performed if the Operating Instructions expressly permit this.

### 1.3 Operational safety

### 1.3.1 Explosion hazardous area (optional)

Devices for use in hazardous areas are additionally identified on the nameplate ( $\rightarrow$ see Page 6). If the device is to be installed in an explosion hazardous area, then the specifications in the certificate as well as all national and local regulations must be observed. A separate Ex documentation is enclosed with the device and is an integral part of this documentation. The installation regulations, connection values and Safety Instructions listed in this document must be observed. The documentation number of the related Safety Instructions (XAs) is also indicated on the nameplate.

- Ensure that all personnel are suitably qualified.

| Versions in the order code <br> (e.g. FMX167-D ...) | Certificate | Protection |
| :--- | :--- | :--- |
| B | ATEX | ATEX II 2 G EEx ia IIC T6 |
| C | ATEX | ATEX II 3 G EEx nA II T6 |
| D | FM | IS, Class I, Division 1, Groups A-D |
| E | CSA | IS, Class I, Division 1, Groups A-D |

### 1.4 Notes on safety conventions and icons

In order to highlight safety-relevant or alternative operating procedures in the manual, the following conventions have been used, each indicated by a corresponding icon in the margin.

| Symbol | Meaning |
| :--- | :--- |
|  | Warning! <br> A warning highlights actions or procedures which, if not performed correctly, will lead to <br> personal injury, a safety hazard or destruction of the instrument. |
|  | Caution! <br> Caution highlights actions or procedures which, if not performed correctly, may lead to <br> personal injury or incorrect functioning of the instrument. |
|  | Note! <br> A note highlights actions or procedures which, if not performed correctiy, may indirectly <br> affect operation or may lead to an instrument response which is not planned. |


| Ex | Device certified for use in explosion hazardous area <br> If the device has this symbol embossed on its nameplate, it can be installed in an explosion <br> hazardous area or a non-explosion hazardous area, according to the approval. |
| :--- | :--- |
|  | Explosion hazardous area <br> Symbol used in drawings to indicate explosion hazardous areas. <br> - Devices used in hazardous areas must possess an appropriate type of protection. |
|  | Safe area (non-explosion hazardous area) <br> Symbol used in drawings to indicate, if necessary, non-explosion hazardous areas. <br> - Devices used in hazardous areas must possess an appropriate type of protection. Lines <br> used in hazardous areas must meet the necessary safety-related characteristic quantities. |


|  | Direct voltage <br> A terminal to which or from which a direct current or voltage may be applied or supplied. |
| :--- | :--- |
| $\sim$ | Alternating voltage <br> A terminal to which or from which an alternating (sine-wave) current or voltage may be <br> applied or supplied. |
| - | Grounded terminal <br> A grounded terminal, which as far as the operator is concerned, is already grounded by <br> means of an earth grounding system. |
| $\square$ | Protective grounding (earth) terminal <br> A terminal which must be connected to earth ground prior to making any other connection <br> to the equipment. |
| $\square$ | Equipotential connection (earth bonding) <br> A connection made to the plant grounding system which may be of type e.g. neutral star or <br> equipotential line according to national or company practice. |

## 2 Identification

### 2.1 Device designation

- Waterpilot FMX167 for hydrostatic level measurement, refer to Section 2.1.1.
- Waterpilot FMX167 with optional Pt 100 resistance thermometer for simultaneous level and temperature measurement, refer to Section 2.1.1.
- Waterpilot FMX1 67 with optional Pt 100 resistance thermometer and optional temperature transmitter TMT181, refer to Sections 2.1.1 and 2.1.2.


### 2.1.1 Nameplate Waterpilot FMX167

The nameplate is fitted to the FMX167 extension cable.


Fig. I: Nameplate for Waterpilot FMX107
1 Order code
See the specifications on the order confirmation for the meaning of the individual letters and digits.
2 Serial number
3 Length of extension cable
4 Nominal measuring range
5 Current output
0 Supply voltage
7 TAG
8 Wetted materials
9 Ex symbol (optional)
10 CSA symbol (optional)
11 FM symbol (optional)
12 Pay attention to the installation instructions in the Operating Instructions!
13 ID number of notified body with regard to ATEX (optional)
14 Text for approval (optional)
15 Approval symbol (optional)
10 Test date (optional)
17 Symbol: Observe Safety Instructions, indicating the documentation number, e.g. XA13IP-C (optional)
18 Wiring diagram FMXIO7
19 Wiring diagram Pt 100 if Waterpilot was ordered with Pt 100.

The following information is also provided on the FMX167 with outer diameter $=22 \mathrm{~mm}(0.87 \mathrm{in})$ and 42 mm ( 1.66 in ):


Fig. 2: FMXI67 labeling
1 Serial number
2 Nominal measuring range
3 CE symbol or approval symbol
4 ID number of notified body with regard to ATEX (optional)
5 Text for approval (optional)

### 2.1.2 Nameplate of temperature transmitter TMT181



Fig. 3: Nameplate of temperature transmitter TMT181
1 Order code of temperature transmitter TMTI81-A41DA
A: Version for non-hazardous area
4: 4-wire
1: Sensor Pt 100
D: Temperature transmitter with settings for $-20 \ldots+80^{\circ} \mathrm{C}\left(-4 \ldots+174^{\circ} \mathrm{F}\right)$ range
A: Label: Standard version
2 Serial No.
3 Current output: $4 \ldots 20 \mathrm{~mA}$
4 Supply voltage: 8... 35 VDC

### 2.2 Scope of supply

The scope of delivery comprises:

- Waterpilot FMX167, optionally with integrated Pt 100 resistance thermometer
- Optional accessories ( $\rightarrow$ see also Chapter 7)

Documentation supplied:

- Operating Instructions BA231P (this document)
- Final inspection report
- Drinking water approval SD126P (optional)
- Devices which are suitable for use in hazardous areas: additional documentation such as Safety Instructions (XAs), Control or Installation Drawings (ZDs)


### 2.3 CE mark, declaration of conformity

The device is designed to meet state-of-the-art safety requirements, has been tested and left the factory in a condition in which it is safe to operate. The device complies with the applicable standards and regulations as listed in the EC declaration of conformity and thus complies with the statutory requirements of the EC Directives. Endress+Hauser confirms the successful testing of the device by affixing to it the CE mark.

## 3 Installation

### 3.1 Incoming acceptance and storage

### 3.1.1 Incoming acceptance

- Check the packaging and the contents for damage.
- Check the shipment, make sure nothing is missing and that the scope of supply matches your order.


### 3.1.2 Storage

The device must be stored in a dry, clean area and protected against damage from impact (EN 837-2).

Storage temperature range:

- FMX167: $-40 \ldots+80^{\circ} \mathrm{C}\left(-40 \ldots+176^{\circ} \mathrm{F}\right)$
- TMT181: $-40 \ldots+100^{\circ} \mathrm{C}\left(-40 \ldots+212^{\circ} \mathrm{F}\right)$


### 3.2 Installation conditions



Fig. 4: Installation examples
For accessories see Page 18, Chapter 7.
1 Extension cable mounting screw can be ordered via order code or as an accessory
2 Terminal housing can be ordered via order code or as an accessory
3 Extension cable bending radius > 120 mm (4.72 in)
4 Mounting clamp can be ordered via order code or as an accessory
5 Extension cable up to 300 m (384 ft)
0 Guide tube
7 Additional weight can be ordered as an accessory
8 Protection cap

Note!

- A sideways movement of the level probe can lead to measuring errors. Therefore install the probe at a point free from flow and turbulence, or use a guide tube. The internal diameter of the guide tube should be at least $1 \mathrm{~mm}(0.04 \mathrm{in})$ bigger than the outer diameter of the selected FMX167.
- The cable must end in a dry room or in a proper terminal box. The terminal box from Endress+Hauser provides optimum humidity and climatic protection and is suitable for outdoor installation.
- Protective cap: to avoid mechanical damage to the measuring cell, the device is provided with a protective cap.
You can order protective caps ( 5 pieces per set) as spare part directly from your Endress+Hauser. Sérvice Óōganisation using Örder No.: 52008999.


### 3.2.1 Dimensions

$\rightarrow$ For dimensions, please refer to the Technical Information for Waterpilot TI351P, "Mechanical construction" section ( $\rightarrow$ see also: www.endress.com $\rightarrow$ Download).

### 3.3 Installation instructions

### 3.3.1 Installing Waterpilot with a mounting clamp



Fig. S: Installing Waterpilot FMX 107 with a mounting clamp
I Extension cable
2 Mounting clamp
3 Clamping jaws

## How to mount the mounting clamp:

1. Mount the mounting clamp (Pos. 2). When selecting the type of fixing, note the weight of the extension cable (Pos. 1) and the device.
2. Raise clamping jaws (Pos. 3). Place extension cable (Pos. 1) acc. to Figure 5 between clamping jaws.
3. Hold extension cable (Pos. 1) tight and push clamping jaws (Pos. 3) back down. Fix clamping jaws by tapping lightly.

### 3.3.2 Installing Waterpilot with cable mounting screw



Fig. 6: Installing the Waterpilot FMX107 with cable mounting screw, here depicted with G I 1/2 thread
Extension cable
Mounting screw cap nut
Sealing ring
Clamping sleeve
Mounting screw adapter
Top edge of clamping sleeve
required length of extension cable and FMXI 167 probe before assembly
after assembly Pos. 7 is located next to the mounting screw with
G 1 1/2 thread: sealing surface of mounting screw adapter
$1 / 12$ NPT thread run-out of mounting screw adapter

Note!
If you want to lower the level probe to a certain depth, place the top edge of the clamping sleeve 4 cm ( 1.57 in) higher than the required depth. Then push the extension cable and the clamping sleeve into the adapter as described in the following Section, Step 6.

