ebmpapst

MODBUS parameter specification for "ebm-papst product range"

V6.3

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Excerpt

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Foreword

This document specifies the Modbus and RFID parameters of the device "product range" from ebm-papst.

This excerpt differs from the full document in that it does not describe parameters for ebm-papst internal use. These parameters are marked with the word "Reserved".

Knowledge of the general Modbus specifications is assumed:
- MODBUS over Serial Line Specification & Implementation guide V1.0
- MODBUS Application Protocol Specification V1.1

The documents are available in the internet at modbus.org

The general Modbus specifications form the basis for this document and apply in full with the exception of the restrictions described in this document.

Change history

Version	Changes
1.00	Document creation
1.01	
1.02	
2.00	Change to coding of the following registers from 8-bit to 16-bit (previously MSB was always 0): a) Holding registers D001 Setpoint D114 / D115 Set value (EEPROM) D12A – D12D Potentiometer characteristic curve b) Input registers D010 Actual speed D01A Current set value D01B Sensor actual value Change to coding of control parameter I factor (resolution 1...1/65536 instead of 256...1/256) Change to controller equation (kp no longer influences I component) Definition for ramp-up curve / ramp-down curve changed, as set value can now assume 65536 steps instead of 256 steps With write access, setpoint is no longer stored in the parameter "Set value (stored)" but rather in "Set value (EEPROM)"; the parameter "Set value (stored)" has been discontinued Identification 0x0002 re-defined for Modbus Parameter Specification V2.00
2.01	Addition of the following holding registers: D135 Max. power D136 – D138 Parameters for derating max. power D13B Max. coil current D13C – D13F Potentiometer characteristic curve "Night" D140 – D143 Characteristic curve output 0..10 V Re-definition of holding register D12F: "Limitation Control" The following holding register has been deleted: D11D Max. DC-link current Addition of input register D021 Current power Addition of new bits in input register D012 Warning: P_Limit and I_Limit
2.02	
3.00	Addition of the following holding registers: D009 Operating hours counter D00A Operating minutes counter D145 Speed limit for running monitoring D15C Bypass function on / off D15D Bypass function set value D15E Bypass function time delay

Version	Changes
	Function of following holding registers changed D180 Operating hours counter: now only back-up D181 Operating minutes counter: now only back-up Addition of new bits in input register D012 Warning: n_Low
3.01	
3.02	Addition of the following holding registers: D148 Running direction source D147 Sensor actual value source Change to the following holding registers: D104 Parameter set source (new value: 2) D12E Direction of action source (new value: 2) D130 Function output 0..10 V (new value: 2) D184ff Error history: Bit 15 "Brake" deleted Bit 14 "UeHigh" added D1A2 -D1A3 Fan serial number D1A4 Date of fan manufacture Addition of the following input registers: D023 Sensor actual value 1 D024 Sensor actual value 2 Change to the following input registers: D011 Motor status: Bit 15 "Brake" deleted Bit 14 "UeHigh" added Bit 13 "UeLow" added D012 Warning: Bit 7 "Brake" added Renaming of the following holding registers: D102 Preferred running direction (instead of running direction) D104 Parameter set source (instead of day / night switching external / internal) D105 Parameter set internal (instead of day / night internal) D12E Direction of action source (instead of direction of action switching external / internal) D15C Fail-safe mode on / off (instead of bypass function on / off) D15D Fail-safe set value (instead of bypass function set value) D15E Fail-safe time delay (instead of fail-safe mode time delay) All "Day" designations renamed "Parameter set 1" All "Night" designations renamed "Parameter set 2" Renaming of the following input registers: D01D Current parameter set (instead of parameter set day / night)
4.00	New command: 0x46 Write single register addressed by serial no. Permit change of interface setting Fail-safe mode extended to analog input (open circuit detection) Addition of the following holding registers: D149 Transmission speed D14A Parity configuration

Version	Changes
	D15F Potentiometer characteristic curve limiting value for open circuit Addition of the following input register D012 Warning: Bits 10 "Open circ."; 1 "L_high" added Write authorization changed for holding register D145 Speed limit for running monitoring (customer)
5.00	New commands: 0x43 Read holding register addressed by serial no. 0x44 Read input register addressed by serial no. 0x50 Write multiple register addressed by serial no. Broadcast addressing for all commands "... addressed by serial no." Maximum telegram length increased to 23 bytes Change to the following holding registers: D130 Function 0..10 V output / speed monitoring: new value 3 (actual speed -> pulses per revolution); MSB: pulses per revolution added D149 Transmission speed (new values: 6, 7 -> 57600, 115200 bits/sec) D182 – D19F Error history: Bits 14 "UeHigh", 11 "UzHigh" and 9 "TFEI" deleted Addition of the following holding registers: D14D Motor temperature power derating start D14E Motor temperature power derating end D150 Shedding function D151 Max. starting modulation level D152 Number of start attempts D153 Relay dropout delay D155 Max. power D15B Fail-safe running direction Renaming of the following holding registers: D135 Max. **permissible** power D136 Max. power at ~~temperature~~derating end D137 **Module** temperature power derating start D138 **Module** temperature power derating end Change to the following input registers: D011 Motor status: Bits 14 "UeHigh", 13 "UeLow, 11 "UzHigh" and 9 "TFEI" deleted D012 Warning: Bits 15 "LRF", 14 "UeHigh", 12 "UzHigh" and 11 "Heating" added D016 Motor temperature (format: signed integer; permit negative values)
5.02	
6.00	Maximum telegram length increased to 80 bytes Addition of the following holding registers: D00C Addressing on / off D00D – D00E Stored set value D00F Enable / Disable D010 Remote control output 0-10 V D158 Configuration of I/O 1 D159 Configuration of I/O 2 D15A Configuration of I/O 3 D16A Enable / Disable source

Version	Changes
	D16B Stored Enable / Disable D16C Set value source switching D16D Power derating ramp D16E Voltage output D16F RFID access D1F7 Rotor position sensor calibration set value D1F8 Rotor position sensor calibration D380 – D39F Mirrored holding registers D400 – D40F Original addresses of mirrored input registers D480 – D49F Original addresses of mirrored holding registers Renaming of the following holding registers D12A – D12D Potentiometer characteristic curve (par. 1) -> Input characteristic curve (par. 1) D13C – D13F Potentiometer characteristic curve (par. 2) -> Input characteristic curve (par. 2) D15C Fail-safe mode on / off -> Fail-safe set value source D15F Open circuit limit value potentiometer characteristic curve-> Open circuit limit value input characteristic curve Change to the following holding registers: D101 Set value source: Values 2 and 3 extended: Ain2, PWMin3 D104 Parameter set source: Value 3 extended: Din1 D12E Direction of action source: Value 3 extended: Din1 D130 Function output 0-10 V: Values 4 + 5 extended (addressing, remote control) Value 3 deleted (actual speed pulses per revolution) D148 Running direction source: Value 3 extended: Din1 D15C Fail-safe set value source (values 2 – 4 extended: Ain1, Ain2, PWMin3) D182 – D19F Error history: Bit 8 (n_Limit) added Addition of the following input registers: D027 Current power [W] D028 Current set value source D029 – D02A Energy consumption counter D100 – D10F Mirrored input registers Change to the following input registers: D011 Motor status: Bits 10 + 8 (RL_Cal, n_Limit) added D012 Warning: Bit 8 RL_Cal added Renaming of the following input registers: D01C Enable input state -> Enable / Disable input state Access option via RFID interface
6.2	Addition of the following holding registers: D011 Test run Control D012 Mask-out Back-up Control D342 – D34B Speed mask-out ranges (back-up) D34C – D355 Modulation level mask-out ranges (back-up) D356 Test run time stamp D357 Number of mask-out ranges D603 Mask-out Control D604 – D60D Speed mask-out ranges D60E – D617 Modulation level mask-out ranges D61A Device internal bus slave select

Version	Changes
	Addition of the following input registers: D040 Vibration sensor time stamp D041 Vibration sensor speed D042 – D044 Vibration sensor harmonic vibration velocity D048 – D04A Vibration sensor RMS vibration velocity D04B Vibration sensor status
6.3	Addition of the following holding registers: D620 Error output delay D621 Warning output delay D622 Warning output mask D623 Relay actuation mask error D624 Relay actuation mask warning Change to the following holding registers: D158 – D15A Configuration of I/O: new value 8 (PWM input; idle level low) D16C Set value source switching: new values 4 + 5 (PWM status PWMin3) Addition of the following input register D02D Actual speed [rpm] D03D Line voltage Renaming of the following input registers D04B Vibration sensor status -> Vibration status

1 Protocol frame

Data transmission using the MODBUS protocol defined in this specification
takes place solely in an environment defined as a master–slave system. An orderly flow of data is governed by the master. A slave has to respond to a command request from the master. When structuring an installation, it is therefore important to ensure that a slave address is not allocated twice.

The preferred transmission medium is a twisted-pair cable to RS485 standard.

RTU is the only transmission mode supported (see MODBUS over Serial Line Specification & Implementation guide V1.0, Section 2.5.1)

ASCII transmission mode is not supported!

1.1 Byte structure

In accordance with the MODBUS over Serial Line Specification & Implementation guide V1.0, a byte has the following structure:

Start (low)	Bit 0 (LSB)	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7 (MSB)	Parity	Stop (high)

The definition of the parity bit ("Even", "Odd", "None") can be set by way of the parameter "Parity configuration" (see 2.44.2).

The transmission speed is variable and can be set by way of the parameter "Transmission speed" (see 2.44.1).

1.2 Communication

MODBUS over Serial Line Specification & Implementation guide V1.0 defines the following frame for the transmission protocol:

Command from master:	Start > 3.5 char	Address 8 bits	Command 8 bits	Data N * 8 bits	CRC L 8 bits	CRC H 8 bits

Response from fan:	Start > 3.5 char	Address 8 bits	Command 8 bits	Data N * 8 bits	CRC L 8 bits	CRC H 8 bits

Contrary to the general specification the maximum telegram length is 80 bytes.

1.2.1 Command from master

A master device is a PC or a control unit, for example.

Start synchronization:

Start synchronization is provided by a silent interval of at least 3.5 bytes.
The next following byte is then interpreted as the first byte of a frame (i.e. address).
The interval between the individual bytes of a frame must not exceed 1.5 bytes.

Address:

The size of the address field is 8 bits.
Address values between 1 and 247 are permitted
The address 0 is intended for broadcast commands (i.e. command to all fans in the network).

Command:

The following commands of the general specification "MODBUS Application Protocol Specification V1.1" are supported:

Code	Command
0x03	Read holding register
0x04	Read input register
0x06	Write single register
0x08	Diagnostics
0x10	Write multiple register

The other commands are not supported.

ebm-papst has additionally defined the following commands:

Code	Command
0x43	Read holding register addressed by serial no.
0x44	Read input register addressed by serial no.
0x46	Write single register addressed by serial no.
0x50	Write multiple register addressed by serial no.

Data:

The number of data bytes and their meaning differ depending on the command.
See 1.3 Commands

CRC L / CRC H

A checksum CRC is formed across the entire telegram.
The polynomial for checksum formation is $1 + x^2 + x^{15} + x^{16}$ (i.e. XOR operation with 0xA001).
The start value is 0xFFFF.

The low byte of the checksum is transmitted first, then the high byte.

Further information on calculating the checksum can be found in the "MODBUS over Serial Line Specification & Implementation guide V1.0".

1.2.2 Response from fan

A fan only responds if

- it has been addressed with its own address.
  No response is transmitted in the case of a broadcast address.
- the telegram length is max. 80 bytes.
- the correct number of data bytes has been transmitted to permit interpretation of the telegram.
- the checksum has been correctly detected.

Start synchronization:

Following completion of the command from the master the fan waits for a silent interval of *at least* 3.5 bytes to elapse. Depending on the command and processing time, the interval may also be considerably longer (until all the requested data are available to the fan)
For access times to holding registers, see 2.1

Address:

The address from the command of the master (i.e. the fan's own address) is repeated

Command:

If the command can be processed, the command code is repeated.

If the command cannot be processed, the fan responds with an exception.
In this case, the MSB is set in the command.
The command byte for the command "Read holding register (0x03)" is then 0x83, for example.

Data:

The number of data bytes and their meaning differ depending on the command.
See 1.3 Commands.

CRC L / CRC H

A checksum CRC is formed across the entire telegram.
The checksum formation process is the same as the procedure described above for the command from the master.

1.3 Commands

1.3.1 Read holding register

Command code: 0x03

The content of multiple holding registers can be read out with this command.
Holding registers are parameters for which both read access and write access exist

Command from master:

4 data bytes are transmitted:
- 1st holding register address MSB
- 1st holding register address LSB
- Number of addresses to be read MSB
- Number of addresses to be read LSB

The holding registers will be described later.

Response from fan:

The following data bytes are transmitted:
- Byte count (number of addresses to be read * 2)
- Data of 1st holding register MSB
- Data of 1st holding register LSB

Optional:
- Data of the following holding registers (0..n)

Exception codes:

Just one data byte (exception code) is transmitted in the event of an error

Exception codes:

0x02: The permissible range of the holding registers has been exceeded
0x03: The maximum telegram length for the response (80 bytes) has been exceeded, i.e. more than 37 holding registers or 0 holding registers were requested.
0x04: A holding register cannot be read on account of a fault in the electronics

1.3.2 Read input register

Command code: 0x04

The content of multiple input registers can be read out with this command.
Input registers are parameters for which only read access exists.

Command from master:

4 data bytes are transmitted:
- 1st input register address MSB
- 1st input register address LSB
- Number of addresses to be read MSB
- Number of addresses to be read LSB

The input registers will be described later.

Response from fan:

The following data bytes are transmitted:
- Byte count (number of addresses to be read * 2)
- Data of 1st input register MSB
- Data of 1st input register LSB

Optional:
- Data of the following input registers (0..n)

Exception codes:

Just one data byte (exception code) is transmitted in the event of an error

Exception codes:

0x02: The permissible range of the input registers has been exceeded
0x03: The maximum telegram length for the response (80 bytes) has been exceeded, i.e. more than 37 input registers or 0 input registers were requested.

1.3.3 Write single register

Command code: 0x06

The content of *one* holding register can be written with this command.

<u>Command from master:</u>

4 data bytes are transmitted:
- Holding register address MSB
- Holding register address LSB
- Data to be written MSB
- Data to be written LSB

The holding registers will be described later.

<u>Response from fan:</u>

4 data bytes are transmitted:
- Holding register address MSB
- Holding register address LSB
- Data to be written MSB
- Data to be written LSB

<u>Exception codes:</u>

Just one data byte (exception code) is transmitted in the event of an error

Exception codes:

0x02: The permissible range of the holding registers has been exceeded
0x04: - The holding register cannot be written on account of a fault in the electronics
- There is no write authorization at this authorization level (password).

1.3.4 Diagnostics

Command code: 0x08

The Modbus function can be checked with this command

Command from master:

The following data bytes are transmitted:
- Subfunction code MSB
- Subfunction code LSB
- 1 – 17 data bytes

Only the subfunction code 0000 is supported.

Response from fan:

The following data bytes are transmitted:
- Subfunction code MSB
- Subfunction code LSB
- 1 – 17 data bytes

Exception codes:

Just one data byte (exception code) is transmitted in the event of an error

Exception codes:

0x01: Subfunction code is not supported (≠ 0000)

1.3.5 Write multiple register

Command code: 0x10

The content of *multiple* holding registers can be written with this command.

Command from master:

The following data bytes are transmitted:
- Holding register address MSB
- Holding register address LSB
- Number of addresses to be written MSB
- Number of addresses to be written LSB
- Byte count (number of addresses to be written * 2)
- Data to be written of 1st holding register MSB
- Data to be written of 1st holding register LSB

Optional:
- Data to be written of the following holding registers (0..n)

The holding registers will be described later.

Response from fan:

4 data bytes are transmitted:
- Holding register address MSB
- Holding register address LSB
- Number of addresses to be written MSB
- Number of addresses to be written LSB

Exception codes:

Just one data byte (exception code) is transmitted in the event of an error

Exception codes:

0x02: The permissible range of the holding registers has been exceeded
0x03: - The maximum possible number of registers has been exceeded,
i.e. more than 123 holding register data or 0 holding register data were defined
- Byte count ≠ 2 * number of registers
- Number of data bytes ≠ byte count
0x04: - The holding register cannot be written on account of a fault in the electronics
- There is no write authorization at this authorization level (password).