How to mount the cable mounting screw with G $11 / 2$ or NPT thread:

1. Mark required length of extension cable, refer to "Note" on this Page.
2. Insert probe through measuring opening and carefully lower on extension cable. Fix extension cable to prevent it from slipping.
3. Push adapter (Pos. 5) over extension cable and screw tightly in measuring opening.
4. Push sealing ring (Pos. 3) and cap (Pos. 2) from top onto cable. Press sealing ring into cap.
5. Place clamping sleeve (Pos. 4) around extension cable (Pos. 1) acc. to Figure 0.
6. Push extension cable and clamping sleeve (Pos. 4) into adapter (Pos. 5).
7. Push cap (Pos. 2) and sealing ring (Pos. 3) onto adapter (Pos. 5) and screw tightly to adapter.

Note!
Remove the cable mounting screw in the opposite sequence of operation to installation.

### 3.3.3 Mounting the terminal box

Mount the optional terminal box with four screws (M 4). $\rightarrow$ For dimensions of the terminal box, please refer to the Technical Information for Waterpilot TI351P, "Mechanical construction" section $(\rightarrow$ see also: www.endress.com $\rightarrow$ Download).

### 3.3.4 Mounting the temperature transmitter TMT181



Fig. 7: $\quad$ Mounting the temperature transmitter, depicted here with terminal box Only open terminal box with a screwdriver.

1 Mounting screws
2 Mounting springs
3 Temperature transmitter TMT181
4 Circlips
5 Terminal box

## How to mount the temperature transmitter:

1. Insert the mounting screws (Pos. 1) with the mounting springs (Pos. 2) through the boring of the temperature transmitter (Pos. 3).
2. Fix the mounting screws with the circlips (Pos. 4).

The circlips, mounting screws and springs are contained in the scope of supply of the temperature transmitter.
3. Screw the temperature transmitter tightly in the field housing. (thread tapper max. 6 mm (0.23 in))


Warning!
To prevent damage to the temperature transmitter, do not tighten the mounting screw too tightly.

### 3.4 Checking the installation

Check that all screws are seated firmly.

## 4 Wiring

### 4.1 Connecting the device

Note!
When using the measuring device in hazardous areas, installation must comply with the corresponding national standards and regulations and the Safety Instructions (XAs) or Installation or Control Drawings (ZDs).

- The supply voltage must match the supply voltage on the nameplate. ( $\rightarrow$ See also Page 6 ff , Sections 2.1.1 and 2.1.2.)
- Switch off supply voltage before you connect the device.
- The cable mustend in a dry room or in a proper terminal box. The terminal box with GORE-TEX ${ }^{\circledR}$ filter, IP $66 /$ IP 67 from Endress + Hauser is suitable for outdoor installation.
- Connect device acc. to the following figures. A polarity protection is integrated in the Waterpilot FMX167 and the temperature transmitter TMT181. Changing the polarities will not destroy the devices.


## Waterpilot FMX167, Standard



Fig. 8: FMX107 electrical connection, versions "7" or "3" for Feature 70 "Additional options" in the order code.

I Not for $\mathrm{FMX1} 167$ with outer diameter $=29 \mathrm{~mm}$ (1.15 in)

Waterpilot FMX167 with Pt 100


Fig. 9:
FMX107 electrical connection with Pt 100, versions " $/$ " or " 4 " for Feature 70 "Additional options" in the order code.

I Not for FMX167 with outer diameter $=29 \mathrm{~mm}$ (1.15 in)

Wire colors: $\mathrm{RD}=$ red, $\mathrm{BK}=$ black, $\mathrm{WH}=$ white, $\mathrm{YE}=$ yellow, $\mathrm{BU}=$ blue, $\mathrm{BR}=$ brown

Waterpilot FMX167 with Pt 100 and temperature transmitter TMT181 ( $4 . . .20 \mathrm{~mA}$ )


Fig. 10: FMXI 67 with Pt 100 and TMTI81 temperature transmitter ( $4 \ldots 20 \mathrm{~mA}$ ), version "5" for Feature 70 in the order code
1 Not for $F M X 107$ with outer diameter $=29 \mathrm{~mm}(1.15 \mathrm{in})$
Wire colours: $\mathrm{RD}=$ red, $\mathrm{BK}=$ black, $\mathrm{WH}=$ white, $\mathrm{YE}=$ yellow, $\mathrm{BU}=$ blue, $\mathrm{BR}=$ brown

### 4.1.1 Supply voltage

| Certificate | Supply voltage |  |  |
| :---: | :---: | :---: | :---: |
|  | FMX167 | FMX167 + Pt 100 | Temperature transmitter TMT181 |
| Standard | $10 . .30 \mathrm{~V}$ DC | 10... 30 V DC | 8... 35 V DC |

### 4.1.2 Cable specification

- FMX167 with optional Pt 100
- Commercially available installation cable
- Terminals in terminal box FMX 167: 0.08... $2.5 \mathrm{~mm}^{2}$
- Temperature transmitter TMT181 (optional)
- Commercially available installation cable
- Terminals in terminal box FMX 167: $0.08 \ldots 2.5 \mathrm{~mm}^{2}$
- Transmitter terminals: max. $1.75 \mathrm{~mm}^{2}$


## Note!

For versions with outer diameter $=22 \mathrm{~mm}$ ( 0.87 in ) and $42 \mathrm{~mm}(1.66 \mathrm{in})$ the extension cables are shielded. In the following cases Endress+Hauser recommends use of a shielded cable for the cable extension:

- for large distances between extension cable end and display and/or evaluation unit,
- for large distances between extension cable end and temperature transmitter
- for directly connecting Pt 100 signals to the display and/or evaluation unit.


### 4.1.3 Power consumption/current drain

|  | FMX167 | FMX167+Pt 100 | Temperature transmitter <br> TMT181 |
| :--- | :--- | :--- | :--- |
| Power consumption | $\leq 0.675 \mathrm{~W}$ at 30 V DC | $\leq 0.675 \mathrm{~W}$ at 30 V DC | $\leq 0.875 \mathrm{~W}$ at 35 V DC |
| Current drain | max. $\leq 22.5 \mathrm{~mA}$ |  |  |
| $\min . \geq 3.5 \mathrm{~mA}$ | $\max . \leq 22.5 \mathrm{~mA}$ <br> $\min . \geq 3.5 \mathrm{~mA}$ <br> Pt $100: \leq 0.6 \mathrm{~mA}$ | $\max . \leq 25 \mathrm{~mA}$ |  |
| $\min . \geq 3.5 \mathrm{~mA}$ |  |  |  |

### 4.1.4 Load

The maximum load resistance is dependent on the supply voltage $\left(\mathrm{U}_{\mathrm{b}}\right)$ and must be determined for every current loop separately. Refer to the equations and diagrams for "FMX 167" and "Temperature transmitter".
The total resistance resulting from the resistances of the connected devices, the connecting cable and if necessary, the resistor of the extension cable may not exceed the load resistance.

## FMX167

$$
\mathrm{R}_{\mathrm{tot}} \leq \frac{U_{\mathrm{b}}-10 \mathrm{~V}}{0.0225 \mathrm{~A}}-2 \cdot 0.09 \frac{\Omega}{\mathrm{~m}} \cdot 1-\mathrm{R}_{\mathrm{add}}
$$

Р01-FAX107xx-16-xI-xx-xx-000

Temperature transmitter

$$
\mathrm{R}_{\mathrm{tot}} \leq \frac{\mathrm{U}_{\mathrm{b}}-8 \mathrm{~V}}{0.025 \mathrm{~A}}-\mathrm{R}_{\mathrm{add}}
$$


$R_{\text {tot }}=$ Max. load resistance $\Omega /$
$R_{\text {add }}=$ additional resistances, e.g. resistance of evaluating device and/or the display instrument, line resistance $\Omega \Omega /$
$U_{b}=$ Supply voltage (V)
$1=$ Simple length of extension cable (m) (cable resistance per wire $\leq 0,00 \Omega / \mathrm{m}$ )


Fig. 11: Load chart FMXI67 for estimating load resistance. Subtract the additional resistances, e.g. resistance of extension cable, from the calculated value as shown in the equation.


Fig. 12: Load chart temperature transmitter for estimating load resistance. Subtract the additional resistances from the calculated value as shown in the equation.

### 4.2 Wiring up the measuring unit

### 4.2.1 Overvoltage protection

Note!

- In order to protect the Waterpilot FMX167 and the temperature transmitter TMT181 from large transients, Endress+Hauser recommends the installation of an overvoltage protector upstream and downstream of the display and/or evaluation device as shown in the figure.
- The Waterpilot FMX 167 has an integrated overvoltage protection to EN 61000 of $\leq 1.2 \mathrm{kV}$ as standard.


Fig. 13: Wiring up the measuring unit
1 Power supply, display and evaluation unit with one input for Pt 100
2 Power supply, display and evaluation unit with one input for $4 \ldots 20 \mathrm{~mA}$
3 Power supply, display and evaluation unit with two inputs for 4... 20 mA
OP Ovenvoltage protection e.g. HAW from Endress+Hauser

### 4.3 Checking the wiring

Perform the following checks after completing electrical installation of the device:

- Does the supply voltage match the specifications on the nameplate?
- Is the device connected as per Section 4.1?
- Are all screws firmly tightened?
- Optional terminal box: are the cable glands tight?


## 5 Operation

Note!
Endress+Hauser offers extensive measuring point solutions with display and/or evaluation units for the Waterpilot FMX167 and the temperature transmitter TMT181. For more information, please contact your nearest Endress+Hauser Service Organisation. For contact addresses, please go to www.endress.com/worldwide.

## 6 Maintenance

No special maintenance work is required for the Waterpilot FMX167 or for the optional temperature transmitter TMT181.

### 6.1 Exterior cleaning

Please note the following points when cleaning the exterior of the device:

- Do not use a cleaning agent that is aggressive to the housing surface or the seal.
- Waterpilot FMX167: avoid any mechanical damage to the membrane or the extension cable.


## 7 Accessories

There are a number of accessories available for the Waterpilot FMX167. You can order them separately from Endress+Hauser.

## Mounting clamp

- Endress+Hauser offers a mounting clamp for simple FMX167 mounting. $\rightarrow$ See also Page 10, Section 3.3.1.
- Material: 1.4435 (AISI 316L) and glass fiber reinforced PA (polyamide)
- Order number: 52006151


## Terminal box

- Terminal box IP $66 /$ IP 67 with GORE-TEX ${ }^{\circledR}$ filter incl. 3 mounted terminals. The terminal box is also suitable for installing a temperature transmitter (Order No. 52008794) or for four additional terminals (Order No. 52008938). $\rightarrow$ See also Page 12, Section 3.3.4.
- Order number: 52006152

Additional weight for FMX 167 with $\mathrm{d}_{\mathrm{O}}=22 \mathrm{~mm}(0.87 \mathrm{in})$ and $\mathrm{d}_{\mathrm{O}}=29 \mathrm{~mm}(1.15 \mathrm{in})$


- To prevent sideways movement leading to measuring errors or to ensure that the device lowers into a guide tube, Endress + Hauser provides additional weights.
You can screw several weights together. The weights are then attached directly to the FMX167. For FMX1 67 with outer diameter $=29 \mathrm{~mm}(1.15 \mathrm{in})$, a maximum of 5 weights may be screwed on to FMX167.
- Material: 1.4435 (AISI 316L)
- Weight: 300 g
- Order number: 52006153


## Temperature transmitter TMT181 ( $4 \ldots 20 \mathrm{~mA}$ )

- Temperature transmitter, 2 -wire, preset for measuring range from $-20 \ldots+80^{\circ} \mathrm{C}\left(-4 \ldots+176^{\circ} \mathrm{F}\right)$. This setting offers an easily displayable temperature range of 100 K . Note that the Pt 100 resistance thermometer is designed for a temperature range of $-10 \ldots+70^{\circ} \mathrm{C}\left(+14 \ldots+158^{\circ} \mathrm{F}\right)$. $\rightarrow$ See also Page 12, Section 3.3.4.
- Order number: 52008794


## Cabel mounting screw

- Endress+Hauser offers extension cable mounting screws to simplify the installation of the

FMX167 and to close the measuring open. $\rightarrow$ See also Page 11, Section 3.3.2.

- Material: 1.4301 (AISI 304)
- Order number for extension cable mounting screw with G $11 / 2$ A thread: 52008264
- Order number for extension cable mounting screw with 1 1/2 NPT thread: 52009311


## Terminals

- Four terminals in strip for FMX167 terminal box, suitable for wire cross-section of $0.08 \ldots . .2 .5 \mathrm{~mm}^{2}$
- Order number: 52008939


## Test adapter for FMX 167 with $d_{0}=22 \mathrm{~mm}(0.87 \mathrm{in})$ and $d_{0}=29 \mathrm{~mm}(1.15 \mathrm{in})$



Abb. 14: Test adapter
A Connection suitable for level probe FMX167
B Connection compressed air hose, internal diameter, quick hose gland $4 \mathrm{~mm}(0.157$ in)

- Endress+Hauser offers a test adapter to simplify the function test of level probes.
- Note the maximum pressure for the compressed air hose and the maximum level probe overload. $(\rightarrow$ For the maximum level probe overload refer to Technical Information for Waterpilot TI351P or Internet: www.endress.com $\rightarrow$ Download)
- The maximum pressure for the supplied quick hose gland is 10 bar ( 145 psi ).
- Adapter material: 1.4301 (AISI 304)
- Quick hose gland material: Anodized aluminum
- Adapter weight: 39 g
- Order number: 52011868


## 8 Trouble-shooting

### 8.1 Faults on Waterpilot FMX167 and Waterpilot FMX167 with optional Pt 100

| Error description | Cause | Action |
| :---: | :---: | :---: |
| No measuring signal | Connection of $4 \ldots 20 \mathrm{~mA}$ line incorrect | Connect device acc. to Section 4.1, Page 13. |
|  | No supply voltage over 4... 20 mA line | Check current loop. |
|  | Supply voltage too low (min. 10 V DC ) | - Check supply voltage. <br> - Total resistance grater than max. load resistance, refer to Section 4.1, Page 15. |
|  | Waterpilot defective | Replace Waterpilot. |
| Temperature measuring value inaccurate/incorrect (only with Waterpilot FMX167 with Pt 100) | Pt 100 connected to 2-wire circuit, line resistance not compensated | - Compensate line resistance. <br> - Connect Pt 100 as 3 -wire or 4-wire circuit. |

### 8.2 Faults of temperature transmitter TMT181

| Error description | Cause | Action |
| :---: | :---: | :---: |
| No measuring signal | Connection of $4 \ldots 20 \mathrm{~mA}$ line incorrect | Connect device acc. to Section 4.1, Page 13. |
|  | No supply voltage over 4... 20 mA line | Check current loop. |
|  | Supply voltage too low (min. 8 V DC ) | - Check supply voltage. <br> - Total resistance grater than max. load resistance, refer to Section 4.1, Page 13. |
| Error current $\leq 3,6 \mathrm{~mA}$ or $\geq 21 \mathrm{~mA}$ | Connection of Pt 100 incorrect | Connect device acc. to Section 4.1, Page 13. |
|  | Connection of $4 \ldots 20 \mathrm{~mA}$ line incorrect | Connect device acc. to Section 4.1, Page 13. |
|  | Pt 100 resistance thermometer defective | Replace Waterpilot FMX167. |
|  | Temperature transmitter defective | Replace temperature transmitter. |
| Measuring value inaccurate/incorrect | Pt 100 connected in 2-wire circuit, line resistance not compensated | - Compensate line resistance. <br> - Connect Pt 100 as 3 -wire or 4 -wire circuit. |

### 8.3 Spare Parts

Note!
You can order spare parts directly from your nearest Endress+Hauser Service Organisation.
Membrane protective cap

- 5 pieces in set
- Order No.: 52008999

Pressure compensation set

- 10 pieces in set, comprising Teflon filter and sleeve for extension cable
- Order No.: 52005578


## 9 Technical Data

For technical data, please refer to the Technical Information for Waterpilot TI351P $(\rightarrow$ see also: www.endress.com $\rightarrow$ Download).

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## Declaration of Contamination

Erklärung zur Kontamination

## Endress+Hauser <br> [3+1]

People for Process Automation

Because of legal regulations and for the safety of our employees and operating equipment, we need the "declaration of contamination", with your signature, before your order can be handled. Please make absolutely sure to include it with the shipping documents, or - even better - attach it to the outside of the packaging.
Aufgrund der gesetzlichen Vorschniften und zum Schutz unserer Mitarbeiter und Betriebseinrichtungen, benötigen wir die unterschriebene "Erklärung zur Kontamination", bevor Ihr Auftrag bearbeitet werden kann. Legen Sie diese unbedingt den Versandpapieren bei oder bringen Sie sie idealerweise außen an der Verpackung an.

Type of instrument / sensor
Geräte-/Sensortyp

## Serial number

Seriennummer $\qquad$

Process data/Prozessdaten $1^{\circ} \mathrm{C} \mid$ Pressure / Druck | Pa | Conductivity / Leitfähigkeit__ $|\mathrm{S}|$ Viscosity / Viskosität___ $\left\{\mathrm{mm}^{2} / \mathrm{s}\right\}$

Medium and warnings
Warnhinweise zum Medium

|  |  |  | csas | $420$ | 1 |  | A:M |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Medjum / concentration Medium /Konzentration | Identification CAS No. | flammable entzündlich | toxic giftig | comosive ätzend | harmful/ irritant gesundheitsschädlich/ reizend | other * sonstiges* | harmless unbedenklich |
| Process medium |  |  |  |  |  |  |  |  |
| Medium im Prozess |  |  |  |  |  |  |  |  |
| Medium for process cleaning |  |  |  |  |  |  |  |  |
| Medium zur Prozessreinigung |  |  |  |  |  |  |  |  |
| Returned part cleaned with |  |  |  |  |  |  |  |  |
| Medium zur Endreinigung |  |  |  |  |  |  |  |  |

* explosive; oxidising; dangerous for the environment; biological risk; radioactive
* explosiv; brandfördernd; umweltgefährlich; biogefährlich; radioaktiv

Please tick should one of the above be applicable, include security sheet and, if necessary, special handling instructions.
Zutreffendes ankreuzen; triff einer der Warnhinweise zu, Sicherheitsdatenblatt und ggf. spezielle Handhabungsvorschriften beilegen.