1.3.6 Commands with addressing by serial number

These commands additionally use the serial numbers of the fans for addressing:
An identifier for the serial number of the fan (6 bytes) is transmitted in the data area of the commands.
Only the fan with the Modbus address and serial number specified in the command reacts to the command and responds.

The command with addressing by serial number is obtained from the standard command by inserting an identifier for the serial number after the command byte.

Serial number format:

ebm-papst allocates an individual serial number for each fan. The part which customers can read out is made up of the date of manufacture and the consecutive number. This can likewise be used for addressing. Should any unexpected problems arise, please inform us accordingly.

Format: YYWW00XXXX

YY	: Year of manufacture
WW	: Week of manufacture
00	: Fixed value 00
XXXX	: Consecutive number

The first 4 characters contain the date of manufacture (year / week).
The number XXXX starts running at zero at the start of each week of manufacture and is incremented by 1 for each fan. Each character can assume values from 0-9 and from A-Z. This yields a maximum encodable number of 36 characters per position, i.e. 36^4 = 1,679,616 devices / week

Example:
ebm-papst serial number: 09230012GY

Year of manufacture:	09	(2009)
Week:	23	(23)
Consecutive no.:	12GY	(49525)

The year of manufacture and week are each coded as a hex value in the command.
Each character of the consecutive no. is coded as an ASCII value.

In commands with addressing by serial number the serial number must be specified as follows:

Byte no.	Meaning	Example	Corresponds to holding register
Byte 0:	[Address]		
Byte 1:	[Command code]		
Byte 2:	Year of manufacture	0x09 (-> 2009)	D1A4 MSB
Byte 3:	Week	0x17 (-> 23)	D1A4 LSB
Byte 4:	Consecutive no. 1st character	0x31 (-> 1)	D1A3 MSB
Byte 5:	Consecutive no. 2nd character	0x32 (-> 2)	D1A3 LSB
Byte 6:	Consecutive no. 3rd character	0x47 (-> G)	D1A2 MSB
Byte 7:	Consecutive no. 4th character	0x59 (-> Y)	D1A2 LSB

This sequence differs from the one in which the serial number is stored in the holding registers D1A2 – D1A4 (cf. 2.62.1)!

Broadcast addressing

If the value 0x00 is transmitted in one or more bytes of the serial number identifier, the corresponding part of the serial number will not be checked by the fan. All the fans which have the rest of the serial number identifier will then respond.
All fans will respond if all bytes are transmitted with the value 0x00.

In the response, the fan's own address and serial number are given instead of the broadcast address / serial number 0x00.

Ways of determining the serial number:

- Printed on the nameplate of the fan
- Read serial number out of holding registers D1A2 – D1A4 (cf. 2.62.1)
- Broadcast addressing: The fan responds with its serial number

1.3.6.1 Read holding register addressed by serial no.

Command code: 0x43

The content of multiple holding registers can be read out with this command.
Holding registers are parameters for which both read access and write access exist.

Contrary to "MODBUS over Serial Line Specification & Implementation guide V1.0", the fan also responds to a broadcast command (Modbus address = 0).

<u>Command from master:</u>

10 data bytes are transmitted:
- Serial no. byte 1
- Serial no. byte 2
- Serial no. byte 3
- Serial no. byte 4
- Serial no. byte 5
- Serial no. byte 6
- 1st holding register address MSB
- 1st holding register address LSB
- Number of addresses to be read MSB
- Number of addresses to be read LSB

The holding registers will be described later.

<u>Response from fan:</u>

The following data bytes are transmitted:
- Serial no. byte 1
- Serial no. byte 2
- Serial no. byte 3
- Serial no. byte 4
- Serial no. byte 5
- Serial no. byte 6
- Byte count (number of addresses to be read * 2)
- Data of 1st holding register MSB
- Data of 1st holding register LSB

Optional:
- Data of the following holding registers (0..n)

<u>Exception codes:</u>

Just one data byte (exception code) is transmitted in the event of an error

Exception codes:

0x02: The permissible range of the holding registers has been exceeded
0x03: The maximum telegram length for the response (80 bytes) has been exceeded,
i.e. more than 34 holding registers or 0 holding registers were requested.
0x04: A holding register cannot be read on account of a fault in the electronics

1.3.6.2 Read input register addressed by serial no.

Command code: 0x44

The content of multiple input registers can be read out with this command.
Input registers are parameters for which only read access exists.

Contrary to "MODBUS over Serial Line Specification & Implementation guide V1.0", the fan also responds to a broadcast command (Modbus address = 0).

<u>Command from master:</u>

10 data bytes are transmitted:
- Serial no. byte 1
- Serial no. byte 2
- Serial no. byte 3
- Serial no. byte 4
- Serial no. byte 5
- Serial no. byte 6
- 1st input register address MSB
- 1st input register address LSB
- Number of addresses to be read MSB
- Number of addresses to be read LSB

The input registers will be described later.

<u>Response from fan:</u>

The following data bytes are transmitted:
- Serial no. byte 1
- Serial no. byte 2
- Serial no. byte 3
- Serial no. byte 4
- Serial no. byte 5
- Serial no. byte 6
- Byte count (number of addresses to be read * 2)
- Data of 1st holding register MSB
- Data of 1st holding register LSB

Optional:
- Data of the following input registers (0..n)

<u>Exception codes:</u>

Just one data byte (exception code) is transmitted in the event of an error

Exception codes:

0x02: The permissible range of the input registers has been exceeded
0x03: The maximum telegram length for the response (80 bytes) has been exceeded,
i.e. more than 34 input registers or 0 input registers were requested.

1.3.6.3 Write single register addressed by serial no.

Command code: 0x46

The content of *one* holding register can be written with this command.

Contrary to "MODBUS over Serial Line Specification & Implementation guide V1.0", the fan also responds to a broadcast command (Modbus address = 0) provided that no broadcast identifier (0) was used in the serial number. As two different fans cannot have the same serial number, it is impossible for multiple fans to respond to one command.

Command from master:

10 data bytes are transmitted:
- Serial no. byte 1
- Serial no. byte 2
- Serial no. byte 3
- Serial no. byte 4
- Serial no. byte 5
- Serial no. byte 6
- Holding register address MSB
- Holding register address LSB
- Data to be written MSB
- Data to be written LSB

The holding registers will be described later.

Response from fan:

10 data bytes are transmitted:
- Serial no. byte 1
- Serial no. byte 2
- Serial no. byte 3
- Serial no. byte 4
- Serial no. byte 5
- Serial no. byte 6
- Holding register address MSB
- Holding register address LSB
- Data to be written MSB
- Data to be written LSB

The command from the master is repeated in the response

Exception codes:

Just one data byte (exception code) is transmitted in the event of an error

Exception codes:

0x02: The permissible range of the holding registers has been exceeded
0x04: There is no write authorization at this authorization level (password).

1.3.6.4 Write multiple register addressed by serial no.

Command code: 0x50

The content of *multiple* holding registers can be written with this command.

<u>Command from master:</u>

The following data bytes are transmitted:
- Serial no. byte 1
- Serial no. byte 2
- Serial no. byte 3
- Serial no. byte 4
- Serial no. byte 5
- Serial no. byte 6
- Holding register address MSB
- Holding register address LSB
- Number of addresses to be written MSB
- Number of addresses to be written LSB
- Byte count (number of addresses to be written * 2)
- Data to be written of 1st holding register MSB
- Data to be written of 1st holding register LSB

Optional:
- Data to be written of the following holding registers (0..n)

The holding registers will be described later.

<u>Response from fan:</u>

10 data bytes are transmitted:
- Serial no. byte 1
- Serial no. byte 2
- Serial no. byte 3
- Serial no. byte 4
- Serial no. byte 5
- Serial no. byte 6
- Holding register address MSB
- Holding register address LSB
- Number of addresses to be written MSB
- Number of addresses to be written LSB

<u>Exception codes:</u>

Just one data byte (exception code) is transmitted in the event of an error

Exception codes:
0x02: The permissible range of the holding registers has been exceeded
0x03: - The maximum possible number of registers has been exceeded,
i.e. more than 123 holding register data or 0 holding register data were defined
- Byte count ≠ 2 * number of registers
- Number of data bytes ≠ byte count
0x04: - The holding register cannot be written on account of a fault in the electronics
- There is no write authorization at this authorization level (password).

1.3.6.5 Applications

Initialization of an installation

All fans have the same address 1 ex works. To be able to address each fan individually in the case of an installation made up of multiple fans, this address has to be changed so that each fan has a different address.

Standard procedure (command 0x06 Write single register):
1. Switch on the first fan (leave all others switched off)
2. Change the address using the command 0x06 Write single register
3. Switch on the next fan
4. Repeat steps 2 and 3 until all fans have an individual address

Procedure if serial numbers are known (e.g. printed on nameplate)
1. Switch on all fans
2. Change the addresses using the command 0x46 Write single register addressed by serial no.

Procedure if serial numbers are not known:
1. Switch on all fans
2. Identify the serial numbers using the command 0x43 Read holding register addressed by serial no. or 0x44 Read input register addressed by serial no. in broadcast addressing with collision detection
3. Once a serial number has been identified:
   Change the Modbus address using the command 0x46 Write single register addressed by serial no.

The advantage over the standard procedure is that all the fans can be switched on simultaneously on initializing an installation. Each fan can be addressed individually despite having the same address 1. The master device (e.g. PC) can allocate an individual address to each fan without the need for any switching operations in the installation.

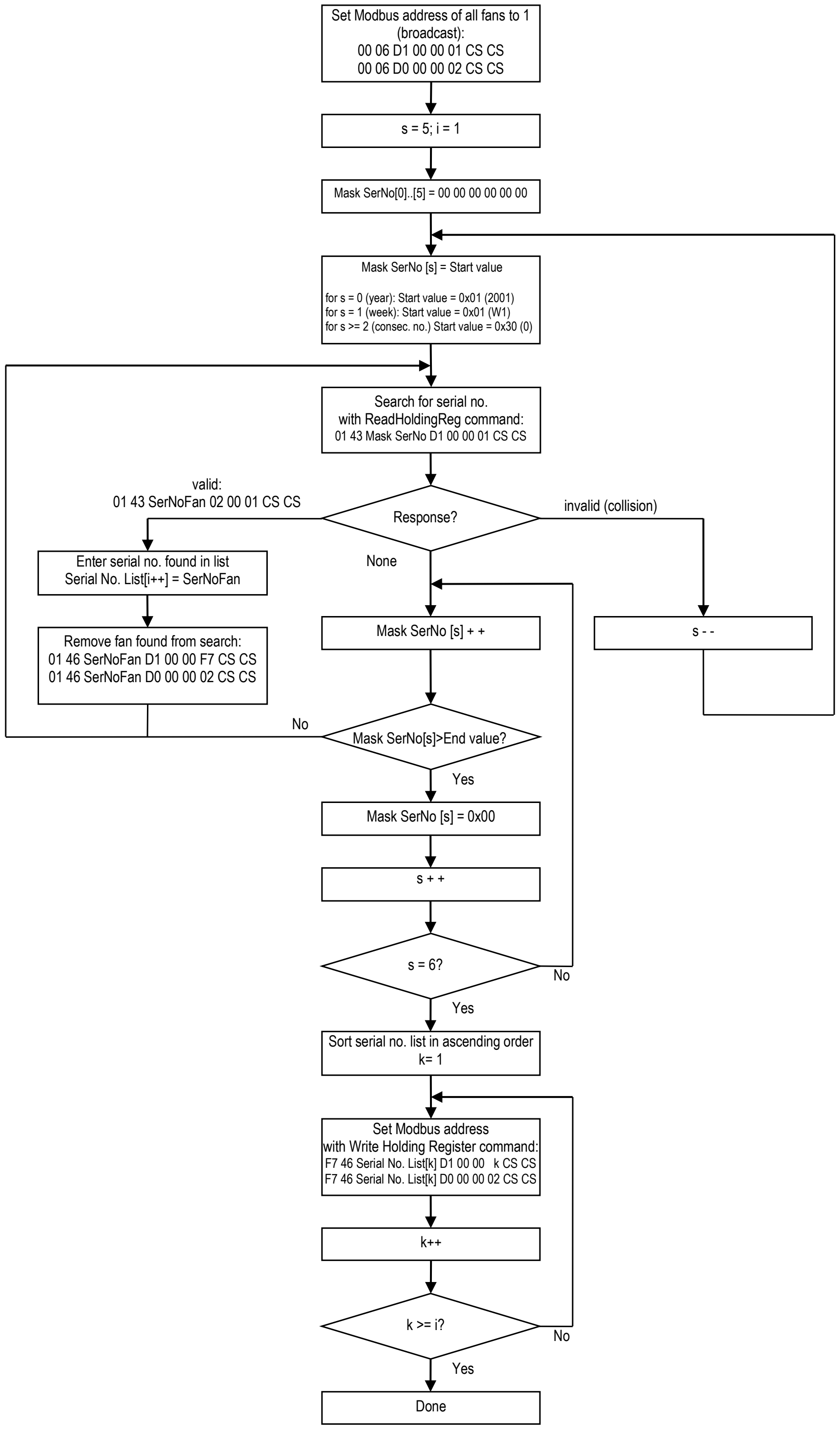
Implementation in master device (e.g. PC):

If the serial numbers are known, the following procedure is recommended for implementation in a master device:

1. The master device is informed of all serial numbers by way of manual input

2. A Modbus address is allocated to each fan by way of the serial number.
   For this, 2 broadcast commands are required for each fan:
   a. Set holding register for fan address (D100):
      00 46 SNo SNo SNo SNo SNo SNo D1 00 00 Add CS CS
      (CS = CRC checksum)
   b. Set holding register for reset (D000) to 0x02 Transfer parameter:
      00 46 SNo SNo SNo SNo SNo SNo D0 00 00 02 CS CS
      SNo = fan serial number established;   Add = allocated Modbus address

If the serial numbers are not known, the following algorithm is recommended for implementation in a master device:



Procedure:

On setting up the installation, the fans must be arranged in the ascending order of their serial numbers. This is necessary to ensure simple assignment of the automatically allocated Modbus addresses to the fans in the installation.

To start with, all fans are set to the Modbus address 0x01.
2 broadcast commands are required for this:

- Set holding register fan address (D100) to 0x01: 00 06 D1 00 00 01 CS CS
  (CS = CRC checksum)
- Set holding register for reset (D000) to 0x02 Transfer parameter: 00 06 D0 00 00 02 CS CS

All the serial numbers of the installation are determined in a loop:
The mask for serial number addressing is first set to broadcast addressing
(00 00 00 00 00 00). The last byte is set to the start value 0x30 (0).
The SerNo mask is thus 00 00 00 00 00 30.
This mask is used to search for fans with the value 0x30 (0) at the last position of the serial number.
Use can be made of any command for reading a holding register or input register, e.g. Read holding register fan address: 01 43 00 00 00 00 00 30 D1 00 00 01 CS CS

There are several possible outcomes for the response:

- An unequivocal response:
  The fan responds with its serial number (SerNoFan) in the address field.
  This serial number is stored in a list.
  The fan is then blocked for further requests by setting the Modbus address to 0xF7 (247).
  The same serial number then has to be polled again, as there is a possibility that a further fan may also have been addressed but did not respond as it had already detected the start of the response of the other fan on account of differences in runtime.
- An invalid response due to overlaid responses from multiple fans:
  The serial number mask then has to be further restricted by also setting the penultimate byte to the start value 0x30 (0). Only fans with the value 0x30 (0) at the last two positions of the serial number will then respond to the next request.
- No response:
  All serial numbers with the value 0x30 at the last position can then be excluded. The last byte of the mask is incremented to the value 0x31 (1). All fans with the value 0x31 (1) at the last position of the serial number will then respond on next polling.

The loop is continued until all serial numbers have been polled:

- In the event of a valid response, the serial number of the fan is stored in the list
- In the event of an invalid response, the serial number range is further restricted by masking another byte, commencing with the start value. For the last 4 bytes the start value is 0x30 (0). The first two bytes have a start value of 0x01, as the year (2001) and week (W1) are coded here.
- If there is no response, the position concerned is incremented by 1 until the end value is reached.
  For the last 4 bytes the end value is 0x5A (Z). For the first byte (year), the end value is 0x63 (2099); for the second byte (W), the end value is 0x35 (W53).
  Once the end value has been reached, the position concerned is addressed again by way of broadcast addressing (0x00) and the next position is incremented by 1. When the addressing for the last byte reaches the end value 0x5A (Z), all serial numbers have been checked. The polling of serial numbers can thus be concluded.