Reason for return / Grund zur Rücksendung $\qquad$

Company data / Angaben zum Absender

| Company / Firma | Contact person / Ansprechpartner |
| :---: | :---: |
|  | Department / Abteilung |
| Address / Adresse | Phone number/ Telefon |
|  | Fax / E-Mail |
|  | Your order No. / Ihre Auftragsnr. |

We hereby certify that the returned parts have been carefully cleaned. To the best of our knowledge they are free from any residues in dangerous quantities.
Hiermit bestätigen wir, dass die zurückgesandten Teile sorgfätigg gereinigt wurden, und nach unserem Wissen frei von Rückständen in gefahrbringender Menge sind.

People for Process Automation


## Operating Instructions <br> VEGABAR 74 <br> 4 ... 20 mA/HART



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## Supplementary documentation

## Information:

1 Depending on the ordered version, supplementary documentation belongs to the scope of delivery. You find this documentation in chapter "Product description".

## Instructions manuals for accessories and replacement parts

## - Tip:

1 To ensure reliable setup and operation of your VEGABAR 74 we offer accessories and replacement parts. The associated documents are:

- Supplementary instructions manual 32036 "Welded socket and seals"
- Operating instructions manual 32798 "Breather housing VEGABOX 02"
- Operating instructions manual 20591 "External indicating and adjustment unit VEGADIS 12"


## 1 About this document

### 1.1 Function

This operating instructions manual provides all the information you need for mounting, connection and setup as well as important instructions for maintenance and fault rectification. Please read this information before putting the instrument into operation and keep this manual accessible in the immediate vicinity of the device.

### 1.2 Target group

This operating instructions manual is directed to trained personnel. The contents of this manual should be made available to these personnel and put into practice by them.

### 1.3 Symbolism used



Information, tip, note
1 This symbol indicates helpful additional information.
Caution: If this warning is ignored, faults or malfunctions can result.
Warning: If this warning is ignored, injury to persons and/or serious damage to the instrument can result.
Danger: If this warning is ignored, serious injury to persons and/or destruction of the instrument can result.

## Ex applications

This symbol indicates special instructions for Ex applications.

- List

The dot set in front indicates a list with no implied sequence.
$\rightarrow \quad$ Action
This arrow indicates a single action.
1 Sequence
Numbers set in front indicate successive steps in a procedure.

## 2 For your safety

## 2．1 Authorised personnel

All operations described in this operating instructions manual must be carried out only by trained specialist personnel authorised by the operator．

During work on and with the device the required personal protection equipment must always be worn．

## 2．2 Appropriate use

VEGABAR 74 is a pressure transmitter for measurement of gauge pressure，absolute pressure and vacuum．

You can find detailed information on the application range in chapter＂Product description＂．

Operational reliability is ensured only if the instrument is properly used according to the specifications in the operating instructions manual as well as possible supplementary instructions．
Due to safety and warranty reasons，any invasive work on the device beyond that described in the operating instructions manual may be carried out only by personnel authorised by the manufacturer．Arbitrary conversions or modifications are explicitly forbidden．

## 2．3 Warning about misuse

Inappropriate or incorrect use of the instrument can give rise to application－specific hazards，e．g．vessel overill or damage to system components through incorrect mounting or adjustment．

## 2．4 General safety instructions

This is a high－tech instrument requiring the strict observance of standard regulations and guidelines．The user must take note of the safety instructions in this operating instructions manual， the country－specific installation standards as well as all prevailing safety regulations and accident prevention rules．
The instrument must only be operated in a technically flawless and reliable condition．The operator is responsible for trouble－ free operation of the instrument．


During the entire duration of use, the user is obliged to determine the compliance of the required occupational safety measures with the current valid rules and regulations and also take note of new regulations.

### 2.5 Safety approval markings and safety tips

The safety approval markings and safety tips on the device must be observed.

### 2.6 CE conformity

VEGABAR 74 is in CE conformity with EMC (89/336/EWG), fulfils NAMUR recommendation NE 21 and is in CE conformity with LVD (73/23/EWG)

Conformity has been judged according to the following standards:

- EMC:
- Emission EN 61326: 2004 (class B)
- Susceptibility EN 61326: 2004 including supplement A
- LVD: EN 61010-1: 2001

VEGABAR 74 is not subject to the pressure device guideline. ${ }^{\text {t }}$

### 2.7 Fulfilling NAMUR recommendations

VEGABAR 74 fulfills the following NAMUR recommendations:

- NE 21 (interference resistane and emitted interference)
- NE 43 (signal level for failure information)
- NE 53 (compatibility sensor and indicating/adjustment components)
VEGA instruments are generally upward and downward compatible:
- Sensor software to DTM VEGABAR 74 HART
- DTM VEGABAR 74 for adjustment software PACTware ${ }^{\text {TM }}$

The parameter adjustment of the basic sensor functions is independent of the software version. The range of available functions depends on the respective software version of the individual components.
The software version of VEGABAR 74 HART can be read out $\AA$ via PACTware ${ }^{\text {TM }}$.

1) Due to the flush diaphragm, no own pressure compartment is formed

You can view all software histories on our website www.vega. com. Make use of this advantage and get registered for update information via e-mail.

### 2.8 Safety instructions for Ex areas

Please note the Ex-specific safety information for installation and operation in Ex areas. These safety instructions are part of the operating instructions manual and come with the Exapproved instruments.

### 2.9 Environmental instructions

Protection of the environment is one of our most important duties. That is why we have introduced an environment management system with the goal of continuously improving company environmental protection. The environment management system is certified according to DIN EN ISO 14001.
Please help us fulfil this obligation by observing the environmental instructions in this manual:

- Chapter "Packaging, transport and storage"
- Chapter "Disposal"


## 3 Product description

### 3.1 Configuration

Scope of delivery

## Components

The scope of delivery encompasses:

- VEGABAR 74 pressure transmitter
- Documentation
- this operating instructions manual
- Test certificate for pressure transmitters
- Ex-specific "Safety instructions" (with Ex-versions)
- if necessary, further certificates

VEGABAR 74 consists of the following components:

- Process fitting with measuring cell
- Housing with electronics
- Connection cable (direct cable outiet)

The components are available in different versions.


Fig. 1: Example of a VEGABAA 74 with process fitting G11/2 A
1 Connection cable
2 Housing with glectronics
3 Process fitting with measuring celf


### 3.2 Principle of operation

## Area of application

## Functional principle

Supply

VEGABAR 74 is a pressure transmitter for use in the paper, food processing and pharmaceutical industry. Thanks to the high protection class IP 68/IP 69 K it is particularly suitable for use in humid environment. Depending on the version, it is used for level, gauge pressure, absolute pressure or vacuum measurements. Measured products are gases, vapours and liquids, also with abrasive contents.

The sensor element is the CERTEC ${ }^{\text {® }}$ measuring cell with flush, abrasion resistant ceramic diaphragm. The hydrostatic pressure of the medium or the process pressure causes a capacitance change in the measuring cell via the diaphragm. This change is converted into an appropriate output signal and outputted as measured value.
The CERTEC ${ }^{(1)}$ measuring cell is also equipped with a temperature sensor. The temperature value can be processed via the signal output.

Two-wire electronics $4 \ldots 20 \mathrm{~mA} /$ HART for power supply and measured value transmission over the same cable.

The supply voitage range can differ depending on the instrument version.

The data for power supply are stated in chapter "Technical data" in the "Supplemenf".

### 3.3 Operation

VEGABAR $744 \ldots 20 \mathrm{~mA} / \mathrm{HART}$ can be adjusted with different adjustment media:

- with external adjustmentindication VEGADIS 12
- an adjustment software according to FDT/DTM standard, e.g. PACTware ${ }^{\text {TM }}$ and PC
- with a HART handheld

The kind of adjustment and the adjustment options depend on the selected adjustment component. The entered parameters are generally saved in the respecitive sensor, when adjusting with PACTware ${ }^{\text {TM }}$ and PC optionally also in the PC.

28432-EN-070718

## 3．4 Packaging，transport and storage

\(\left.$$
\begin{array}{ll}\text { Packaging } & \begin{array}{l}\text { Your instrument was protected by packaging during transport．} \\
\text { lts capacity to handle normal loads during transport is assured } \\
\text { by a test according to DIN EN } 24180 .\end{array}
$$ <br>
\& The packaging of standard instruments consists of environ－ <br>
ment－friendly，recyclable cardboard．For special versions，PE <br>
foam or PE foil is also used．Dispose of the packaging material <br>

via specialised recycling companies．\end{array}\right\}\)|  | Transport must be carried out under consideration of the notes |
| :--- | :--- |
| on the transport packaging．Nonobservance of these instruc－ |  |
| tions can cause damage to the device． |  |

## 4 Mounting

### 4.1 General instructions

Materials, wetted parts

## Temperature limits

## Connection

28432-EN-070718

### 4.2 Mounting steps

Sealing/Screwing in threaded versions

Seal the thread with teflon, hemp or a similar resistant seal material on the process fitting thread $1 / 2$ NPT.
$\rightarrow$ Screw VEGABAR 74 into the welded socket. Tighten the hexagon on the process fitting with a suitable wrench. Wrench size, see chapter "Dimensions".

## Sealing/Screwing In flange versions

Sealing/Screwing in hygienlc fittings

Seal the flange connections according to DIN/ANSI with a suitable, resistant seal and mount VEGABAR 74 with suitable screws.

Use the seal suitable for the respective process fitting. You can find the components in the line of VEGA accessories in the supplementary instructions manual "Welded socket and seals".

## 5 Connecting to power supply

### 5.1 Preparing the connection

Note safety instructions

Take note of safety instructions for Ex applications

## Selecting connection cable

Always keep in mind the following safety instructions:

- Connect only in the complete absence of line voltage
- If overvoltage surges are expected, versions with integrated overvoltage arresters should be used or external overvoltage arresters should be installed

We recommend the version of VEGABAR 74 with integrated overvoltage arrester or VEGA type ÜSB62-36G.X as external overvoltage arreaster.

In hazardous areas you should take note of the appropriate regulations, conformity and type approval certificates of the sensors and power supply units.

Power supply and current signal are carried on the same twowire cable. The voltage supply range can differ depending on the instrument version.

The data for power supply are stated in chapter "Technical data" in the "Supplement".

Provide a reliable separation of the supply circuit from the mains circuits according to DIN VDE 0106 part 101.

VEGA power supply units VEGATRENN 149AEx, VEGASTAB 690, VEGADIS 371 as well as all VEGAMETs meet this requirement. When using one of these instruments, protection class III is ensured for VEGABAR 74.

Bear in mind the following factors regarding supply voltage:

- Output voltage of the power supply unit can be lower under nominal load (with a sensor current of 20.5 mA or 22 mA in case of fault message)
- Influence of additional instruments in the circuit (see load values in chapter "Technical data")

VEGABAR 74 is connected with standard two-wire cable without screen. An outer cable diameter of $5 \ldots 9 \mathrm{~mm}$ ensures the seal effect of the cable gland when connecting via VEGABOX 02 or VEGADIS 12. If electromagnetic interference is expected which is above the test values of EN 61326 for

industrial areas, screened cable should be used. For HART multidrop operation we recommend as standard practice the use of screened cable.


Fig. 3: Connection of VEGABAR 74
1 Direct connection
2 Connection via VEGABOX 02 or VEGADIS 12
Cable screening and ground- If screened cable is necessary, connect the cable screen on ing both ends to ground potential. In the VEGABOX 02 or VEGADIS 12, the screen must be connected directly to the internal ground terminal. The ground terminal on the outside of the housing must be connected to the potential equalisation (low impedance).

If potential equalisation currents are expected, the connection on the processing side must be made via a ceramic capacitor (e.g. $1 \mathrm{nF}, 1500 \mathrm{~V}$ ). The low frequency potential equalisation currents are thus suppressed, but the protective effect against high frequency interference signals remains.


Take note of the corresponding installation regulations for Ex applications. In particular, make sure that no potential equalisation currents flow over the cable screen. In case of grounding on both sides this can be achieved by the use of a capacitor or a separate potential equalisation.

### 5.2 Connection procedure

Direct connection
Proceed as follows:
1 Wire the connection cable up to the connection compartment. The bending radius must be at least $25 \mathrm{~mm} .{ }^{2}$ )
2 Connect the wire ends to the screw terminals according to the wiring plan

## Via VEGABOX 01 or VEGADIS

 12Proceed as follows:
1 Snap connection housing onto the carrier rail or screw it to the mounting plate
2 Loosen the cover screws and remove the cover
3 Insert the cable through the cable entry into the connection housing housing
4 Loosen the screws with a screwdriver
5 Insert the wire ends into the open terminals according to the wiring plan
6 Tighten the screws with a screwdriver
7 Check the hold of the wires in the terminals by lightly pulling on them
8 Tighten the compression nut of the cable entry. The seal ring must completely encircle the cable
9 Connect the supply cable according to steps 3 to 8
10 Screw the housing. cover back on
The electrical connection is finished.

[^1]
### 5.3 Wiring plan

## Direct connection



Fig. 4: Wire assignment, connection cable
1 brown ( + ): to power supply or to the processing system
2 blue ( - : to power supply or to the processing system
3 yellow: is only required with VEGADIS 12, otherwise connect to minus or with VEGABOX 01 to terminal $3^{3}$
4 Screen
5 Breather capillaries with fitter element


Fig. 5: Terminal assignment VEGABAR 74
1 To power supply or the processing system
2 Screan'

| Wire number | Wire colour/Polarity | VEGABAR 74 terminal |
| :--- | :--- | :--- |
| 1 | brown $(+)$ | 1 |
| 2 | blue $(-)$ | 2 |
| 3 | Yellow | 2 |
|  | Screen | Ground |

3) For customer-specific versions already connected with blue (-) when being shipped.
4) Connect screen to ground terminal. Connect ground terminal on the outside of the housing as prescribed. The two terminals are galvanically connected

## Connection via VEGADIS 12



Fig. 6: Terminal assignment, VEGADIS 12
1 To power supply or the processing system
2 Control instrument (4 ... 20 mA measurement)
3 Screens
4 Breather capillartes
5 Suspension cable

| Wire number | Wire colour/Polarity | Terminal VEGADIS <br> 12 |
| :--- | :--- | :--- |
| 1 | brown $(+)$ | 1 |
| 2 | blue $(-)$ | 2 |
| 3 | Yellow | 3 |

s) Connect screen to ground terminal. Connect ground terminal on the outside of the housing as prescribed. The two terminals are galvanically connected.

## 6 Set up

## 6．1 Setup steps without VEGADIS 12

After mounting and electrical connection，VEGABAR 74 is ready for operation．
$\rightarrow$ Switch on voltage
The electronics now carries out a self－check for approx． 2 seconds．Then VEGABAR 74 delivers a current of $4 \ldots 20 \mathrm{~mA}$ according to the actual level．

## 6．2 Setup steps with VEGADIS 12

Adjustment volume
－zero－measuring range begin
－span－measuring range end
－ti－Integration time
Adjustment system

Adjustment steps，adjustment Proceed as follows for adjustment with VEGADIS 12：
1 Open housing cover
2 Connect hand multimeter to terminals 10 and 12
3 Meas．range begin：Set rotary switch to＂zero＂

4 Empty the vessel or reduce process pressure
5 Set a current of 4 mA with the [ + ] and [-] keys
6 Meas. range end: Set rotary switch to "span"
7 Fill the vessel or increase process pressure
8 Set a current of 20 mA with the [ +$]$ and $[-]$ keys
9 Operation: Set rotary switch to "OPERATE"
10 Close housing cover
The adjustment data are effective, the output current $4 \ldots 20 \mathrm{~mA}$ corresponds to the actual level.

Adjustment steps, integration Proceed as follows for the adjustment of the integration time time

Adjustment steps, scaling


[^2]
## 7 Setup with PACTware ${ }^{\text {TM }}$

### 7.1 Connect the PC with VEGACONNECT 3

Connecting the PC to the signal cable


Fig. 8: Connecting the PC to the signal cable
1 RS232 connection (with VEGACONNECT 3) or USB connection (with VEGACONNECT 4)
2 VEGABAR 74
3 HART adapter cable
4 HART resistance 250 Ohm (optional depending on the processing)

Necessary components:

- VEGABAR 74
- PC with PACTware ${ }^{\text {TM }}$ and suitable VEGA DTM
- VEGACONNECT 3 or 4 with HART adapter cable (art. no. 2.25397)
- HART resistance approx. 250 Ohm
- Power supply unit
- Note:

1 With power supply units with integrated HART resistance (internal resistance approx. 250 Ohm ), an additional external resistance is not necessary (e.g. VEGATRENN 149A, VEGADIS 371, VEGAMET 381/624/625, VEGASCAN 693). In such cases, VEGACONNECT 3 can be connected parallel to the $4 . .20 \mathrm{~mA}$ cable.

## 7．2 Connect the PC with VEGACONNECT 4

## Connection via HART



Fig．9：Connecting the PC via HART to the signal cable VEGABAR 74
2 HART resistance 250 Onm（optional depending on the processing）
3 Connection cable with 2 mm pins and terminals
4 Processing system／PLCNottage supply

Necessary components：
－VEGABAR 74
－PC with PACTware ${ }^{\text {TM }}$ and suitable VEGA DTM
－VEGACONNECT 4
－HART resistance 250 Ohm（optional depending on the processing）
－Power supply unit or processing system
Note：
With power supply units with integrated HART resistance （internal resistance approx． 250 Ohm ），an additional external resistance is not necessary．This applies，e．g．to the VEGA instruments VEGATRENN 149A，VEGADIS 371，VEGAMET 381）．Also usual Ex separators are most of the time equipped with a sufficient current limitation resistor．In such cases， VEGACONNECT 4 can be connected parallel to the $4 \ldots 20 \mathrm{~mA}$ cable．


### 7.3 Parameter adjustment with PACTware ${ }^{\text {TM }}$

Further setup steps are described in the operating instructions manual "DTM Collection/PACTware ${ }^{\text {TM" }}$ attached to each CD and which can also be downloaded from our homepage. A detailed description is available in the online help of PACTware ${ }^{\text {TM }}$ and the VEGA DTMs.

## - Note:

Keep in mind that for setup of VEGABAR 74, DTM-Collection in the actual version must be used
All currently available VEGA DTMs are provided in the DTM Collection on CD and can be obtained from the responsible VEGA agency for a token fee. This CD includes also the up-todate PACTware ${ }^{\text {rM }}$ version. The basic version of this DTM Collection incl. PACTware ${ }^{\text {TM }}$ is also available as a free-ofcharge download from the internet.