All the serial numbers found are then sorted in ascending order in the master.
A Modbus address is allocated to each fan by way of the serial number.
For this, 2 commands are required for each fan:

- Set holding register for fan address (D100): F7 46 SNo SNo SNo SNo SNo SNo D1 00 00 Add CS CS
- Set holding register for reset (D000) to 0x02 Transfer parameter:
  F7 46 SNo SNo SNo SNo SNo SNo D0 00 00 02 CS CS
  SNo = fan serial number established; Add = allocated Modbus address

Extension of address space

A maximum of 247 fans can be addressed with standard Modbus commands.
The commands with addressing by serial number make it possible to address any number of ebm-papst fans with a Modbus interface. In this case the fan address is not made up of just one byte but rather of 7 bytes (Modbus address + 6-byte serial number). This address is set at the factory and cannot be changed.

The serial number must be known to the master device (e.g. PC) for addressing, as a scan of all serial numbers is not possible on account of the large number involved. See above for determination of serial number ("Initialization of an installation").

With an extended address space, use can only be made of commands with addressing by serial number.
Collisions are inevitable if standard commands are used, as multiple fans have the same Modbus address.

Determination of unknown Modbus address

- There must not be more than one fan connected to the bus
- Command 0x43 Read holding register addressed by serial no. or 0x44 Read input register addressed by serial no. in broadcast addressing:
  Modbus address and serial number identifier are given as 0x00
- The connected fan responds with its Modbus address and serial number

1.3.7 Other commands

All other commands are not supported.
The response to a command is always the exception code 0x01.

2 Holding registers

2.1 Overview

The holding registers are stored in the RAM and in the EEPROM of the fan.
The access times (and thus also the response times) differ depending on the area

The following areas have been defined:

Address	Area	Typ. time for read access	Typ. time for write access
D000 to D0FF	RAM	1 µs / holding register	1 µs / holding register
D100 to D37F D400 to D5FF D600 to D67F	EEPROM	160 µs / holding register	6.3 ms / holding register
D380 to D3FF	Mirror range	See corresponding original range	See corresponding original range

The following list provides an overview of all parameters.
In addition to the Modbus address and the designation, it shows the authorization level required to write a parameter, as well as the address of the memory location for factory setting and customer setting (if applicable).

The function of the parameters is described in the following sections

Modbus address	Designation	Writing ebm-papst	Writing Customer	Writing End customer	Fact. setting Address	Cust. setting Address
D000	Reset	X	X	X	-	-
D001	Setpoint	X	X	X	-	-
D002 D003 D004	Password	X	X	X	-	-
D005	Factory setting Control	X	X *)	-	-	-
D006	Customer setting Control	X	X	X *)	-	-
D007	Reserved	X	-	-	-	-
D008	Reserved	X	-	-	-	-
D009	Operating hours counter	X	-	-	-	-
D00A	Operating minutes counter	X	-	-	-	-
D00B	Reserved	-	-	-	-	-
D00C	Addressing on / off	X	X	X	-	-
D00D	Stored set value (parameter set 1)	X	X	X	-	-
D00E	Stored set value (parameter set 2)	X	X	X	-	-
D00F	Enable / Disable	X	X	X	-	-
D010	Remote control output 0-10 V	X	X	X	-	-
D011	Test run Control	X	X	X	-	-
D012	Mask-out Back-up Control	X	X	X	-	-
D013 to D0F5	Not assigned	-	-	-	-	-
D0F6 to D0FF	Reserved	X	-	-	-	-

Modbus address	Designation	Writing ebm-papst	Writing Customer	Writing End customer	Fact. setting Address	Cust. setting Address
D100	Fan address	X	X	X	D280	D200
D101	Set value source	X	X	X	D281	D201
D102	Preferred running direction	X	X	X	D282	D202
D103	Store set value	X	X	X	D283	D203
D104	Parameter set source	X	X	X	D284	D204
D105	Parameter set internal	X	X	X	D285	D205
D106	Operating mode (parameter set 1)	X	X	X	D286	D206
D107	Operating mode (parameter set 2)	X	X	X	D287	D207
D108	Direction of action (parameter set 1)	X	X	X	D288	D208
D109	Direction of action (parameter set 2)	X	X	X	D289	D209
D10A	P factor (parameter set 1)	X	X	X	D28A	D20A
D10B	P factor (parameter set 2)	X	X	X	D28B	D20B
D10C	I factor (parameter set 1)	X	X	X	D28C	D20C
D10D	I factor (parameter set 2)	X	X	X	D28D	D20D
D10E	Max. modulation level (parameter set 1)	X	X	-	D28E	D20E
D10F	Max. modulation level (parameter set 2)	X	X	-	D28F	D20F
D110	Min. modulation level (parameter set 1)	X	X	X	D290	D210
D111	Min. modulation level (parameter set 2)	X	X	X	D291	D211
D112	Motor stop enable (parameter set 1)	X	X	X	D292	D212
D113	Motor stop enable (parameter set 2)	X	X	X	D293	D213
D114	Reserved	X	-	-	D294	D214
D115	Reserved	X	-	-	D295	D215
D116	Starting modulation level	X	-	-	D296	D216
D117	Max. permissible modulation level	X	-	-	D297	D217
D118	Min. permissible modulation level	X	-	-	D298	D218
D119	Max. speed	X	X	-	D299	D219
D11A	Max. permissible speed	X	-	-	D29A	D21A
D11B	Reserved	X	-	-	D29B	D21B
D11C	Reserved	X	-	-	D29C	D21C
D11D	Not assigned	X	X	X	D29D	D21D
D11E	Reserved	X	-	-	D29E	D21E
D11F	Ramp-up curve	X	X	X	D29F	D21F
D120	Ramp-down curve	X	X	X	D2A0	D220
D121	Reserved	X	-	-	D2A1	D221
D122	Reserved	X	-	-	D2A2	D222
D123	Reserved	X	-	-	D2A3	D223
D124	Reserved	X	-	-	D2A4	D224
D125	Not assigned	X	X	X	D2A5	D225
D126	Reserved	X	-	-	D2A6	D226
D127	Reserved	X	-	-	D2A7	D227
D128	Speed limit	X	-	-	D2A8	D228
D129	Not assigned	X	X	X	D2A9	D229
D12A	Input characteristic curve point 1 X-coordinate (par. 1)	X	X	X	D2AA	D22A
D12B	Input characteristic curve point 1 Y-coordinate (par. 1)	X	X	X	D2AB	D22B
D12C	Input characteristic curve point 2 X-coordinate (par. 1)	X	X	X	D2AC	D22C
D12D	Input characteristic curve point 2 Y-coordinate (par. 1)	X	X	X	D2AD	D22D
D12E	Direction of action source	X	X	X	D2AE	D22E
D12F	Limitation Control	X	-	-	D2AF	D22F
D130	Function output 0..10 V / speed monitoring	X	X	-	D2B0	D230
D131	Reserved	X	-	-	D2B1	D231
D132	Reserved	X	-	-	D2B2	D232
D133	Reserved	X	-	-	D2B3	D233
D134	Reserved	X	-	-	D2B4	D234

Modbus address	Designation	Writing ebm-papst	Writing Customer	Writing End customer	Fact. setting Address	Cust. setting Address
D135	Max. permissible power	X	-	-	D2B5	D235
D136	Max. power at derating end	X	X	-	D2B6	D236
D137	Module temperature power derating start	X	X	-	D2B7	D237
D138	Module temperature power derating end	X	X	-	D2B8	D238
D139	Reserved	X	-	-	D2B9	D239
D13A	Reserved	X	-	-	D2BA	D23A
D13B	Max. coil current	X	-	-	D2BB	D23B
D13C	Input characteristic curve point 1 X-coordinate (par. 2)	X	X	X	D2BC	D23C
D13D	Input characteristic curve point 1 Y-coordinate (par. 2)	X	X	X	D2BD	D23D
D13E	Input characteristic curve point 2 X-coordinate (par. 2)	X	X	X	D2BE	D23E
D13F	Input characteristic curve point 2 Y-coordinate (par. 2)	X	X	X	D2BF	D23F
D140	Characteristic curve output 0..10 V point 1 X	X	X	X	D2C0	D240
D141	Characteristic curve output 0..10 V point 1 Y	X	X	X	D2C1	D241
D142	Characteristic curve output 0..10 V point 2 X	X	X	X	D2C2	D242
D143	Characteristic curve output 0..10 V point 2 Y	X	X	X	D2C3	D243
D144	Not assigned	X	X	X	D2C4	D244
D145	Speed limit for running monitoring	X	X	-	D2C5	D245
D146	Reserved	X	-	-	D2C6	D246
D147	Sensor actual value source	X	X	X	D2C7	D247
D148	Running direction source	X	X	X	D2C8	D248
D149	Transmission speed	X	X	-	D2C9	D249
D14A	Parity configuration	X	X	-	D2CA	D24A
D14B	Not assigned	X	X	X	D2CB	D24B
D14C	Not assigned	X	X	X	D2CC	D24C
D14D	Motor temperature power derating start	X	X	-	D2CD	D24D
D14E	Motor temperature power derating end	X	X	-	D2CE	D24E
D14F	Not assigned	X	X	X	D2CF	D24F
D150	Shedding function	X	X	-	D2D0	D250
D151	Max. starting modulation level	X	-	-	D2D1	D251
D152	Number of start attempts	X	X	-	D2D2	D252
D153	Relay dropout delay	X	X	X	D2D3	D253
D154	Reserved	X	-	-	D2D4	D254
D155	Max. power	X	X	-	D2D5	D255
D156	Not assigned	X	X	X	D2D6	D256
D157	Reserved	X	-	-	D2D7	D257
D158	Configuration of I/O 1	X	X	X	D2D8	D258
D159	Configuration of I/O 2	X	X	X	D2D9	D259
D15A	Configuration of I/O 3	X	X	X	D2DA	D25A
D15B	Fail-safe running direction	X	X	-	D2DB	D25B
D15C	Fail-safe set value source	X	X	-	D2DC	D25C
D15D	Fail-safe set value	X	X	-	D2DD	D25D
D15E	Fail-safe time delay	X	X	-	D2DE	D25E
D15F	Open circuit limit value input characteristic curve	X	X	-	D2DF	D25F
D160 D161	Min. sensor value	X	X	X	D2E0 D2E1	D260 D261
D162 D163	Max. sensor value	X	X	X	D2E2 D2E3	D262 D263
D164 to D169	Sensor unit	X	X	X	D2E4 to D2E9	D264 to D269
D16A	Enable / Disable source	X	X	X	D2EA	D26A
D16B	Stored Enable / Disable	X	X	X	D2EB	D26B
D16C	Set value source switching	X	X	X	D2EC	D26C
D16D	Power derating ramp	X	X	-	D2ED	D26D

Modbus address	Designation	Writing ebm-papst	Writing Customer	Writing End customer	Fact. setting Address	Cust. setting Address
D16E	Voltage output	X	X	X	D2EE	D26E
D16F	RFID access	X	X	-	D2EF	D26F
D170 to D17F	Customer data	X	X	-	D2F0 to D2FF	D270 to D27F
D180	Operating hours counter (back-up)	X	-	-	-	-
D181	Reserved	X	-	-	-	-
D182	Error indicator	X	-	-	-	-
D183	Not assigned	X	-	-	-	-
D184	1st error	X	-	-	-	-
D185	Time of 1st error	X	-	-	-	-
D186 to D19F	Error history Time of error history	X	-	-	-	-
D1A0	DC-link voltage reference value	X	-	-	-	-
D1A1	DC-link current reference value	X	-	-	-	-
D1A2 D1A3	Fan serial number	X	-	-	-	-
D1A4	Date of fan manufacture	X	-	-	-	-
D1A5 to D1AA	Fan type	X	-	-	-	-
D1AB to D1AC	Reserved	X	-	-	-	-
D1AD to D1AE	Reserved	X	-	-	-	-
D1AF	Reserved	X	-	-	-	-
D1B0	Reserved	X	-	-	-	-
D1B1	Reserved	X	-	-	-	-
D1B2	Reserved	X	-	-	-	-
D1B3	Reserved	X	-	-	-	-
D1B4 to D1B5	Reserved	X	-	-	-	-
D1B6	Reserved	X	-	-	-	-
D1B7	Reserved	X	-	-	-	-
D1B8 to D1BF	Reserved	X	-	-	-	-
D1C0 to D1C1	Reserved	X	-	-	-	-
D1C2 to D1C9	Reserved	X	-	-	-	-
D1CA to D1D1	Reserved	X	-	-	-	-
D1D2 to D1D9	Reserved	X	-	-	-	-
D1DA to D1E1	Reserved	X	-	-	-	-
D1E2	Not assigned	X	-	-	-	-
D1E3 to D1E4	Reserved	X	-	-	-	-
D1E5 to D1E6	Reserved	X	-	-	-	-
D1E7	Reserved	X	-	-	-	-
D1E8	Reserved	X	-	-	-	-
D1E9	Reserved	X	-	-	-	-

Modbus address	Designation	Writing ebm-papst	Writing Customer	Writing End customer	Fact. setting Address	Cust. setting Address
D1EA to D1EC	Reserved	X	-	-	-	-
D1ED to D1EE	Not assigned	X	-	-	-	-
D1EF to D1F4	Reserved	X	-	-	-	-
D1F5	Reserved	X	-	-	-	-
D1F6	Reserved	X	-	-	-	-
D1F7	Rotor position sensor calibration set value	X	-	-	-	-
D1F8	Rotor position sensor calibration	X	-	-	-	-
D1F9 to D1FA	Reserved	X	-	-	-	-
D1FB to D1FC	Reserved	X	-	-	-	-
D1FD	Reserved	X	-	-	-	-
D1FE	Reserved	X	-	-	-	-
D1FF	Reserved	X	-	-	-	-
D300 to D30F	Reserved	X	-	-	-	-
D310 to D31F	Reserved	X	-	-	-	-
D320	Reserved	X	-	-	-	-
D321	Reserved	X	-	-	-	-
D322	Reserved	X	-	-	-	-
D323	Reserved	X	-	-	-	-
D324 to D341	Reserved	X	-	-	-	-
D342	Speed mask-out range 1 min back-up	X	-	-	-	-
D343	Speed mask-out range 1 max back-up	X	-	-	-	-
D344	Speed mask-out range 2 min back-up	X	-	-	-	-
D345	Speed mask-out range 2 max back-up	X	-	-	-	-
D346	Speed mask-out range 3 min back-up	X	-	-	-	-
D347	Speed mask-out range 3 max back-up	X	-	-	-	-
D348	Speed mask-out range 4 min back-up	X	-	-	-	-
D349	Speed mask-out range 4 max back-up	X	-	-	-	-
D34A	Speed mask-out range 5 min back-up	X	-	-	-	-
D34B	Speed mask-out range 5 max back-up	X	-	-	-	-
D34C	Modulation level mask-out range 1 min back-up	X	-	-	-	-
D34D	Modulation level mask-out range 1 max back-up	X	-	-	-	-
D34E	Modulation level mask-out range 2 min back-up	X	-	-	-	-
D34F	Modulation level mask-out range 2 max back-up	X	-	-	-	-
D350	Modulation level mask-out range 3 min back-up	X	-	-	-	-
D351	Modulation level mask-out range 3 max back-up	X	-	-	-	-
D352	Modulation level mask-out range 4 min back-up	X	-	-	-	-
D353	Modulation level mask-out range 4 max back-up	X	-	-	-	-
D354	Modulation level mask-out range 5 min back-up	X	-	-	-	-
D355	Modulation level mask-out range 5 max back-up	X	-	-	-	-
D356	Test run time stamp	X	-	-	-	-
D357	Number of mask-out ranges	X	-	-	-	-
D358 to D359	Reserved	X	-	-	-	-
D35A to D35F	Reserved	X	-	-	-	-