Go via www.vega.com and "Downloads" to the item "Software".

### 7.4 Parameter adjustment with AMS ${ }^{\text {TM }}$ and PDM

For VEGA sensors, instrument descriptions for the adjustment programs AMS ${ }^{\text {TM }}$ and PDM are available as DD or EDD. The instrument descriptions are already implemented in the current versions of $A M S^{T M}$ and PDM. For older versions of AMS $^{T M}$ and PDM, a free-of-charge download is available via Internet.

Go via www.vega.com and "Downloads" to the item "Software".

### 7.5 Saving the parameter adjustment data

It is recommended to document or save the parameter adjustment data. They are hence available for multiple use or service purposes.
The VEGA DTM Collection and PACTware ${ }^{\text {TM }}$ in the licensed, professional version provide suitable tools for systematic project documentation and storage.

## 8 Maintẹnance and fault rectification

### 8.1 Maintenance

When used as directed in normal operation, VEGABAR 74 is completely maintenance free.

### 8.2 Fault clearance


$\rightarrow$ Check the pressure compensation in the housing and clean the filter element, if necessary
? $4 \ldots 20 \mathrm{~mA}$ signal missing

- Wrong connection to power supply
$\rightarrow$ Check connection according to chapter "Connection steps" and if necessary, correct according to chapter "Wiring plan"
- No voltage supply
$\rightarrow$ Check cables for breaks; repair if necessary
- supply voltage too low or load resistance too high
$\rightarrow$ Check, adapt if necessary
? Current signal $3.6 \mathrm{~mA} ; 22 \mathrm{~mA}$
- electronics module or measuring cell defective
$\rightarrow$ Exchange instrument or return instrument for repair
In Ex applications, the regulations for the wiring of intrinsically safe circuits must be observed.


## Reaction after fault rectifica-

 tionDepending on the failure reason and measures taken, the steps described in chapter "Set up" must be carried out again, if necessary.

### 8.3 Instrument repair

If a repair is necessary, please proceed as follows:
You can download a return form ( 23 KB ) from the Internet on our homepage www.vega.com under: "Downloads - Forms and centificates-Repair form".

By doing this you help us carry out the repair quickly and without having to call back for needed information.

- Print and fill out one form per instrument
- Clean the instrument and pack it damage-proof
- Attach the completed form and, if need be, also a safety data sheet outside on the packaging
- Please ask the agency serving you for the address of your return shipment. You can find the respective agency on our website www.vega.com under: "Company - VEGA worldwide"


## 9 Dismounting

### 9.1 Dismounting steps

## Warning:

Before dismounting, be aware of dangerous process conditions such as e.g. pressure in the vessel, high temperatures, corrosive or toxic products etc.

Take note of chapters "Mounting" and "Connecting to power supply" and carry out the listed steps in reverse order.

### 9.2 Disposal

The instrument consists of materials which can be recycled by specialised recycling companies. We use recyclable materials and have designed the electronics to be easily separable.

## WEEE directive 2002/96/EG

This instrument is not subject to the WEEE directive 2002/96/
EG and the respective national laws (in Germany, e.g.
ElektroG). Pass the instrument directly on to a specialised recycling company and do not use the municipal collecting points. These may be used only for privately used products according to the WEEE directive.

Correct disposal avoids negative effects to persons and environment and ensures recycling of useful raw materials.

Materials: see chapter "Technical data"
If you cannot dispose of the instrument properly, please contact us about disposal methods or return.

## 10 Supplement

### 10.1 Technical data

General data

| Manufacturer | VEGA Grieshaber KG, D-77761 Schiltach |
| :--- | :--- |
| Type name | VEGABAR 74 |
| Parameter, pressure | Gauge pressure, absolute pressure, vacuum |
| Measuring principle | Ceramic-capacitive, dry measuring cell |
| Communication interface | None |

## Materials and weights

Material 316L corresponds to 1.4404 or 1.4435
Materials, wetted parts

- Process fitting 316L
- Diaphragm sapphire ceramic ${ }^{\oplus}$ ( $99.9 \%$ oxide ceramic)
- Seal FKM (e.g. Viton), Kalrez 6375, EPDM, Chemraz 535
- Seal process fitting thread $G 1 / 2 \mathrm{~A}$, Klingersil C-4400 G1 $1 / 2$ A
Materials, non-wetted parts
- Housing 316L
- Ground terminal 316Ti/316L
- Connection cable PUR, FEP, PE
- type label support on cable

Weight
PE-HART
$0.8 \ldots 8 \mathrm{~kg}(1.8 \ldots 17.6 \mathrm{lbs})$, depending on process fitting


Range
Resolution
Accuracy
－in the range of $0 \ldots+100^{\circ} \mathrm{C}$ $\left(+32 \ldots+212{ }^{\circ} \mathrm{F}\right)$
－in the range of $-50 \ldots 0^{\circ} \mathrm{C}$
$\left(-58 \ldots+32^{\circ} \mathrm{F}\right)$ and $+100 \ldots+150^{\circ} \mathrm{C}$ $\left(+212 \ldots+302{ }^{\circ} \mathrm{F}\right)$
$-50 \ldots+150^{\circ} \mathrm{C}\left(-58 \ldots+302^{\circ} \mathrm{F}\right)$
$1^{\circ} \mathrm{C}\left(1.8^{\circ} \mathrm{F}\right)$
$\pm 3 \mathrm{~K}$
typ．$\pm 4 \mathrm{~K}$

## Input variable

## Adjustment

Zero adjustable $\quad-20 \ldots+95 \%$ of the nominal measuring range
Span adjustable
Recommended max．turn down $3.3 \ldots+120 \%$ of the nominal measuring range

Nominal measuring ranges and overload resistance

| Nominal range | Overload，max．pressuref） | Overload，min．pressure |
| :---: | :---: | :---: |
| Gauge pressure |  |  |
| 0 ．．． 0.1 bar／0 ．．． 10 kPa | $15 \mathrm{bar} / 1500 \mathrm{kPa}$ | －0．2 bar／－20 kPa |
| 0 ．．． $0.2 \mathrm{bar} / 0 . . .20 \mathrm{kPa}$ | $20 \mathrm{bar} / 2000 \mathrm{kPa}$ | －0．4 bar／－40 kPa |
| $0 . .00 .4$ bar／0 ．．． 40 kPa | $30 \mathrm{bar} / 3000 \mathrm{kPa}$ | －0．8 bar／－80 kPa |
| 0．．． 1 bar／0 ．．． 100 kPa | $35 \mathrm{bar} / 3500 \mathrm{kPa}$ | －1 bar／－100 kPa |
| 0 ．．． 2.5 baro ．．． 250 kPa | $50 \mathrm{bar} / 5000 \mathrm{kPa}$ | －1 barl－100 kPa |
| 0 ．．． 5 bar／0 ．．． 500 kPa | $65 \mathrm{bar} / 6500 \mathrm{kPa}$ | －1 bar／－100 kPa |
| 0 ．．． $10 \mathrm{bar} / 0 . . .1000 \mathrm{kPa}$ | $90 \mathrm{bar} / 9000 \mathrm{kPa}$ | －1 bar／ 100 kPa |
| 0 ．．． 25 bar／0 ．．． 2500 kPa | $130 \mathrm{bar} / 13000 \mathrm{kPa}$ | －1 bar／ 100 kPa |
| 0 ．．． $60 \mathrm{bar} / 0 . . .6000 \mathrm{kPa}$ | 200 bar／20000 kPa | －1 bar／－100 kPa |
| －1 ．．． 0 bar／－100 ．．． 0 kPa | $35 \mathrm{bar} / 3500 \mathrm{kPa}$ | －1 bar／－100 kPa |
| －1 ．．． $1.5 \mathrm{bar} / 100 \ldots 150 \mathrm{kPa}$ | $50 \mathrm{bar} / 5000 \mathrm{kPa}$ | －1 bar／－100 kPa |
| －1 ．． 5 bar／ $100 \ldots 500 \mathrm{kPa}$ | 65 bar／6500 kPa | －1 bar／ 100 kPa |
| －1 ．．． 10 bar／－100 ．．． 1000 kPa | 90 bar／9000 kPa | －1 bar／ 100 kPa |
| －1 ．．． 25 bar／ $100 \ldots 2500 \mathrm{kPa}$ | $130 \mathrm{bar} / 13000 \mathrm{kPa}$ | －1 bar／ 100 kPa |
| －1 ．．． $60 \mathrm{bar} / 100 \ldots 6000 \mathrm{kPa}$ | 300 bar 30000 kPa | －1 bar／－100 kPa |
| －0．05 ．．． 0.05 bar／ $5 . . .5 \mathrm{kPa}$ | $15 \mathrm{bar} / 1500 \mathrm{kPa}$ | －0．2 bar／－20 kPa |
| －0．1 ．．． 0.1 bar／ $10 \ldots 10 \mathrm{kPa}$ | $20 \mathrm{bar} / 2000 \mathrm{kPa}$ | －0．4 bar／ 40 kPa |