Modbus address	Designation	Writing ebm-papst	Writing Customer	Writing End customer	Fact. setting Address	Cust. setting Address
D360 to D37F	Reserved	X	-	-	-	-
D380 to D39F	Mirrored holding registers	See original	See original	See original	-	-
D3A0 to D3FF	Not defined	-	-	-	-	-
D400 to D40F	Original addresses of mirrored input registers	X	X	-	-	-
D410 to D47F	Not defined	-	-	-	-	-
D480 to D49F	Original addresses of mirrored holding registers	X	X	-	-	-
D4A0 to D4FF	Not defined	-	-	-	-	-
D500 to D509	Reserved	X	X	X	-	-
D50A to D53F	Not assigned	X	X	X	-	-
D540 to D549	Reserved	X	X	-	-	-
D54A to D57F	Not assigned	X	X	-	-	-
D580 to D5FF	Not assigned	X	-	-	-	-
D600 to D602	Not assigned	X	X	X	D780 to D782	D700 to D702
D603	Mask-out Control	X	X	X	D783	D703
D604	Speed mask-out range 1 min	X	X	X	D784	D704
D605	Speed mask-out range 1 max	X	X	X	D785	D705
D606	Speed mask-out range 2 min	X	X	X	D786	D706
D607	Speed mask-out range 2 max	X	X	X	D787	D707
D608	Speed mask-out range 3 min	X	X	X	D788	D708
D609	Speed mask-out range 3 max	X	X	X	D789	D709
D60A	Speed mask-out range 4 min	X	X	X	D78A	D70A
D60B	Speed mask-out range 4 max	X	X	X	D78B	D70B
D60C	Speed mask-out range 5 min	X	X	X	D78C	D70C
D60D	Speed mask-out range 5 max	X	X	X	D78D	D70D
D60E	Modulation level mask-out range 1 min	X	X	X	D78E	D70E
D60F	Modulation level mask-out range 1 max	X	X	X	D78F	D70F
D610	Modulation level mask-out range 2 min	X	X	X	D790	D710
D611	Modulation level mask-out range 2 max	X	X	X	D791	D711
D612	Modulation level mask-out range 3 min	X	X	X	D792	D712
D613	Modulation level mask-out range 3 max	X	X	X	D793	D713
D614	Modulation level mask-out range 4 min	X	X	X	D794	D714
D615	Modulation level mask-out range 4 max	X	X	X	D795	D715
D616	Modulation level mask-out range 5 min	X	X	X	D796	D716
D617	Modulation level mask-out range 5 max	X	X	X	D797	D717
D618	Reserved	X	-	-	D798	D718
D619	Reserved	X	-	-	D799	D719
D61A	Device internal bus slave select	X	-	-	D79A	D71A
D61B	Not assigned	X	X	X	D79B	D71B
D61C	Reserved	X	-	-	D79C	D71C
D61D	Reserved	X	-	-	D79D	D71D

Modbus address	Designation	Writing ebm-papst	Writing Customer	Writing End customer	Fact. setting Address	Cust. setting Address
D61E	Reserved	X	-	-	D79E	D71E
D61F	Reserved	X	-	-	D79F	D71F
D620	Error output delay	X	X	X	D7A0	D720
D621	Warning output delay	X	X	X	D7A1	D721
D622	Warning output mask	X	X	X	D7A2	D722
D623	Relay actuation mask error	X	X	X	D7A3	D723
D624	Relay actuation mask warning	X	X	X	D7A4	D724
D625	Reserved	X	-	-	D7A5	D725
D626	Reserved	X	-	-	D7A6	D726

*) Only in part

There is no direct write access to the customer setting values (D200 – D27F; D700 – D77F) and the factory setting values (D280 – D2FF; D780 – D7FF). These holding registers can only be changed by way of the holding registers Customer setting Control (see 2.6) and Factory setting Control (see 2.5).

<u>Coding of parameters:</u>
Unless otherwise stated, parameters are coded in "big endian" format, i.e. the byte with the most significant bits comes first. This applies in particular to parameters covering multiple holding registers.

2.2 Reset

Address : D000
Write authorization : ebm-papst, customer, end customer

Coding:

MSB	0	0	0	0	0	0	0	0
LSB	0	0	0	0	Reset	Error	Param.	Rst AS

A bit triggers the following action in the fan if it has been set:

Reset : Software reset (incorporates "Reset error" and "Transfer parameter")
Software is started at the start of the bootloader
Error : Errors are reset
Param. : All parameters are transferred from the EEPROM to the RAM
This bit has to be set to validate changed parameters
Reset AS : Application software reset
(incorporates "Reset error" and "Transfer parameter")
Software is started at the start of the application software

Following implementation of the action the bit is automatically reset by the fan.

On reset (bit 3), the program is re-started at the start of the bootloader. Commands from the master are then neither answered nor executed for a few seconds.
Reset (bit 3) is only recommended if a new application software is to be loaded via the bootloader (on account of the break in communication).
The application software reset (bit 0) is recommended if the software is to be merely re-started. There is then no break in communication.

2.3 Setpoint

Address : D001
Write authorization : ebm-papst, customer, end customer

A set value can be specified for each operating mode via Modbus using the parameter Setpoint.
This is only possible if RS485 (1) has been specified as "Set value source" (see 2.16 Set value source).
Otherwise the parameter has no function.

If the function "Store" is activated in the parameter "Store set value" (see 2.20 Store set value), the value is transferred to the parameter Stored set value with every write access to the setpoint (see 2.10 Stored set value).

The external input "Parameter set 1/2" or the parameter "Parameter set internal" can be used to select whether the value is stored in "Stored set value (parameter set 1)" or in "Stored set value (parameter set 2)" (see 2.22 Parameter set internal).

After a reset, the motor then starts up again with this value, provided that the parameter set selection has not been changed (see 2.20 Store set value).

> Attention!
> If the function "Store set value" is active and the parameter set is switched (from 1 to 2 or vice versa), the setpoint automatically changes to the value specified in the corresponding parameter "Stored set value (parameter set 1)" or "Stored set value (parameter set 2)".

Coding:

Note: The 4 LSBs have no significance for the set value and are always assumed to be 0.

a) In speed control operating mode

The setpoint designates a speed:

$$\mathit{Set\ value}\,[\mathrm{rpm}] = \frac{\mathit{Data\ bytes}}{64000} \cdot \mathit{nMax}\,[\mathrm{rpm}]$$

nMax [rpm] ... maximum speed in revolutions per minute (see 2.33 Maximum speed)

The value zero signifies motor standstill

b) In open-loop control operating mode

The setpoint designates a modulation level:

$$\mathit{Set\ value}\,[\%] = \frac{\mathit{Data\ bytes}}{65536} \cdot 100\%$$

The value zero signifies motor standstill

c) In sensor control operating mode

The setpoint designates a sensor quantity:

A sensor which converts the control variable into a voltage of 0..10 V or 4..20 mA must be connected to the fan.

A set value can be entered for the output voltage or output current of the sensor used.
The setpoint for the control variable is then obtained from the set value parameter and the characteristic curve Cv (U/I) of the sensor used.

Cv (U) = Control variable as a function of voltage

$$Set\ value\ [V] = \frac{Data\ bytes}{65536} \cdot 10V$$

$$Set\ value\ [unit\ (Cv)] = Cv\ (set\ value\ [V])$$

$$= Cv\ (\frac{Data\ bytes}{65536} \cdot 10V)$$

or

Cv (I) = Control variable as a function of current

$$Set\ value\ [mA] = \frac{Data\ bytes}{65536} \cdot 16mA + 4mA$$

$$Set\ value\ [unit(Cv)] = Cv\ (set\ value\ [V])$$

$$= Cv\ (\frac{Data\ bytes}{65536} \cdot 16mA + 4mA)$$

2.4 Password

Address : D002 – D004
Write authorization : ebm-papst, customer, end customer

Coding:

$$Password = Data\ bytes$$

To prevent the unauthorized writing of certain parameters, these will only be written if the correct password for the necessary authorization has been entered at this point.
If a user forgets to reset the password, this will be automatically reset to 0x000000000000 after 4 minutes of inactivity.

2.5 Factory setting Control

Address : D005
Write authorization : ebm-papst, customer (in part)

Coding:

MSB	0	0	0	0	0	0	0	0
LSB	0	0	0	0	0	Error	D -> F	F -> D

Setting the bit D -> F causes all the parameters of the data area (D100..D17F) to be copied to the factory setting (area D280..D2FF).
"ebm-papst" authorization is required for setting this bit.

Setting the bit F -> D causes all the parameters of the factory setting (area D280..D2FF) to be copied to the data area (D100..D17F).
"Customer" authorization is sufficient for setting this bit.

On completion of copying, the bit is automatically reset by the fan.

If an error occurs during copying, the "Error" bit is set and copying is terminated

2.6 Customer setting Control

Address : D006
Write authorization : ebm-papst, customer, end customer (in part)

Coding:

MSB	0	0	0	0	0	0	0	0
LSB	0	0	0	0	0	Error	D -> C	C -> D

Setting the bit D -> C causes all the parameters of the data area (D100..D17F) for which the customer has write authorization to be copied to the customer setting (area D200..D27F). A minimum of "Customer" authorization is required for setting this bit.

Setting the bit C -> D causes all the parameters of the customer setting (area D200..D27F) for which the customer has write authorization to be copied to the data area (D100..D17F).
"End customer" authorization is sufficient for setting this bit.

On completion of copying, the bit is automatically reset by the fan.

If an error occurs during copying, the "Error" bit is set and copying is terminated

2.7 Operating hours counter

Address : D009
Write authorization : ebm-papst

Coding:

$$Operating\ time\,[h] \quad = \quad Data\ bytes$$

The operating hours counter is incremented by 1 for every hour for which the fan runs.
The holding register D180 "Operating hours counter back-up" is simultaneously updated with every change (see 2.58 Operating hours counter (back-up))

A total of max. 65,535 hours (approx. 7.5 years) can be counted with 16 bits.
The operating hours counter will no longer be written to if it overflows, i.e. it remains on 65,535.

2.8 Operating minutes counter

Address : D00A
Write authorization : ebm-papst

Coding:

$$\textit{Operating minutes}\,[\text{min}] = \textit{Data bytes}$$

The operating minutes counter is incremented by 1 for every full minute for which the fan runs.

2.9 Addressing on / off

Address : D00C
Write authorization : ebm-papst, customer, end customer

Coding:

Value	Function
0x00	Addressing function inactive
0x01	Addressing function active

If the addressing function is active, the signal at the input Din1 is used to change the fan address (see 2.15 Fan address). I/O 1 must be configured as digital input for this (see 2.46)

Every positive edge (transition from "low" to "high") at the digital input Din1 causes the fan address to be incremented by 1. The maximum permissible frequency of the signal is 1.5 Hz (pulse length > 333 ms)

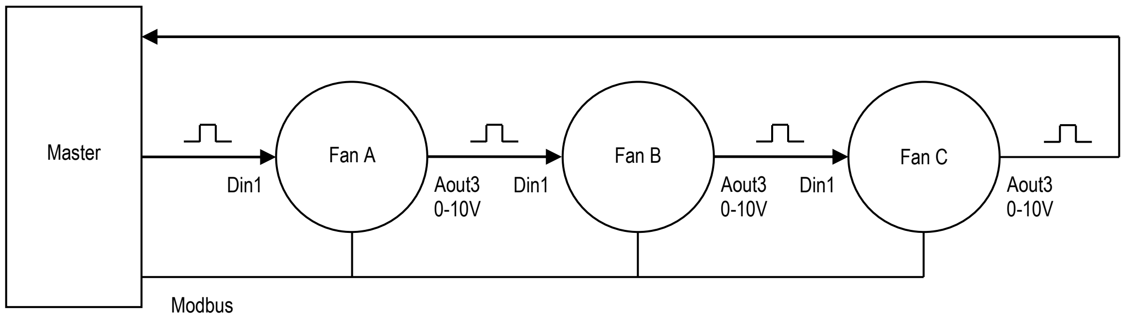
The pulses at the digital input Din1 can be passed on to the next fan at the 0-10 V output. The parameter "Function output 0-10 V" is to be accordingly set for this (see 2.39.1).
The first pulse following activation of the function is not passed on.

Attention:
This function has to be deactivated again on completion of addressing
- To transfer the fan address to the non-volatile memory (holding register D100, Fan address see 2.15)
- To avoid unintentional address changes

Application: Automatic addressing of an installation with the aid of an additional equipment wire

Hardware prerequisites:
Each fan requires a digital input (Din1) and a 0-10 V output (Aout 0-10 V)

System set-up:



- Fan A is connected to the master via the input Din1
- The 0-10 V output (Aout 0-10 V) of each fan is connected to the input Din1 of the next fan
- The 0-10 V output (Aout 0-10 V) of the last fan (C) is routed back to the master
- All the fans are connected to the master via Modbus

Sequence:

- All the fan addresses are set to the same value (e.g. 1) using a broadcast command.
- The parameter "Function output 0-10 V" of all fans is set to the value 4 Clock output for addressing using a broadcast command (see 2.39.1).
- The parameter Addressing on / off of all fans is set to the value 1 (active) using a broadcast command.
- The master generates a pulse on the equipment wire.
  Fan A increments its address to 2.
- The master generates another pulse on the equipment wire.
  Fan A increments its address to 3 and passes on the pulse to fan B.
  Fan B increments its address to 2.
- The master generates another pulse on the equipment wire.
  Fan A increments its address to 4 and passes on the pulse to fan B.
  Fan B increments its address to 3 and passes on the pulse to fan C.
  Fan C increments its address to 2.
- The master generates another pulse on the equipment wire.
  Fan A increments its address to 5 and passes on the pulse to fan B.
  Fan B increments its address to 4 and passes on the pulse to fan C.
  Fan C increments its address to 3 and passes on the pulse to the master.
- The master recognizes that the last fan has been addressed and deactivates the addressing function by setting the parameter Addressing on / off of all fans to the value 0 (inactive) using a broadcast command

A similar procedure applies to larger installations. The master continues generating pulses until the last fan sends a pulse back to the master.

2.10 Stored set value

Parameter set 1 address : D00D
Parameter set 2 address : D00E
Write authorization : ebm-papst, customer, end customer

The information in these parameters is only of relevance if the value for the parameter "Set value source" is "RS485" (1) (see 2.16 Set value source) and the function "Store set value" is active (see 2.20 Store set value). Otherwise the two parameters have no function.

As the setpoint is located in the volatile memory, this value (if applicable) has to be saved in the non-volatile memory as well to permit restarting with the last setpoint following interruption and restoration of the power supply. The parameter "Stored set value" is intended for this purpose.

If the parameter "Setpoint" is changed, the corresponding parameter "Stored set value (parameter set 1)" or "Stored set value (parameter set 2)" is also automatically set to the same value if the function "Store set value" is active (see 2.3 Setpoint, 2.20 Store set value).
The parameter "Parameter set internal" or the digital input can be used to select whether to store the value in "Stored set value (parameter set 1)" or the value in "Stored set value (parameter set 2)" (see 2.22 Parameter set internal).

Coding:

<u>a) In speed control operating mode</u>

The setpoint designates a speed:

$$Set\ value\,[\mathrm{rpm}] \quad = \quad \frac{Data\ bytes}{64000} \cdot nMax\,[\mathrm{rpm}]$$

nMax [rpm] ... maximum speed in revolutions per minute (see 2.33 Maximum speed)

The value zero signifies motor standstill

<u>b) In open-loop control operating mode</u>

The set value designates a modulation level:

$$Set\ value\,[\%] \quad = \quad \frac{Set\ value}{65536} \cdot 100\%$$

The value zero signifies motor standstill

Note: The 4 LSBs have no significance for the set value and are always assumed to be 0.

<u>c) In sensor control operating mode</u>

The set value designates a sensor quantity:

A sensor which converts the control variable into a voltage of 0..10 V or 4..20 mA must be connected to the fan.

A set value can be entered for the output voltage or output current of the sensor used.
The set value for the control variable is then obtained from the set value parameter and the characteristic curve Cv (U/I) of the sensor used.

Cv (U) = Control variable as a function of voltage

$$\textit{Set value}\,[V] \;=\; \frac{\textit{Data bytes}}{65536}\cdot 10V$$

$$\begin{aligned}\textit{Set value}\,[unit(Cv)] &= Cv\,(\textit{Set value}\,[V]) \\ &= Cv\,(\frac{\textit{Data bytes}}{65536}\cdot 10V)\end{aligned}$$

or

Cv (I) = Control variable as a function of current

$$\textit{Set value}\,[mA] = \frac{\textit{Data bytes}}{65536}\cdot 16mA + 4mA$$

$$\begin{aligned}\textit{Set value}\,[unit(Cv)] &= Cv\,(\textit{Set value}\,[V]) \\ &= Cv\,(\frac{\textit{Data bytes}}{65536}\cdot 16mA + 4mA)\end{aligned}$$

Note: The 4 LSBs have no significance for the set value and are always assumed to be 0.

2.11 Enable / Disable

Address : D00F
Write authorization : ebm-papst, customer, end customer

The information in this parameter is only of relevance if the value for "Disable source" is 1 (parameter Enable / Disable) (see 2.53). For more information on the Enable signal function, see 2.53

If the function "Store" is activated in the parameter "Store set value" (see 2.20 Store set value), the value will be transferred to the parameter "Stored Enable / Disable" if the power supply is interrupted (see 2.54). Once the power supply has been restored, the value of the parameter "Stored Enable / Disable" will be transferred back to the parameter "Enable / Disable" again.

Coding:

Value	Enable / Disable
0	Off (no enable)
1	On (enable)

Permissible value range: 0..1

2.12 Remote control output 0-10 V

Address : D010
Write authorization : ebm-papst, customer, end customer

Coding:

$$Remotecontrol\,value = \frac{Data\,bytes}{65536} \cdot 100\%$$

The information in this parameter is only of relevance if the value for "Function output 0-10 V" is "Remote control" (5) (see 2.39.1).

In this case the voltage at the output 0-10 V is obtained from the remote control value and the output 0-10 V characteristic curve. This characteristic curve assigns a voltage for the analog output to the remote control value: For further information, see 2.39.2 Characteristic curve output 0..10 V

2.13 Test run Control

Address : D011
Write authorization : ebm-papst, customer, end customer

Coding:

MSB	0	0	0	0	0	0	0	0
LSB	0	0	0	0	0	0	MinMax	Start

Start : Test run for determination of speed and modulation level ranges with excessively high vibration velocities.
Following implementation of the action the bit is automatically reset by the fan.

MinMax : If more than 5 ranges are detected in a test run...
– The ranges with the 5 lowest speeds are stored (MinMax = 0)
– The ranges with the 5 highest speeds are stored (MinMax = 1)

The content of the following parameters is ignored for the duration of the test run.
During the test run, the device operates with the values indicated below:

- Operating mode (see 2.23) = Speed control
- Maximum modulation level (see 2.27) = Maximum permissible modulation level (see 2.31)
- Minimum modulation level (see 2.28) = Minimum permissible modulation level (see 2.32)
- Motor stop enable (see 2.29) = Activated
- Maximum speed (see 2.33) = Maximum permissible speed (see 2.34)
- Ramp-up curve (see 2.35) = 0 / inactive
- Mask-out Control (see 2.66.1) = 0 / inactive

The setpoint (see 2.3) is ramped up from the value 0 until the value 0xFFFF is attained.

If vibration velocities that are greater than the limit value for the critical vibration velocity are measured during the test run, the parameters for masking-out a speed range (see 2.66.2) or modulation level range (see 2.66.3) are automatically written with the corresponding values.

The parameters for the back-up of these mask-out ranges (see 2.66.4, 2.66.5) are also automatically written with the same values.

2.14 Mask-out Back-up Control

Address : D012
Write authorization : ebm-papst, customer, end customer

Coding:

MSB	0	0	0	0	0	0	0	0
LSB	0	0	0	0	0	0	Error	Restore

Setting the Restore bit causes all ranges for the masking-out of speeds or modulation levels (see 2.66.2, 2.66.3) to be overwritten with the back-up values (see 2.66.4, 2.66.5)

On completion of copying, the bit is automatically reset by the fan.

If an error occurs during copying, the "Error" bit is set.

2.15 Fan address

Address : D100
Write authorization : ebm-papst, customer, end customer

Coding:

$$Fan\ address = Data\ bytes(LSB)$$

The MSB has no significance.

Permissible value range: 1...247

2.16 Set value source

Address : D101
Write authorization : ebm-papst, customer, end customer

Coding:

This parameter specifies the source of the set value:

Value	Set value source
0	Analog input Ain1
1	RS485 (parameter Setpoint D001)
2	Analog input Ain2
3	PWM input PWMin3

The MSB has no significance.
Permissible value range: 0..3

The information in this parameter is only of relevance if the value for the parameter "Set value source switching" is "Parameter set value source" (0) – see 2.17 Set value source switching

2.17 Set value source switching

Address : D16C
Write authorization : ebm-papst, customer, end customer

Coding:

This parameter can be used to select a signal that is used to switch the set value source.

The following table provides an overview of the selected set value source:

Value	Set value source 1 / 2 is selected by:	Set value source 1		Set value source 2	
		selected if	Source	selected if	Source
0	Parameter Set value source - see 2.16	always	see 2.16	---	---
1	Digital input Din1	Din1 = inactive	RS485	Din1 = active	Ain2
2	Digital input Din2	Din2 = inactive	RS485	Din2 = active	Ain1
3	Digital input Din3	Din3 = inactive	RS485	Din3 = active	Ain1
4	PWM status PWMin3	PWMin3 = static	Ain1	PWMin3 = active	PWMin3
5	PWM status PWMin3	PWMin3 = static	Ain2	PWMin3 = active	PWMin3

For a definition of DinX active / inactive, see 2.46

Definition of PWMin3 = static: The signal at the PWM input has no edges (0% or 100%)
PWMin3 = active: The signal at the PWM input has edges

The MSB has no significance.

Permissible value range: 0..5

Application example for selection of set value source by means of PWM status PWMin3 (value 4 or 5)

The control signal wire is simultaneously connected to an analog input (Ain1 or Ain2) and to the PWM input (PWMin3).
The control wire can optionally be supplied with an analog signal or a PWM signal without having to change the fan configuration or without connecting the bus line.

2.18 Running direction source

Address : D148
Write authorization : ebm-papst, customer, end customer

Coding:

This parameter specifies the sources through which the running direction is determined

Value	Running direction source
0	Digital input Din2 and parameter "Preferred running direction"
1	Parameter "Preferred running direction" only
2	Digital input Din3 and parameter "Preferred running direction"
3	Digital input Din1 and parameter "Preferred running direction"

The MSB has no significance.

Permissible value range: 0..3

If just the parameter "Preferred running direction" (1) is selected as running direction source, the actual running direction will correspond to the information in the parameter "Preferred running direction"

If a digital input is selected as running direction source, the actual running direction will correspond to the information in the parameter "Preferred running direction" if the corresponding digital input is inactive.
If the digital input is active, the actual running direction will be opposite to that specified in the parameter Preferred running direction.

The following table provides an overview of the actual running direction:

Running direction source	0	0	0	0	1	1
Preferred running direction	0	0	1	1	0	1
Digital input Din1	X	X	X	X	X	X
Digital input Din2	Active	Inactive	Active	Inactive	X	X
Digital input Din3	X	X	X	X	X	X
Running direction	Clockwise	Counterclockwise	Counterclockwise	Clockwise	Counterclockwise	Clockwise

Running direction source	2	2	2	2	3	3	3	3
Preferred running direction	0	0	1	1	0	0	1	1
Digital input Din1	X	X	X	X	Active	Inactive	Active	Inactive
Digital input Din2	X	X	X	X	X	X	X	X
Digital input Din3	Active	Inactive	Active	Inactive	X	X	X	X
Running direction	Clockwise	Counter-clockwise	Counter-clockwise	Clockwise	Clockwise	Counter-clockwise	Counter-clockwise	Clockwise

For definition of active / inactive, see 2.46

If the fail-safe mode is active and an interruption in the connection is detected, the direction of rotation is set to the value "Fail-safe running direction" (see 2.50). The parameter Running direction source is then not relevant.

2.19 Preferred running direction

Address : D102
Write authorization : ebm-papst, customer, end customer

Coding:

This parameter specifies the preferred running direction

Value	Preferred running direction
0	Counterclockwise
1	Clockwise

The MSB has no significance.

Permissible value range: 0..1

The new value becomes valid immediately (without reset) after writing this parameter.

The actual running direction is influenced not just by this parameter, but also by "Running direction source" and the digital inputs Din1, Din2 and Din3.
For details of the actual running direction, see 2.18 Running direction source

If the fail-safe mode is active and an interruption in the connection is detected, the direction of rotation is set to the value "Fail-safe running direction" (see 2.50). The parameter Preferred running direction is then not relevant.

2.20 Store set value

Address : D103
Write authorization : ebm-papst, customer, end customer

Coding:

This parameter specifies whether
- The setpoint (see 2.3) is additionally stored in the Stored set value (see 2.10)
- The parameter Enable / Disable (see 2.11) is additionally stored in the parameter Stored Enable / Disable (see 2.54) in the event of an interruption of the power supply

Value	Function
0	Set value and Enable / Disable are not stored The fan does not run after switching on the power supply or following reset
1	Set value and Enable / Disable are stored The fan runs with the stored set value and Enable / Disable state after switching on the power supply or following reset

The MSB has no significance.
Permissible value range: 0..1

2.21 Parameter set source

Address : D104
Write authorization : ebm-papst, customer, end customer

Coding:

This parameter specifies whether a digital input or the internal parameter is used for selection of the parameter set.

Value	Parameter set switching by...
0	Digital input Din2
1	Parameter "Parameter set internal" (see 2.22 Parameter set internal)
2	Digital input Din3
3	Digital input Din1

The MSB has no significance.

Permissible value range: 0..3

The following table provides an overview of the selected parameter set:

Parameter set source	0	0	1	1	2	2	3	3
Parameter set internal	X	X	0	1	X	X	X	X
Digital input Din1	X	X	X	X	X	X	Active	Inactive
Digital input Din2	Active	Inactive	X	X	X	X	X	X
Digital input Din3	X	X	X	X	Active	Inactive	X	X
Selected parameter set	2	1	1	2	2	1	2	1

For definition of active / inactive, see 2.46

2.22 Parameter set internal

Address : D105
Write authorization : ebm-papst, customer, end customer

Coding:

This parameter specifies whether parameter set 1 or parameter set 2 is used.
The information in this parameter is only of relevance if the value for "Parameter set source" is "internal" (1) (see 2.21 Parameter set source).

Value	Parameter set
0	Parameter set 1
1	Parameter set 2

The MSB has no significance.

Permissible value range: 0..1

The new value becomes valid immediately (without reset) after writing this parameter.

2.23 Operating mode

Parameter set 1 address : D106
Parameter set 2 address : D107
Write authorization : ebm-papst, customer, end customer

The parameter "Parameter set internal" or the digital input can be used to select whether the value in "Operating mode (parameter set 1)" or the value in "Operating mode (parameter set 2)" is valid (see 2.22 Parameter set internal).

Coding:

Value	Operating mode
0	Speed control
1	Sensor control
2	Open-loop control

The MSB has no significance.

Permissible value range: 0..2

2.24 Direction of action source

Address : D12E
Write authorization : ebm-papst, customer, end customer

Coding:

This parameter specifies whether a digital input or the internal parameter is used for selection of the direction of action.

Value	Determination of direction of action by...
0	Digital input Din3
1	Parameter "Direction of action" (see 2.25 Direction of action)
2	Digital input Din2
3	Digital input Din1

The MSB has no significance.

Permissible value range: 0..3

The following table provides an overview of the selected direction of action:

Direction of action source	0	0	1	1	2	2	3	3
Direction of action internal	X	X	0	1	X	X	X	X
Digital input Din1	X	X	X	X	X	X	Active	Inactive
Digital input Din2	X	X	X	X	Active	Inactive	X	X
Digital input Din3	Active	Inactive	X	X	X	X	X	X
Selected direction of action	Negative	Positive	Positive	Negative	Negative	Positive	Negative	Positive

For definition of active / inactive, see 2.46

2.25 Direction of action

Parameter set 1 address : D108
Parameter set 2 address : D109
Write authorization : ebm-papst, customer, end customer

The parameter "Parameter set internal" or the digital input can be used to select whether the value in "Direction of action (parameter set 1)" or the value in "Direction of action (parameter set 2)" is valid (see 2.22 Parameter set internal).

The information in these parameters is only of relevance if the value for the parameter "Direction of action source" is "internal" (1) (see 2.24 Direction of action source). Otherwise the two parameters have no function.

The direction of action specifies how the control deviation is formed from the set value and the actual value

Coding:

Value	Direction of action
0	Positive: Control deviation = set value – actual value
1	Negative: Control deviation = actual value – set value

The MSB has no significance.

A positive direction of action means that the modulation level of the fan decreases as the actual value increases.
A negative direction of action means that the modulation level of the fan increases as the actual value increases.

Notes:

For sensor control with a temperature sensor, a positive direction of action is synonymous with "Heating" and a negative direction of action is synonymous with "Cooling".

Only a positive direction of action is appropriate in "Speed control" operating mode. For this reason, the parameter "Direction of action" has no function in "Speed control" operating mode and is always assumed to be positive.

2.26 Control parameters

2 control parameters are provided for speed control and sensor control:

- P factor kp
- I factor ki

P factor address (parameter set 1)	: D10A
P factor address (parameter set 2)	: D10B
I factor address (parameter set 1)	: D10C
I factor address (parameter set 2)	: D10D
Write authorization	: ebm-papst, customer, end customer

The parameter "Parameter set internal" or the digital input can be used to select whether the values in "P factor / I factor (parameter set 1)" or the values in "P factor / I factor (parameter set 2)" are valid (see 2.22 Parameter set internal).

Coding:

Each control parameter is made up of 2 bytes.

a) P factor

$$P - factor = \frac{Data\ bytes}{256} \cdot 100\%$$

Values between 0 and 25,600% can thus be set for the P factor in increments of 0.39%

b) I factor

$$I - factor = \frac{Data\ bytes}{65536} \cdot 100\%$$

Values between 0 and 100% can thus be set for the I factor in increments of 0.00153%

Notes on control action:

On completion of the sampling time T_a = 50 ms, the fan controller always calculates the new modulation level in accordance with the following equation:

$$a(n) = \frac{kp}{100\%} \cdot xd(n) + \sum_{i=0}^{n} \frac{ki}{100\%} \cdot xd(i)$$

$a(n)$ ....*Modulation level at time n; normalized to range* 0..65536; *i.e.* 65536 −> 100%

$xd(n)$ ....*Normalized deviation at time n (set value - actual value)*

kp ....*P factor in* %

ki ....*I factor in* %

The normalized control deviation is calculated from the set value and the actual value.
The set value and the actual value are also normalized:
- To the maximum speed in speed control
- To the minimum and maximum sensor value in sensor control

The normalized controller equation above and the generally applicable controller equation

$$A(n) = kr \cdot \left(Xd(n) + \frac{Ta}{Tn} \sum_{i=0}^{n} Xd(i) \right)$$

$A(n)$ ....*Modulation level at time n* (0..100%)

$Xd(n)$ ....*Absolute deviation at time n (set value - actual value)*)

kr ....*Proportional action coefficient*

Tn ....*Integral time*

Ta ....*Sampling time*

... can be transformed into one another as follows

$$\mathrm{kr} = \frac{\mathrm{kp}}{Reference\,value\,Max - Reference\,value\,Min} \quad or \quad \mathrm{kp} = \mathrm{kr} \cdot (Reference\,value\,Max - Reference\,value\,Min)$$

$$\mathrm{Tn} = \frac{\mathrm{kp}}{\mathrm{ki}} \cdot \mathrm{Ta} \quad or \quad \mathrm{ki} = \frac{\mathrm{Ta}}{\mathrm{Tn}} \cdot \mathrm{kr} \cdot (Reference\,value\,Max - Reference\,value\,Min)$$

where

$$Ta = 50ms$$

In speed control operating mode:

$Reference\,value\,Max = 1.024 \cdot nMax$

$Reference\,value\,Min = 0$

$nMax$ .... *Max. speed* [rpm]

In sensor control operating mode:

Reference value Max = *Max sensor value*

Reference value Min = *Min sensor value*

Max sensor value ....*Sensor quantity for* $U = 10V$

Min sensor value ....*Sensor quantity for* $U = 0V$

2.27 Maximum modulation level

Parameter set 1 address : D10E
Parameter set 2 address : D10F
Write authorization : ebm-papst, customer

The parameter "Parameter set internal" or the digital input can be used to select whether the value in "Maximum modulation level (parameter set 1)" or the value in "Maximum modulation level (parameter set 2)" is valid (see 2.22 Parameter set internal).

Coding:

$$\text{Max.}\, \textit{modulation level}\ [\%] \quad = \quad \frac{\textit{Data bytes}}{256} \cdot 100\%$$

The MSB has no significance.