の Limited to 200 bar according to the pressure device directive．

V/5[5]

| Nominal range | Overload, max. pres- <br> sure6) | Overload, min. pressure |
| :--- | :--- | :--- |
| $-0.2 \ldots 0.2$ bar/-20 $\ldots 20 \mathrm{kPa}$ | $30 \mathrm{bar} / 3000 \mathrm{kPa}$ | $-0.8 \mathrm{bar} /-80 \mathrm{kPa}$ |
| $-0.5 \ldots 0.5$ bar/-50 $\ldots 50 \mathrm{kPa}$ | $35 \mathrm{bar} / 3500 \mathrm{kPa}$ | $-1 \mathrm{bar} /-100 \mathrm{kPa}$ |
| Absolute pressure | $15 \mathrm{bar} / 1500 \mathrm{kPa}$ |  |
| $0 \ldots 0.1 \mathrm{bar} / 0 \ldots 10 \mathrm{kPa}$ | $35 \mathrm{bar} / 3500 \mathrm{kPa}$ |  |
| $0 \ldots 1$ bar/0 $\ldots 100 \mathrm{kPa}$ | $50 \mathrm{bar} / 5000 \mathrm{kPa}$ |  |
| $0 \ldots 2.5 \mathrm{bar} / 0 \ldots 250 \mathrm{kPa}$ | $65 \mathrm{bar} / 6500 \mathrm{kPa}$ |  |
| $0 \ldots 5$ bar/0 $\ldots 500 \mathrm{kPa}$ | $90 \mathrm{bar} / 9000 \mathrm{kPa}$ |  |
| $0 \ldots 10 \mathrm{bar} / 0 \ldots 1000 \mathrm{kPa}$ | $130 \mathrm{bar} / 13000 \mathrm{kPa}$ |  |
| $0 \ldots 25 \mathrm{bar} / 0 \ldots 2500 \mathrm{kPa}$ | $200 \mathrm{bar} / 20000 \mathrm{kPa}$ |  |
| $0 \ldots 60 \mathrm{bar} / 0 \ldots 6000 \mathrm{kPa}$ |  |  |

## Reference conditions and influencing variables (similar to DIN EN 60770-1)

Reference conditions according to DIN EN 61298-1

- Temperature
- Relative humidity
- Air pressure


## Determination of characteristics

Characteristics
Reference installation position
Influence of the installation position
$+15 \ldots+25^{\circ} \mathrm{C}\left(+59 \ldots+77^{\circ} \mathrm{F}\right)$
45 ... 75 \%
860 ... $1060 \mathrm{mbar} / 86 \ldots 106 \mathrm{kPa}$ (12.5 ... 15.4 psi )

Limit point adjustment according to IEC 61298-2
linear
upright, diaphragm points downward
$<0.2 \mathrm{mbar} / 20 \mathrm{~Pa}(0.003 \mathrm{psi})$

## Deviation determined according to the limit point method according to IEC 607707)

Applies to digital HART interface as well as to analogue current output $4 \ldots 20 \mathrm{~mA}$. Specifications refer to the set span. Turn down (TD) $=$ nominal measuring range/set span.
Deviation

- Turn down 1:1 up to 5:1
- Turn down up to 10:1
$<0.075 \%$
$<0.015 \% \times$ TD

Deviation with absolutely flush process fittings EV, FT

- Turn down 1:1 up to 5:1
$<0.05 \%$

- Turn down up to 10:1
$<0.01 \% \times$ TD

7 Incl. non-linearity, hysteresis and non-repeatability

Deviation with absolute pressure measuring range 0.1 bar

- Turn down 1:1 up to 5:1
- Turn down up to 10:1
$<0.25 \% \times$ TD

Influence of the product or ambient temperature
Applies to digital HART interface as well as to analogue current output $4 \ldots 20 \mathrm{~mA}$.
Specifications refer to the set span. Turn down $(T D)=$ nominal measuring range/set span.

## Average temperature coefficient of the zero signal

In the compensated temperature range of $0 \ldots+100^{\circ} \mathrm{C}\left(+212{ }^{\circ} \mathrm{F}\right)$, reference temperature $20^{\circ} \mathrm{C}\left(68^{\circ} \mathrm{F}\right)$ :
Average temperature coefficient of the zero signal

- Turn down 1:1
<0.05 \%/10 K
- Turn down 1:1 up to 5:1
<0.1 \%/10 K
- Turn down up to 10:1
$<0.15 \% / 10 \mathrm{~K}$

Outside the compensated temperature range:
Average temperature coefficient of the zero signal

- Turn down 1:1 typ. $<0.05 \% / 10 \mathrm{~K}$


## Thermal change of the current output

Applies also to the analogue $4 \ldots 20 \mathrm{~mA}$ current output and refers to the set span.
Thermal change, current output $\quad<0.15 \%$ at $-40 \ldots+80^{\circ} \mathrm{C}\left(-40 \ldots+176{ }^{\circ} \mathrm{F}\right)$

## Long-term stability (similar to DIN 16086, DINV 19259-1 and IEC 60770-1)

Applies to digital HART interface as well as to analogue current output $4 \ldots 20 \mathrm{~mA}$. Specifications refer to the set span. Turn down (TD) $=$ nominal measuring range/set span. Long-term drift of the zero signal $<(0.1 \% \times$ TD)/1 year

## Total deviation (similar to DIN 16086)

The total deviation (max. practical deviation) is the sum of basic accuracy and long-term stability:
$F_{\text {total }}=F_{\text {perf }}+F_{\text {stab }}$
$F_{\text {peri }}=V\left(\left(F_{T}\right)^{2}+\left(F_{K 1}\right)^{2}\right)$
With

- $F_{\text {total }}$ : Total deviation
- $F_{\text {peri: }}$ Basic accuracy
- $F_{\text {stab }}$ : Long-term drift
$\overline{30}$ VEGABAR $74 \cdot 4 \ldots 20$ mA/HART


## NEF医

- $F_{T}$ : Temperature coefficient (influence of medium or ambient temperature)
- $F_{\text {KI: }}$ Deviation


## Ambient conditions

Ambient, storage and transport temperature

- Connection cable PUR, FEP $-40 \ldots+85^{\circ} \mathrm{C}\left(-40 \ldots+185^{\circ} \mathrm{F}\right)$


## Process conditions

The specifications of the pressure stage are used as an overview. The specifications on the type plate are applicable.

Pressure stage, process fitting

- Thread 316L PN 60
- Thread Alu PN 25
- Hygienic fittings 316L

PN 10, PN 16, PN 25, PN 40

- Flange 316L, flange with extension PN 40 or $150 \mathrm{lbs}, 300 \mathrm{lbs}$ 316L

Product temperature depending on the measuring cell seal

- FKM (e.g. Viton) $-20 \ldots+100^{\circ} \mathrm{C}\left(-4 \ldots+212^{\circ} \mathrm{F}\right)$
- EPDM $-40 \ldots+100^{\circ} \mathrm{C}\left(-40 \ldots+212^{\circ} \mathrm{F}\right), 1 \mathrm{~h}: 140^{\circ} \mathrm{C} /$
- Kalrez 6375 (FFKM)
$284^{\circ} \mathrm{F}$ cleaning temperature
- Chemraz 535

Vibration resistance
$-10 \ldots+100^{\circ} \mathrm{C}\left(+14 \ldots+212^{\circ} \mathrm{F}\right)$
mechanical vibrations with 4 g and $5 \ldots 100 \mathrm{~Hz}^{8)}$
Shock resistance
Acceleration $100 \mathrm{~g} / 6 \mathrm{~ms}^{9}$ )

## Electromechanical data

Connection cable

- Configuration
- Wire cross-section
- wire resistance
- Standard length

28432-EN-070718
four wires, one suspension cable, one breather capillary, screen braiding, metal foil, mantle $0.5 \mathrm{~mm}^{2}$ (AWG no. 20)
$<0.036$ Ohm/m (0.011 Ohm/ft)
6 m (19.685 ft)
$200 \mathrm{~m}(656.168 \mathrm{ft})$

Tested according to the regulations of German Lloyd, GL directive 2. 9) Tested according to EN 60068-2-27

- Min. bending radius at $25^{\circ} \mathrm{C} / 77^{\circ} \mathrm{F} \quad 25 \mathrm{~mm}(0.985 \mathrm{in})$
- Diameter
- Colour - standard PE
- Colour - standard PUR
- Colour - Ex-version
approx. 8 mm (0.315 in)
Black
Blue
Blue


## Voltage supply

Supply voltage

- Non-Ex instrument
$12 \ldots 36$ V DC
- EExia instrument
$12 \ldots 29 \mathrm{~V}$ DC
Permissible residual ripple
- $<100 \mathrm{~Hz}$
$\mathrm{U}_{\mathrm{ss}}<1 \mathrm{~V}$
- 100 Hz ... 10 kHz $U_{s s}<10 \mathrm{mV}$

Load see diagram


Fig. 10: Voltage diagram VEGABAR 74
1 HART load
2 Voltage limit Ex instrument
3 Voltage limit non-Ex instrument
4 Voltage supply
Load in conjunction with VEGADIS 12
see diagram


Fig. 11: Voltage diagram VEGABAR 74 with VEGADIS 12 HART load
Voltage limit Ex instrument
3 Voltage limit non-Ex instrument
4 Voltage supply

## Integrated overvoltage protection

| Nominal leakage current $(8 / 20 \mu \mathrm{~s})$ | 10 kA |
| :--- | :--- |
| Min. response time | $<25 \mathrm{~ns}$ |