Limitation:
8% < Maximum modulation level < Maximum permissible modulation level
(see 2.31 Maximum permissible modulation level).

2.28 Minimum modulation level

Parameter set 1 address : D110
Parameter set 2 address : D111
Write authorization : ebm-papst, customer, end customer

The parameter "Parameter set internal" or the digital input can be used to select whether the value in "Minimum modulation level (parameter set 1)" or the value in "Minimum modulation level (parameter set 2)" is valid (see 2.22 Parameter set internal).

Coding:

$$\text{Min.}\, \textit{modulation level}\ [\%] \quad = \quad \frac{\textit{Data bytes}}{256} \cdot 100\%$$

The MSB has no significance.

Limitation:
Minimum modulation level > Minimum permissible modulation level
(see 2.32 Minimum permissible modulation level).

2.29 Motor stop enable

Parameter set 1 address : D112
Parameter set 2 address : D113
Write authorization : ebm-papst, customer, end customer

The parameter "Parameter set internal" or the digital input can be used to select whether the value in "Motor stop enable (parameter set 1)" or the value in "Motor stop enable (parameter set 2)" is valid (see 2.22 Parameter set internal).

Coding:

Value	Motor stop
0	Motor always runs (even with set value = 0)
1	Motor stops with set value = 0

The MSB has no significance.

2.30 Starting modulation level

Address : D116
Write authorization : ebm-papst

The starting modulation level specifies the modulation level with which the motor is started after a start command.

Coding:

$$Starting\ modulation\ level\ [\%] = \frac{Data\ bytes}{256} \cdot 100\%$$

The MSB has no significance.

The motor always starts with the starting modulation level.
A high starting modulation level results in a high current on starting the motor.

2.31 Maximum permissible modulation level

Address : D117
Write authorization : ebm-papst

This parameter forms the upper limit for the maximum modulation level (see 2.27 Maximum modulation level).

Coding:

$$Max.\ perm.\ modulation\ level\ [\%] = \frac{Data\ bytes}{256} \cdot 100\%$$

The MSB has no significance.

2.32 Minimum permissible modulation level

Address : D118
Write authorization : ebm-papst

This parameter forms the lower limit for the minimum modulation level (see 2.28 Minimum modulation level).

Coding:

$$Min.\ perm.\ modulation\ level\ [\%] \quad = \quad \frac{Data\ bytes}{256} \cdot 100\%$$

The MSB has no significance.

If the setting selected for this value is too low (in particular values < 5%), the motor may cut out with the error "Motor blocked".

2.33 Maximum speed

Address : D119
Write authorization : ebm-papst, customer

This parameter has two functions:

- All parameters with speed information (set values, actual values) are referenced to this value. The value 64000 in this speed information corresponds to the maximum speed value specified here.
- In "Sensor control" and "Open-loop control" operating modes, the speed is limited to the value specified here (the speed is controlled in any case in Speed control).

Coding:

$$Max.\ speed\ [\mathrm{rpm}] \quad = \quad Data\ bytes$$

The maximum speed is made up of 2 bytes.

Limitation:
Maximum speed < Maximum permissible speed (see 2.34 Maximum permissible speed)

2.34 Maximum permissible speed

Address : D11A
Write authorization : ebm-papst

This parameter forms the upper limit for the maximum speed (see 2.33 Maximum speed).

Coding:

$$Max. perm. speed\ rpm = data\ bytes$$

The maximum permissible speed is made up of 2 bytes.

2.35 Ramp-up curve / ramp-down curve

Ramp-up curve address : D11F
Ramp-down curve address : D120
Write authorization : ebm-papst, customer, end customer

The parameters Ramp-up curve and Ramp-down curve define the time in which the operating set value is corrected to the setpoint.

The time for the ramp-up curve relates to a step-change in the setpoint from 0 to the maximum value (coded 64000).
The time for the ramp-down curve relates to a step-change in the setpoint from the maximum value (coded 64000) to 0.

If a motor stop condition is detected (e.g. setpoint = 0 and motor stop enable = 1), the motor comes to a stop without following the ramp-down curve.

A new set value with no time delay takes immediate effect for ramp time = 0.

Coding:

$$Ramp\ time\ s = data\ bytes\ \cdot 2.5s$$

The MSB has no significance.

2.36 Speed limit

Address : D128
Write authorization : ebm-papst

This parameter determines the limit value for the safety function "Speed limit". The speed controller of this safety function ensures that the speed limit for the fan impeller is not exceeded.

Coding:

$$Limit\ speed\ rpm = data\ bytes$$

Note: The speed limit is not referenced to the maximum speed.

2.37 Input characteristic curve

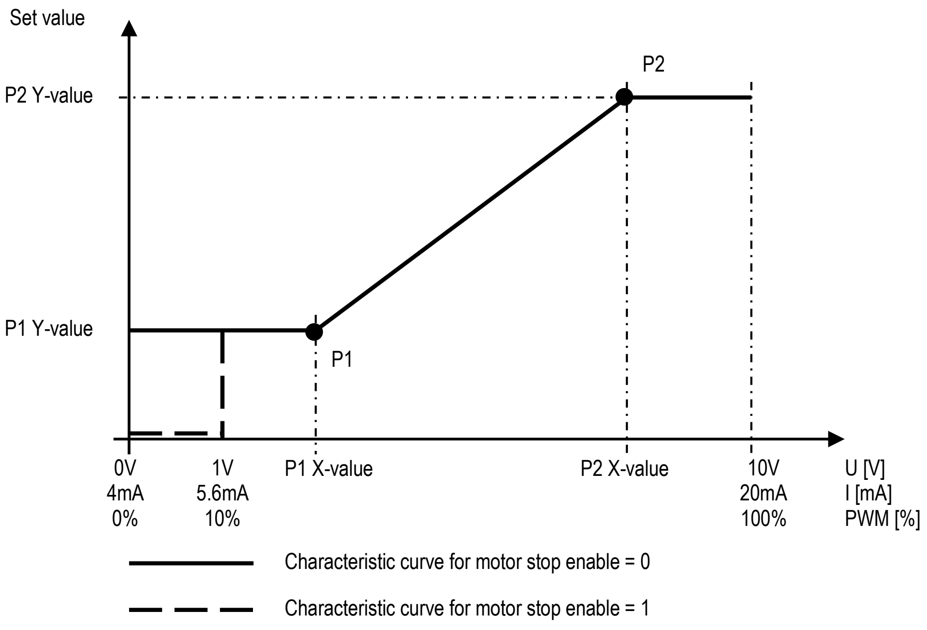
Point 1 X-coordinate parameter set 1 address : D12A
Point 1 Y-coordinate parameter set 1 address : D12B
Point 2 X-coordinate parameter set 1 address : D12C
Point 2 Y-coordinate parameter set 1 address : D12D

Point 1 X-coordinate parameter set 2 address : D13C
Point 1 Y-coordinate parameter set 2 address : D13D
Point 2 X-coordinate parameter set 2 address : D13E
Point 2 Y-coordinate parameter set 2 address : D13F

Write authorization : ebm-papst, customer, end customer

These parameters are used to allocate a set value to the input signal.
Possible input signals:

- Voltage at analog input Ain1
- Voltage or current at analog input Ain2
- PWM modulation level at PWM input PWMin3



Points P1 and P2 can be shifted to anywhere in the graph.

2 different characteristic curves can be defined.
The parameter "Parameter set internal" or the digital input can be used to select whether the values "Parameter set 1" or the values "Parameter set 2" are valid (see 2.22 Parameter set internal).

Coding:

X-coordinate:

The coding of the X-coordinate depends on the configuration of the I/O (see 2.46) for the set value.

a) Analog input 0-10 V

$$U[V](Px) \quad = \quad \frac{Data\ byte}{65536} \cdot 10\,V$$

The X-coordinate defines a voltage value between 0 and 10 V.

b) Analog input 4-20 mA

$$I[mA](Px) \quad = \quad \frac{Data\ byte}{65536} \cdot 16mA + 4mA$$

The X-coordinate defines a current value between 4 and 20 mA.

c) PWM input

$$PWM[\%](Px) \quad = \quad \frac{Data\ byte}{65536} \cdot 100\%$$

The X-coordinate defines a PWM modulation level between 0 and 100%.

Y-coordinate:

The Y-coordinate defines the corresponding set value for this point. Depending on the operating mode (see 2.23), it is a speed (speed control), a sensor quantity (sensor control) or a modulation level (open-loop control).

a) Speed control:

$$Set\ value\,[\mathrm{rpm}] \quad = \quad \frac{Data\ byte}{64000} \cdot nMax\,[\mathrm{rpm}]$$

nMax [rpm] ... maximum speed in revolutions per minute (see 2.33 Maximum speed)

b) In open-loop control operating mode

$$Set\ value\,[\%] \quad = \quad \frac{Data\ byte}{65536} \cdot 100\%$$

c) In sensor control operating mode

The set value for the control variable is then obtained from the set value parameter and the characteristic curve Cv (U/I) of the sensor used.

Cv (U) = Control variable as a function of voltage

$$Set\ value\,[V] \quad = \quad \frac{Data\ bytes}{65536} \cdot 10V$$

$$\begin{aligned} Set\ value\,[unit(Cv)] \quad &= \quad Cv\,(Set\ value\,[V]) \\ &= \quad Cv\,(\frac{Data\ bytes}{65536} \cdot 10V) \end{aligned}$$

or

Cv (I) = Control variable as a function of current

$$Set\ value\,[mA] \;=\; \frac{Data\ bytes}{65536}\cdot 16mA + 4mA$$

$$\begin{aligned} Set\ value\,[unit(Cv)] &= Cv\,(set\ value\,[V]) \\ &= Cv\,(\frac{Data\ bytes}{65536}\cdot 16mA + 4mA) \end{aligned}$$

For voltages at the analog input which are lower than the value defined in the X-coordinate of point 1, the set value is the value defined in the Y-coordinate of point 1.
For voltages at the analog input which are higher than the value defined in the X-coordinate of point 2, the set value is the value defined in the Y-coordinate of point 2.
Between these, the set value changes linearly between the two values specified in the Y-coordinates (see graph above).

Limitation:
X-coordinate (point 1) ≤ X-coordinate (point 2)

Note:
If Y-coordinate (point 1) > Y-coordinate (point 2) is selected, the slope of the characteristic curve will be negative.
In this case the motor stop function takes effect at a voltage at the analog input > 9 V

2.38 Limitation Control

Address : D12F
Write authorization : ebm-papst

This parameter determines which limitation functions are active.

Coding:

MSB	0	0	0	Reserved	Reserved	Reserved	Reserved	Reserved
LSB	0	0	0	0	Reserved	Reserved	I	P

I .... Coil current limitation
P .... Power limiter

2.39 Output 0..10 V / speed monitoring

2.39.1 Function output 0..10 V / speed monitoring

Function address : D130
Write authorization : ebm-papst, customer

This parameter determines
- Which quantity is output at the output (LSB)
- The number of pulses output per revolution at the output (MSB)

LSB coding:

Value	Output quantity
0	Fan modulation level
1	Actual speed
2	Installation modulation level
4	Clock output for addressing
5	Remote control

In order to be able to output one of these quantities at the analog output, IO3 must be configured as analog output (see 2.46)

Applications:

a) Fan modulation level -> 0..10 V (value = 0)

With this configuration, the specified modulation level is output at the 0..10 V output. This signal can be connected to the set value input of other fans, which then run at the same modulation level. In the event of an error, a modulation level of 0% is always output.

b) Actual speed -> 0..10 V (value = 1)

With this configuration, a voltage proportional to the speed is output at the 0..10 V output. The value 10 V is then attained for a speed n = 1.02 * nMax
The signal can be used to evaluate the actual speed.

c) Installation modulation level -> 0..10 V (value = 2)

With this configuration, the specified modulation level is output at the 0..10 V output. This signal can be connected to the set value input of other fans, which then run at the same modulation level.
In the event of an error at the fan, a modulation level is still output at the 0..10 V output as if no error had occurred. This has the advantage that the other fans in the installation are still controlled despite an error at the master fan.

Explanatory notes on the installation modulation level:

- This setting is not appropriate in "Speed control" operating mode, as no speed information for the other fans is available at the master fan and control action is thus not possible in the event of an error.
- In "Sensor control" operating mode, control action continues to be based on the sensor quantity and the modulation level is output at the 0..10 V output in the event of an error.
- In "Open-loop control" operating mode, the specified modulation level continues to be output at the 0..10 V output in the event of an error.
- Once there is no longer an error at the master fan, output of the modulation level of the master fan at the 0..10 V output is resumed again. As this is generally increased from 0% upwards in a ramp function, the same profile will also be set at the output of the 0..10 V output so that the entire installation will be briefly shut down.

d) Clock output for addressing -> 0..10 V (value = 4)

The (clock) signal for the addressing function (see 2.9) at the digital input Din1 is output at the 0-10 V output. The first clock pulse following activation of the addressing function is not passed on.

The parameters of the output characteristic curve 0-10 V (see 2.39.2) have no effect in this configuration.

e) Remote control -> 0..10 V (value = 5)

The parameter Remote control output 0-10 V (see 2.12) can be used to specify a value for the voltage at the 0-10 V output irrespective of the modulation level, speed, etc.

<u>MSB coding:</u>

Number of pulses per revolution = *Databyte*

A frequency proportional to the speed is output at the tacho output. The number of pulses per revolution can be selected. The signal can be used to evaluate the actual speed.

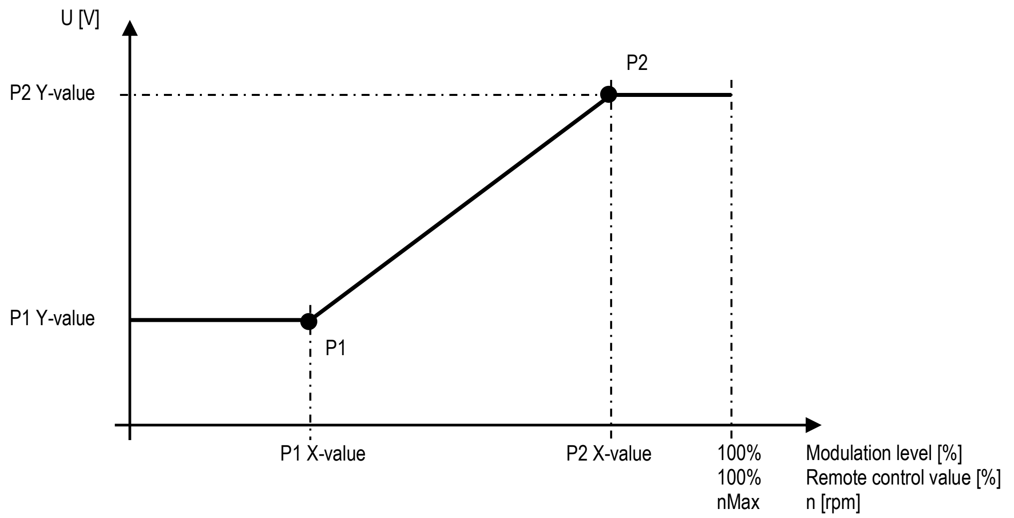
In order to be able to output speed monitoring (pulses per revolution), IO1 or IO3 must be configured as tacho output (see 2.46)

2.39.2 Characteristic curve output 0..10 V

Point 1 X-coordinate address : D140
Point 1 Y-coordinate address : D141
Point 2 X-coordinate address : D142
Point 2 Y-coordinate address : D143

Write authorization : ebm-papst, customer, end customer

These parameters are used to allocate a voltage to the output quantity defined by the parameter "Function output 0..10 V" at the output 0..10 V.



Points P1 and P2 can be shifted to anywhere in the graph.

Coding:

<u>Function output 0..10 V = Modulation level (0 / 2)</u>

The X-coordinate defines a modulation level

$$\mathit{Modulation\ level}\ [\%]\ (Px) \quad = \quad \frac{\mathit{Data\ bytes}}{65536} \cdot 100\%$$

<u>Function output 0..10 V = Actual speed (1)</u>

The X-coordinate defines a speed

$$n\,[\mathrm{rpm}]\,(Px) \quad = \quad \frac{\mathit{Data\ bytes}}{64000} \cdot nMax$$

nMax [rpm] ... maximum speed in revolutions per minute (see 2.33 Maximum speed)

Function output 0..10 V = Remote control (5)

The X-coordinate defines the remote control value

$$Remote\ control\ value\,[\%]\,(Px) \quad = \quad \frac{Data\ bytes}{65536} \cdot 100\%$$

The Y-coordinate defines the corresponding voltage at the 0..10 V output:

$$U[V]\,(Px) \quad = \quad \frac{Data\ byte}{65536} \cdot 10V$$

Limitation:
X-coordinate (point 1) ≤ X-coordinate (point 2)

Applications:

A characteristic curve with the following values is recommended
P1X = 0x0000   0% / 0 rpm
P1Y = 0x0000   0 V
P2X = 0xFF00   100% / 1.02 * nMax
P2Y = 0xFF00   10V

In this case:

$$U_{0..10V}[V] \quad = \quad \frac{Modulation\ \ level\ \ (spec.)\,[\%]}{100} \cdot 10V$$

or:

$$U_{0..10V}[V] \quad = \quad \frac{n\ Act\,[\mathrm{rpm}]}{1.02 \cdot n\ Max\,[\mathrm{rpm}]} \cdot 10V$$

nMax [rpm] ... maximum speed in revolutions per minute (see 2.33 Maximum speed)
or:

$$U_{0..10V}[V] \quad = \quad \frac{Remote\ control\ value\,(spec.)\,[\%]}{100} \cdot 10V$$

Cascaded start-up of the motors can be achieved by shifting the characteristic curve downward in parallel.

2.40 Power limiter

The fan contains a power limiter. This power limiter is activated if the function has been activated in the parameter "Limitation Control" (see 2.38 Limitation Control).

The set value $P_{Lim,Set}$ of the power limiter is obtained from the parameters described in the following as a function of the temperature.

2.40.1 Maximum power

Maximum power address : D155
Write authorization : ebm-papst, customer

Coding:

$$P\max[W] = \frac{Data\ byte}{256} \cdot Reference\ Uz\,[V] \cdot Reference\ \ Iz\,[A]$$

P max .... Maximum power
Reference Uz .... DC-link voltage reference (see 0
DC-link voltage reference value).
Reference Iz .... DC-link current reference (see 2.61 DC-link current reference value)

The MSB has no significance.

Limitation:
Maximum power ≤ Maximum permissible power (see 2.40.2 Maximum permissible power)

2.40.2 Maximum permissible power

Maximum permissible power address : D135
Write authorization : ebm-papst

Coding:

$$P\max,\ perm\ [W] = \frac{Data\ byte}{256} \cdot Reference\ Uz\,[V] \cdot Reference\ \ Iz\,[A]$$

P max, perm .... Maximum permissible power
Reference Uz .... DC-link voltage reference (see 0
DC-link voltage reference value).
Reference Iz .... DC-link current reference (see 2.61 DC-link current reference value)

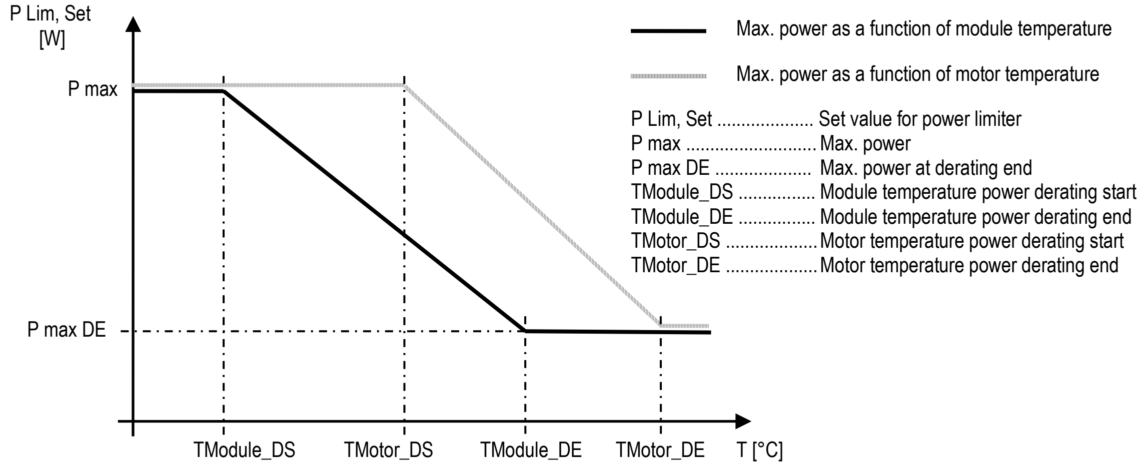
The MSB has no significance.

This parameter forms the upper limit for the maximum power (see 2.40.1) and the max. power at derating end (see 2.40.3)

2.40.3 Power derating

Max. power at derating end address	: D136
Module temperature power derating start address	: D137
Module temperature power derating end address	: D138
Motor temperature power derating start address	: D14D
Motor temperature power derating end address	: D14E
Write authorization	: ebm-papst, customer

The maximum power decreases as a function of the module temperature (see 3.13 Module temperature) and the motor temperature (see 3.14 Motor temperature) in accordance with the following characteristic curves. A separate characteristic curve can be defined for each temperature.



These characteristic curves thus yield

- A max. power value as a function of the module temperature ($P_{Lim,Set}$_TModule)
- A max. power value as a function of the motor temperature ($P_{Lim,Set}$_TMotor)

The lower of the two values $P_{Lim,Set}$_TModule and $P_{Lim,Set}$_TMotor is used as the set value for the power limiter.

Coding:

$$P\max\_DE\,[W] = \frac{Data\ bytes}{256} \cdot Reference\ Uz\,[V] \cdot Reference\ Iz\,[A]$$

$$TModul\_DS\,[°C] = Data\ bytes$$
$$TModul\_DE\,[°C] = Data\ bytes$$
$$TMotor\_DS\,[°C] = Data\ bytes$$
$$TMotor\_DE\,[°C] = Data\ bytes$$

P max DE.................. Maximum power at derating end
Reference Uz .... DC-link voltage reference (see 2.60 DC-link voltage reference value).
Reference Iz .... DC-link current reference (see 2.61 DC-link current reference value)

TModule DS .... Module temperature power derating start
TModule DE .... Module temperature power derating end
TMotor DS .... Motor temperature power derating start
TMotor DE .... Motor temperature power derating end

The MSB has no significance in each case.

The values "Max. power" and "Max. power at temperature derating end" are the same for both characteristic curves.

For temperatures lower than the value defined in TModule DS or TMotor DS, the maximum power corresponds to the value P max.
For temperatures higher than the value defined in TModule DE or TMotor DE, the maximum power corresponds to the value P max DE.
Between these, the maximum power changes linearly between the two values P max and P max_DE (see graph above).

Limitation:
If T DS ≥ T DE, T DS is limited to T DE
If P max DE > P_{max} or $P_{max\ perm}$, P max DE is limited to P_{max} or $P_{max\ perm}$

2.40.4 Power derating ramp

Address : D16D
Write authorization : ebm-papst, customer

For steep temperature characteristic curves, a change in temperature of just 1K is sufficient to produce a considerable change in the set value of the power limiter $P_{Lim,Set}$, which can lead to considerable variation in the action of the power limiter. To stop this happening, this parameter can be used to specify the maximum change in the set value for the power limiter.

Coding:

The change in the set value of the power limiter per second is:

$$\Delta P_{Lim,Set} / \sec [W/s] = \frac{0{,}078125}{Data\ bytes} \cdot Reference\ Uz\,[V] \cdot Reference\ Iz\,[A]$$

Reference Uz .... DC-link voltage reference (see0
DC-link voltage reference value).
Reference Iz .... DC-link current reference (see 2.61 DC-link current reference value)

For data byte = 0, the set value is adopted directly from the temperature characteristic curve without a ramp

When the device is switched on, the set value is directly set to the value determined from the temperature characteristic curve (initial value).

2.41 Maximum coil current

Address : D13B
Write authorization : ebm-papst

Coding:

$$I\ \max, eff\ [A] \quad = \quad \frac{Data\ bytes}{170} \cdot Reference\ \ Iz\ [A]$$

Reference Iz .... DC-link current reference (see 2.61 DC-link current reference value)

The MSB has no significance.

The motor limits the coil current (rms value) to the value specified here if the function has been activated in the parameter "Limitation Control" (see 2.38 Limitation Control).
The coil current is obtained from the DC-link current / modulation level

2.42 Speed limit for running monitoring

Address : D145
Write authorization : ebm-papst, customer

Coding:

The speed limit for running monitoring is obtained from the parameter and the maximum speed:

$$Speed\ \ limit\ \ for\ \ speed\ \ monitor\ [\mathrm{rpm}] \quad = \quad \frac{Data\ bytes}{64000} \cdot nMax\ [\mathrm{rpm}]$$

nMax [rpm] ... maximum speed (in revolutions per minute) – see 2.33 Maximum speed

If the actual speed (see 3.8 Actual speed) is lower than the speed limit for running monitoring, the error relay drops out. The flag "n_Low" is set in the input register "Warning" (see 3.10 Warning)
The entire function is deactivated if "Speed limit for running monitoring" = 0.

2.43 Sensor actual value source

Address : D147
Write authorization : ebm-papst, customer, end customer

Coding:

The parameter "Sensor actual value source" defines the input from which the sensor actual value (see 3.19 Sensor actual values) is determined.
The following options are available:

Value	Sensor actual value source
0x00	Analog input Ain1
0x01	Analog input Ain2
0x02	Maximum (Ain1; Ain2)
0x03	Minimum (Ain1; Ain2)
0x04	Mean value (Ain1; Ain2)

The MSB has no significance.

2.44 Interface settings

2.44.1 Transmission speed

Address : D149
Write authorization : ebm-papst, customer

Coding:

Value	Transmission speed
0x00	1200 bits/sec
0x01	2400 bits/sec
0x02	4800 bits/sec
0x03	9600 bits/sec
0x04	19200 bits/sec
0x05	38400 bits/sec
0x06	57600 bits/sec
0x07	115200 bits/sec

The MSB has no significance.

The standard value 19200 bits/sec (0x04) is recommended for the transmission speed.

It must be ensured that the transmission speed selected for the fan is the same as that in the master (e.g. EC-Control). Communication with the fan is otherwise not possible.

If the value of the customer setting (holding register D249) or the factory setting (holding register D2C9) differs from the value selected here, it must be ensured that the transmission speed has been accordingly altered following completion of data transfer from the customer setting or factory setting (see 2.5 and 2.6). Communication is then no longer possible with the previous setting

2.44.2 Parity configuration

Address : D14A
Write authorization : ebm-papst, customer

Coding:

Value	Parity configuration	Number of data bits	Parity	Number of stop bits
0x00	8E1	8	Even	1
0x01	8O1	8	Odd	1
0x02	8N2	8	None	2
0x03	8N1	8	None	1

The MSB has no significance.

The standard value 8E1 (0x00) is recommended for the parity configuration.

Note:
If parity configuration 8N1 is selected, the device no longer corresponds to the Modbus specification "MODBUS over Serial Line Specification & Implementation Guide V1.0", as this specifies a mandatory 11-bit frame.

It must be ensured that the parity configuration selected for the fan is the same as that in the master (e.g. EC-Control). Communication with the fan is otherwise not possible.

If the value of the customer setting (holding register D24A) or the factory setting (holding register D2CA) differs from the value selected here, it must be ensured that the parity configuration has been accordingly altered following completion of data transfer from the customer setting or factory setting (see 2.5 and 2.6). Communication is then no longer possible with the previous setting.

2.44.3 Procedure for changing interface setting

Communication is not possible if the parameters "Transmission speed" and "Parity configuration" do not correspond to the setting for the interface in the master (e.g. EC-Control).

If the setting differs, the interface setting cannot be polled from the fan, i.e. it is essential to know the interface setting of the fan.

To avoid complications resulting from different interface settings, it is advisable to leave the interface settings on the default values:
Transmission rate : 19200 bits/sec (0x04)
Parity configuration : 8E1 (0x00)

If a change is necessary, care must be taken to ensure that the master and fan always have the same setting so as to ensure faultless communication.

The new interface setting of the fan is only adopted following a corresponding command to the parameter "Reset" (Transfer parameter or Reset) – see 2.2 – or after switching off the device ("Power off"). Until then the fan operates with the existing setting.

Recommended procedure for changing the interface setting, based on the example of a change from 19200 bits/sec, 8E1 to 38400 bits/sec, 8N2:

- To start with, the interface setting at the master must be 19200 bits/sec, 8E1.
- Write password: XX 10 D0 02 00 03 06 PP PP PP PP PP PP CS CS
  (The minimum authorization required for changing the interface setting is "Customer")
- Write transmission speed with value 38400 bits/sec: XX 06 D1 49 00 05 CS CS
- Write parity configuration with value 8N2: XX 06 D1 4A 00 02 CS CS
- Trigger Transfer parameter: XX 06 D0 00 00 02 CS CS
- Following acknowledgment of the command by the fan, it will operate with the new setting.
- Change interface setting in master: 38400 bits/sec, 8N2

XX .... Fan address
PP .... Password
CS .... CRC checksum

2.44.4 Interface emergency function:

2 standard settings for the interface are stored in the fan.
The fan briefly switches automatically to these standard settings if faulty telegrams are received (e.g. on account of different interface settings at the master and slave):

- After 10 unsuccessful attempts, the fan automatically communicates with the setting 19200 bits/sec, 8E1
- After a further 10 unsuccessful attempts, the fan automatically communicates with the setting 2400 bits/sec, 8E1
  Exception: This step is omitted with the configuration 115200 bits/sec.
- After another 10 unsuccessful attempts, the fan switches back to the setting stored in the holding registers "Transmission speed" and "Parity configuration" to avoid inadvertent permanent activation of the interface emergency function.
- In the event of yet more unsuccessful attempts, the interface is no longer automatically switched, i.e. the interface emergency function can then only be activated by switching the device off and on again or by way of a software reset

The interface emergency function can only be activated as long as no valid telegram has been detected by the fan. To ensure that the interface emergency function has been enabled, the device operating voltage should be switched off and on again beforehand.

Application:

If the interface setting of the fan is not known, it can be determined using an interface emergency function.

Recommended sequence:

- Switch on the fan
- Set the interface of the master to standard values 19200 bits/sec, 8E1
- Read interface setting: XX 03 D1 49 00 02 CS CS
- After 10 unsuccessful attempts, the fan automatically communicates with the standard setting 19200 bits/sec, 8E1. In other words, the above-mentioned command has to be sent 11 times before a response is sent by the fan.
- The interface setting of the fan can be determined from the fan response.
- The master and slave interface settings can then be matched to one another.

Note:

The fan should not be permanently operated in the interface emergency function, as the values defined in the parameters "Transmission speed" and "Parity configuration" are activated again after every "Reset" or "Transfer parameter" (cf. 2.2).
The master and fan interface settings must always be matched to one another.

2.45 Shedding function

Shedding function address	: D150
Write authorization	: ebm-papst, customer
Max. starting modulation level address	: D151
Write authorization	: ebm-papst
Number of start attempts address	: D152
Write authorization	: ebm-papst, customer

Coding:

a) Shedding function

Value	Shedding function
0	Inactive
1	Active

The MSB has no significance.
Permissible value range: 0..1

b) Max. starting modulation level

$$Max.\ start\ PWM\ shedding\ [\%] = \frac{Data\ byte}{256} \cdot 100\%$$

The MSB has no significance.

c) Number of start attempts

$$Max.\ number\ of\ start\ attempts = Data\ byte$$

The MSB has no significance.

Function:

The purpose of the shedding function is to make it possible to shake free the rotor of a fan with frozen blades by implementing alternating starting attempts in both directions of rotation, with the modulation level being increased on each attempt.

The first attempt starts with the value specified in the parameter Starting modulation level (see 2.30 Starting modulation level) and the desired direction of rotation. If this does not manage to make the fan turn, the direction of rotation is reversed in each subsequent attempt and the Starting modulation level is increased by 5% up to a maximum of the "Max. starting modulation level" value. At the same time a "Shedding function active" warning is generated (see 3.10 Warning).

This process is continued until the number of attempts specified in the parameter "Number of starting attempts" has been reached. If the fan has then still not been made to turn, the error message "Motor blocked" (see 3.9 Motor status) is generated. If further starting attempts are made, the modulation level is reset back to the value specified in the parameter "Starting modulation level" and no longer increased.