## Electrical protective measures

- Protection

Overvoltage category
Protection class

IP 68 (25 bar)/IP 69K
III
III

## Approvals ${ }^{10}$

## ATEX ia

ATEX \| 1G EEx ia \|C T6; ATEX \| 2G EEx ia IIC T6

## Ship approvals

Others

GL, LRS, ABS, CCS, RINA, DNV WHG

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VEGABAR 74-4... 20 mA/HART 33

## 10．2 Dimensions

VEGABAR 74 －threaded fitting


Fig．12：VEGABAR 74 threaded fitting：$G V=G 1 / 2$ A manometer connection $E N 837, G I=G 1 / 2$ A inner $G 1 / 2 A, G G=G 11 / 2 A$ ， $G N=1 / 2 \mathrm{NPT}, G M=G 11 / 2$ A $70 \mathrm{~mm}, G R=1 / 2 N P T$ inner $1 / 4 \mathrm{NPT}$

8LLOLO－NG－でヤ8

VEGABAR 74 - hygienic fitting 1


TB


RARA

Fig. 13: VEGABAR 74 hygienic fitting: $C C=$ Tri-Clamp 11/2", $C A=T r i-C l a m p ~ 2 ", L A=$ hygienic fitting with compression nut F40, TA = Tuchenhagen Varivent DN 32, TB = Tuchenhagen Varivent DN 25, RA/RB = bolting DN 40/DN 50 according to DIN 11851
28432-EN-070718

VEGABAR 74 - hygienic fitting 2


Fig. 14: VEGABAR $74 \mathrm{KAKH}=$ cone $D N 40, A A=D R D, S D / S E=$ Anderson $3^{\circ}$ long/shont fitting


VEGABAR 74 - flange connection


## Fig. 15: VEGABAR 74 - flange connection

1 Flange connection according to DIN 2501
Flange fitting according to ANSI B16.5
3 Flange with extension
4 Order-specific


VEGABAR 74 - threaded fitting for paper industry


Fig. 16: VEGABAR 74 - connection for paper industry: $B A B B=$ M44×1. 25

VEGABAR 74 - extension fitting for paper industry


Fig. 17: VEGABAR 74 - extension fitting for paper industry: EV/FT = absolutely flush for pulper (EV 2-times flattened), EG = 28432-EN-070718 extension for ball valve fitting ( $L=$ order-specific)

## 10．3 Industrial property rights

VEGA product lines are global protected by industrial property rights．
Further information see http：／／www．vega．com
Only in U．S．A．：Further information see patent label at the sensor housing
VEGA Produktfamilien sind weltweit geschützt durch gewerbliche Schutzrechte． Nähere Informationen unter http：／／www．vega．com

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进一步伯总请参见两站＜http：／／www．vega．com＞。

## 10．4 Trademark

All brands used as well as trade and company names are property of their lawful proprietor／originator．

VEGA Grieshaber KG
Am Hohenstein 113
77761 Schiltach
Germany
Phone +49 7836 50-0
Fax +49 7836 50-201
E-mail: info@de.vega.com
www.vega.com


All statements concerning scope of delivery, application, practical use and operating conditions of the sensors and processing systems correspond to the information available at the time of printing.
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## CERTIFICATE <br> OF TEST

## Project:- PUMP STATION SP118 SANDFORD STREET

## Client:- BRISBANE CITY COUNCIL

"Whelan Electrical Services Pty Ltd certify that the electrical installation, to the extent it is effected by the electrical work, has been tested to ensure it is electrically safe and is in accordance with the requirements of the wiring rules and any other standard applying to the electrical installation under the Electrical Safety Regulation 2002"

Signed:-


## SP118 SANDFORD STREET SEWAGE PUMPING STATION

## SITE COVER SHEET



| STANDARD VARIABLES |  |
| :---: | :---: |
| DESCRIPTION | VALUES |
| CT METERING ISOLATOR | ноt Applicali |
| NORMAL SUPPLY MAIN SWITCH |  |
| GENERATOR SUPPLY MAIN SWITCH | mon $\quad$ xssamy 160 |
| PUMP1 CIRCUIT BREAKER | 2 Aa －Xhbsw／28 |
| PUMP2 CIRCUIT BREAKER | 20 A Xhiswhe |
| DRY WELL SUMP PUMP CIRCUIT PREAKER | ноT APPILCABLE |
| PUMP SOFT STARTER SIZE | Ms5－07． |
| PUMP RATING | 18.8410 |
| PUMP LINE CONTACTOR | ${ }_{\text {car }}$ |
| PUMP BYPASS CONTACTOR | C12－30 |
| SUMP PUMP RATING | Not APPLICABLE |
| SUMP PUMP CONTACTOR \＆TOL | \％ot APplicable |
| PUMP SOCKET OUTLET＋INCLINE SLEEVE | 053336，6892．Scicesi |
| PUMP INLET PLUG • HANDLE |  |
| WET WELL LEVEL TRANSMITTER | епит－кввниз |
| EMERGENCY STORAGE WELL LEVEL TRANSMIT TER | not Applicable |
| DELIVERY PRESSURE TRANSMITER |  |
| WET WELL ULT TRASONIC LEVEL SENSOR | not Applicaile |
| FLOWMETER RANGE | Hot Applicali |
| RADID | O8S0－701020 20 |
| EMERGENCY PUMPING TIME | posee |
| No of SINGLE POINT PROBES | 2 |
| Incoming malis supply Cable | $16 \mathrm{ma}^{2}$ |
| MAIN EARTHINGG CABLE | $6 \mathrm{~mm}^{2}$ |
| INCOMINE GENERA TOR SUPPLY CABLE | Not APPLICABLE |
| PUMP MOTOR SUPPLY CABLE | $4 \mathrm{~mm}^{2}$ |


| STANDARD DESIGN OPTIONS |  |  |
| :---: | :---: | :---: |
| OPTION | DESCRIPTION | FITTE |
| － |  | 四 № |
| － |  | W ${ }^{\text {No }}$ |
| $t$ | W | No |
| $\rightarrow$ | WQYUU P PM | N0 |
| f |  | N0 |
| ＋ | STAF｜OW CRHAENT GIN： | N0 |
| －6 | STA TIN EMEREGNCY STORAEE LEVEI SENSOR | N0 |
| － | STAFIONOELVERY Flowneter | N0 |
| 1 | BACKUP COMMUNICATION OPTIONS | YES 戊 |
| ， | PUMP CONNECTION（Via De－contactors） | YES ${ }^{\text {a }}$ |
| ＊ | Cathor proteftow | N0 |
| 1 | MOTOR THERMISTORS（Vie De－contactors） | YES |
| － | Oboun ermint | N0 |
| － |  | 四 N0 |
| $\bigcirc$ |  | N0 |
| P | WET WELL WASHER | N0 |
| － | VALVE PIT SUMP PUM ANOLEVEL PAOBE | 区 ${ }^{\text {N0 }}$ |
| R | TELEMETRY RADIO | YES |
| － | WET WIt ULTRASONHE LEVCL SENSOR | N N0 |
| T | DOUBLE SIIED SWITCHBOARD | YES |
| U | DELIVERY PRESSURE TRANSMITTER | YES |


|  |  |  |  |  |  | Deatico | P．mague |  | 15.107 |  |  |  | STR 118 SANDFORD STREET sewage pump station | SITTE COVER SHEET | SHEET Mo 0 |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | 07.07 | ISSUED FOR CONSTRUCTION | Р．．． |  |  | Daff mociec | а withort |  | RP．EOM．D．Date |  |  |  |  |  |  |
| 0 | 1.07 | ISSUED FOR TENDER | P． P P／ |  |  | Cosfle | 57－0028sot＿A | Original sioned by AWITHOFT desicn cheor |  |  Culevidelegate | 17.107 |  |  |  | 486／5／7－0029－000 | A |
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SP118 Sanford Street St Lucia SPS Electrical Switchboard OM Mäanual



| LEGEND: |  |
| :---: | :---: |
| - | Swith hoard power terhinal |
| $\varnothing$ | swithboard control terminal |
| $\square$ | swithadaro generator term. |
| $\cdots$ | fill terminal |
| 0 | PLL TERHINAL |
| $\square$ | RTU TERHINAL |
| - | 5 terminal |
| - | PLL/RTU MARSH. fuse terminal |
| $\bigcirc$ | PLC/RTU MARSH. LINK TERMINAL |
| - | disconneet plug |
| (1)02 | rtu digital input |
| 00002 | rtu oigital output |
| A1-02 | rtu analogue input |
| - A00,02 | tu analogue output |

NOTES
 Shroubed.

 3. ALL WIRES 2 CABLL CORES ARE FERULED 4. Fault level of 20 kA at cisv foro 2 sees
Sheet 02
FOR CONSTRUCTION

| Ster ma 2 |  |
| :---: | :---: |
|  | ameno. |
| 486/5/7-0029-002 | A |

Q-Pulse Id TMS891
Active 10/12/2014



$\qquad$ COENMON RTU IIO
SCHEMATIC DIAGRAM
Sheet 07
FOR CONSTRUCTION






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[^0]:    - ompactFlash is a registered trademark of CompactFlash Association.

[^1]:    28432-EN-070718
    2) The connection cable is already preconfectioned. After shortening the cable, fasten the type plate with support again to the cable.

[^2]:    8 Set rotary switch to "OPERATE"
    9 Close housing cover
    The adjustment data are effective, the output current $4 \ldots 20 \mathrm{~mA}$ corresponds to the actual level.