2.46 Configuration of I/O

2.46.1 Parameters

Configuration of I/O 1 address : D158
Configuration of I/O 2 address : D159
Configuration of I/O 3 address : D15A
Write authorization : ebm-papst, customer, end customer

Coding:

Value	Function of I/O	Availability		
		I/O 1	I/O 2	I/O 3
0	Digital input (high active)	X	X	X
1	Digital input (low active)	-	-	X
2	Analog input 0-10V	X	X	-
3	Analog input 4–20 mA	-	X	-
4	Analog output 0-10V	-	-	X
5	Tacho output	X	-	X
6	Diagnostic output	X	-	X
7	PWM input (idle level high)	-	-	X
8	PWM input (idle level low)	-	-	X

Permissible value range:
Only the functions marked with X may be selected for each I/O.
The other functions are not available for the I/O concerned.

Function:

Digital input

Digital inputs are used for the functionality of the parameters
- Set value source switching (see 2.17)
- Running direction source (see 2.18)
- Parameter set source (see 2.21)
- Direction of action source (see 2.24)
- Enable / Disable source (see 2.53)

If a digital input is selected as source for one of these parameters, the corresponding I/O must be configured as digital input here.

There are two configuration options for the digital inputs:

Digital input high active (0):
An integrated pull-down is switched in at the digital input.
This means that a logic state is always defined, even if the digital input is not connected.
An open input corresponds to a potential of U = 0 V and the logic state "inactive".
The digital input can be switched to the logic state "active" by applying a voltage U ≥ 3.5 V.

Digital input low active (1):
An integrated pull-up is switched in at the digital input.
This means that a logic state is always defined, even if the digital input is not connected.
An open input corresponds to a potential of U ≥ 3.5 V and the logic state "inactive".
The digital input can be switched to the logic state "active" by applying a voltage U ≤ 1.5 V.

Value / Function of I/O	Connection	Logic state		
		Din1	Din2	Din3
0 (digital input high active)	U ≥ 3.5 V	Active	Active	Active
	U ≤ 1.5 V	Inactive	Inactive	Inactive
	No connection (open)	Inactive	Inactive	Inactive
1 (digital input low active)	U ≤ 1.5 V	Inactive [1)]	Inactive [1)]	Active
	U ≥ 3.5 V	Inactive	Inactive	Inactive
	No connection	Inactive	Inactive	Inactive
Other [2)]		Inactive	Inactive	Inactive

[1)] Function Digital input low active is not available for I/O 1 and I/O 2
The logic state is always *Inactive*
[2)] If no digital input is selected for the function, the logic state is always *Inactive*

The logic levels are based on the CMOS 5V technology standard.

Analog input

Analog inputs are used for the functionality of the parameters

- Set value source (see 2.16)
- Sensor actual value source (see 2.43)
- Fail-safe set value source (see 2.47)

If an analog input is selected as source for one of these parameters, the corresponding I/O must be configured as analog input here.

If an I/O is not configured as analog input, Ain1 / Ain2 is always set to the value 0 V or 4 mA irrespective of the signal applied. Analog input Ain1 can only be configured as voltage input 0-10 V. Configuration as current input 4-20 mA is not possible. In this case, Ain1 is always set to the value 0 V or 4 mA irrespective of the signal applied.

Analog output 0-10V

The parameters Function output 0-10 V (see 2.39.1) and Characteristic curve output 0-10 V (see 2.39.2) define a quantity which can be output as voltage value 0-10 V.
To enable this voltage to be output, I/O 3 has to be configured as analog output 0-10 V.

Tacho output

When configured as tacho output, a frequency proportional to the speed is output at the I/O (speed monitoring). The number of pulses per revolution is specified by the parameter Function output 0..10 V / speed monitoring (see 2.39.1).

The frequency at the tacho output is:

$$f\ tach\,[Hz] \;=\; Pulses\ per\ revolution \cdot \frac{n\,[rpm]}{60}$$

n .... Speed
Pulses per revolution .... Parameter Speed monitoring – see 2.39.1

I/O 1 is designed as open collector output. A customer pull-up is required here. I/O 3 outputs a square-wave signal with levels 0 V (low) and 10 V (high)

Diagnostic output

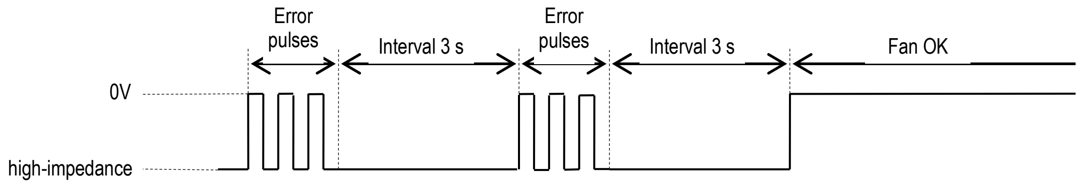
When configured as diagnostic output, a pulse train from which the motor status (see 3.9) can be determined is output at the I/O.

The pulses have a frequency of 2 Hz. An interval of 3 seconds is always inserted after a complete pulse train.

Number of pulses	Error
1	Phase failure (3-phase devices) or line undervoltage (single-phase devices)
3	Output stage overheated
4	Communication error between master controller and slave controller
6	Motor overheated
7	Hall sensor error
8	Motor blocked
9	Speed limit exceeded
11	Rotor position sensor calibration error
13	DC-link undervoltage

In the event of several simultaneous errors, the corresponding pulse trains are output successively.
A static level is output if there is no error.

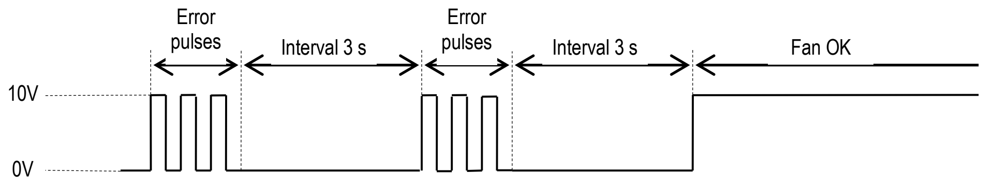
Waveform of I/O 1:



I/O 1 is designed as open collector output. A customer pull-up is required here.

Recommendation for visual indication by LED:
At I/O 1 the LED is connected via a series resistor to a voltage source.
The LED then lights continuously when "Fan OK". In the event of an error the LED shows the above number of flashing pulses

Waveform of I/O 3:



I/O 3 outputs a square-wave signal with levels 0 V (low) and 10 V (high)

Recommendation for visual indication by LED:
At I/O 3 the LED is connected via a series resistor to GND.
The LED then lights continuously when "Fan OK". In the event of an error the LED shows the above number of flashing pulses.

PWM input

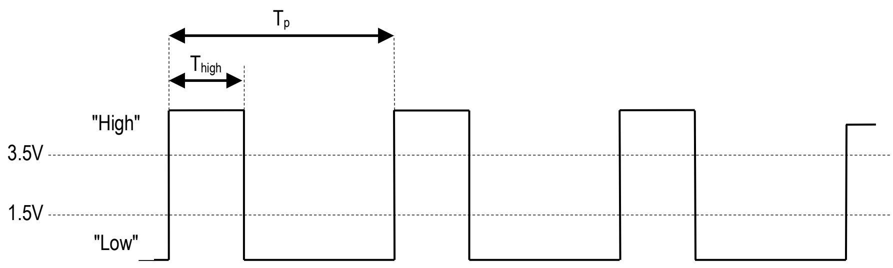
The PWM input is used for the functionality of the parameters

- Set value source (see 2.16)
- Fail-safe set value source (see 2.47)

If a PWM input is selected as source for one of these parameters, I/O 3 must be configured as PWM input here.

If I/O 3 is not configured as PWM input, the PWM modulation level PWMin3 is always set to the value 0% irrespective of the signal applied.

Level:



U ≥ 3.5 V: "High" level
U ≤ 1.5 V: "Low" level

The PWM modulation level at I/O 3 (PWMin3) designates the ratio $PWMin3\,[\%] = \frac{T_{high}}{T_p} \cdot 100\%$

Frequency:
A frequency range of 40 Hz – 10 kHz is supported.
PWM signals outside this frequency range cannot be evaluated by the fan.

There are two configuration options for the PWM input:

Idle level high (7):

In the configuration "PWM input idle level high", I/O 3 has an integrated pull-up. This enables an open collector signal to be connected by the customer, with the level being actively pulled to GND. The level actively pulled to GND corresponds to a low level.

Idle level low (8):

In the configuration "PWM input idle level low", I/O 3 has an integrated pull-down. This enables an open collector signal to be connected by the customer, with the level being actively pulled to a potential > 3.5 V. The level actively pulled to > 3.5 V corresponds to a high level.

2.46.2 Help with settings

Multiple parameters have to be set to allocate a desired functionality to an I/O. This overview lists all the parameters required to allocate the desired functionality to an I/O.

○ *Configurable option*
● *Factory setting*
(●) *Default function, activated via I/O mode*

Configurable I/O function: normal / inverted

			Configurable I/O mode	MODBUS registers for I/O mode configuration	INPUT: Source: Set value (D101 [...])	Source: Sensor actual value (D147 [...])	Switching: Parameter set: #1 / #2 (D104 [...])	Switching: Direction of action: Heating (pos.)/Cooling (neg.) (D12E [...])	Switching: Direction of rotation (D148 [...])	Switching: Set value source (D16C [...])	Switching: Enable/disable input (D16A [...])	OUTPUT: Signal: Tacho output (selected directly via I/O mode)	Signal: Diagnostic output (selected directly via I/O mode)	Signal: Fan modulation level % (D130 [0])	Signal: Actual speed rpm (D130 [1])	Signal: Installation modulation level % (D130 [2])	Signal: Remote control 0-10 V (D130 [5])	Autoaddressing input pulses (D00C [1])	Autoaddressing output pulses (D130 [4])
Customer connection side	IO1	●	**Din1 (high active)**: Digital input	D158 [0]			○	○	○	○	○							○	
		○	**Ain1 0-10 V/PWM**: Analog input	D158 [2]	○	○													
		○	**Tacho output** (open collector)	D158 [5]								(●)							
		○	**Diagnostic output** (open collector)	D158 [6]									(●)						
	IO2	○	**Din2 (high active)**: Digital input	D159 [0]			○	○	○	○	○								
		●	**Ain2 0-10 V/PWM**: Analog input	D159 [2]	○	○													
		○	**Ain2 4-20 mA**: Analog input	D159 [3]															
	IO3	○	**Din3 (high active)**: Digital input	D15A [0]			○	○	○	○	○								
		○	**Din3 (low active)**: Digital input	D15A [1]															
		○	**PWMin3**: Digital PWM input	D15A [7]	○														
		●	**Aout3 0-10 V**: Analog output	D15A [4]										○	○	○	○		○
		○	**Tacho output** (pulses)	D15A [5]								(●)							
		○	**Diagnostic output** (pulses)	D15A [6]									(●)						
	RSA RSB		RS485 bus interface		○		○	○	○	○	○								
	Vout		Power supply	D16E [...]															
			Alternatively: Auxiliary voltage input for parameterization via RS485/MODBUS RTU interface if no line voltage applied																

2.47 Fail-safe set value source

Address : D15C
Write authorization : ebm-papst, customer

Coding:

This parameter specifies the source through which the fail-safe set value is specified.

Value	Fail-safe set value source
0	Fail-safe mode inactive
1	Fail-safe set value specification by parameter Fail-safe set value (see 2.48)
2	Fail-safe set value specification by analog input Ain1
3	Fail-safe set value specification by analog input Ain2
4	Fail-safe set value specification by PWM input PWMin3

The MSB has no significance.
Permissible value range: 0..4

Function:

The fail-safe mode monitors the set value signal wire and reacts in the event of signal failure.
The set value signal wire to be monitored is defined by the parameters Set value source (see 2.16) and Set value source switching (see 2.17).

A break in the signal wire is defined as follows:

Signal wire = RS485:
No command is issued to the fan within the time span specified in the parameter "Fail-safe time delay" (see 2.49).

Signal wire = Analog input Ain1:
The voltage at the analog input Ain1 drops below the value defined in the parameter "Open circuit limit value input characteristic curve" (see 2.51).

Signal wire = Analog input Ain2:
The voltage at the analog input Ain2 drops below the value defined in the parameter "Open circuit limit value input characteristic curve" (see 2.51).

Signal wire = PWM input PWMin3
The input signal is static and corresponds to the potential of the idle level. This corresponds to the signal at an input with no connection. For the definition of the idle level, see 2.46.

If a break in a signal wire is detected, the fan automatically switches to the selected Fail-safe set value source. At the same time the direction of rotation is set to the value "Fail-safe running direction" (see 2.50).

If the signal wire and the Fail-safe set value source are identical (e.g. signal wire = Ain1 and Fail-safe set value source = Ain1), the fail-safe mode is inactive.

The Fail-safe set value signal wire (Fail-safe set value source) itself is not additionally monitored for signal failure in fail-safe.

2.48 Fail-safe set value

Address : D15D
Write authorization : ebm-papst, customer

If a break is detected in the set value signal wire, the fan automatically switches to the fail-safe set value specified here. For further information on the function, see 2.47.

Coding:

Notes: The coding corresponds to the coding of the setpoint (D001)
The 4 LSBs have no significance for the set value and are always assumed to be 0.

a) In speed control operating mode

The fail-safe set value designates a speed:

$$Fail\ safe\ set\ value\,[\mathrm{rpm}] = \frac{Data\ bytes}{64000} \cdot nMax\,[\mathrm{rpm}]$$

nMax [rpm] ... maximum speed in revolutions per minute (see 2.33 Maximum speed)

The value zero signifies motor standstill

b) In open-loop control operating mode

The fail-safe set value designates a modulation level:

$$Fail\ safe\ set\ value\,[\%] = \frac{Data\ bytes}{65536} \cdot 100\%$$

The value zero signifies motor standstill

c) In sensor control operating mode

The fail-safe set value designates a sensor quantity:

A sensor which converts the control variable into a voltage of 0..10 V or 4..20 mA must be connected to the fan.

A set value can be entered for the output voltage or output current of the sensor used.
The fail-safe set value for the control variable is then obtained from the set value parameter and the characteristic curve Cv(U/I) of the sensor used.

Cv (U) = Control variable as a function of voltage

$$Fail\ safe\ value\,[V] \;=\; \frac{Data\ bytes}{65536}\cdot 10V$$

$$\begin{aligned} Fail\ safe\ set\ value\,[unit(Cv)] &= Cv\,(\,fail\ save\ set\ value\,[V])\\ &= Cv\,(\frac{Data\ bytes}{65536}\cdot 10V) \end{aligned}$$

or

Cv (I) = Control variable as a function of current

$$Fail\ safe\ set\ value\,[mA] \;=\; \frac{Data\ bytes}{65536}\cdot 16mA + 4mA$$

$$\begin{aligned} Fail\ safe\ set\ value\,[unit(Cv)] &= Cv\,(\,fail\ safe\ set\ value\,[V])\\ &= Cv\,(\frac{Data\ bytes}{65536}\cdot 16mA + 4mA) \end{aligned}$$

2.49 Fail-safe time delay

Address : D15E
Write authorization : ebm-papst, customer

Only for set value specification by RS485:
If no command is issued to the fan for the time specified here, the fan automatically switches to the selected Fail-safe set value source. At the same time the direction of rotation is set to the value "Fail-safe running direction" (see 2.50). For further information on the function, see 2.47.

Coding:

$$Fail - safe\ time\ lag\ ms = Data\ bytes \cdot 100ms$$

2.50 Fail-safe running direction

Address : D15B
Write authorization : ebm-papst, customer

If the fail-safe mode is active and a break in the set value signal wire is detected, the direction of rotation is set to the value defined here. The settings of the parameters Preferred running direction (see 2.19) and Running direction source (see 2.18) are then not relevant.

For further information, see 2.47 Fail-safe set value source

Coding:

Value	Fail-safe running direction
0	Counterclockwise
1	Clockwise
2	None (set direction of rotation is retained)

The MSB has no significance.

Permissible value range: 0..2

2.51 Open circuit limit value input characteristic curve

Address : D15F
Write authorization : ebm-papst, customer

Only for set value specification by analog input Ain1 or Ain2
If the voltage at the set value input Ain1 or Ain2 drops below the value defined here, the fan automatically switches to the selected Fail-safe set value source. At the same time the direction of rotation is set to the value "Fail-safe running direction" (see 2.50). For further information on the function, see 2.47.

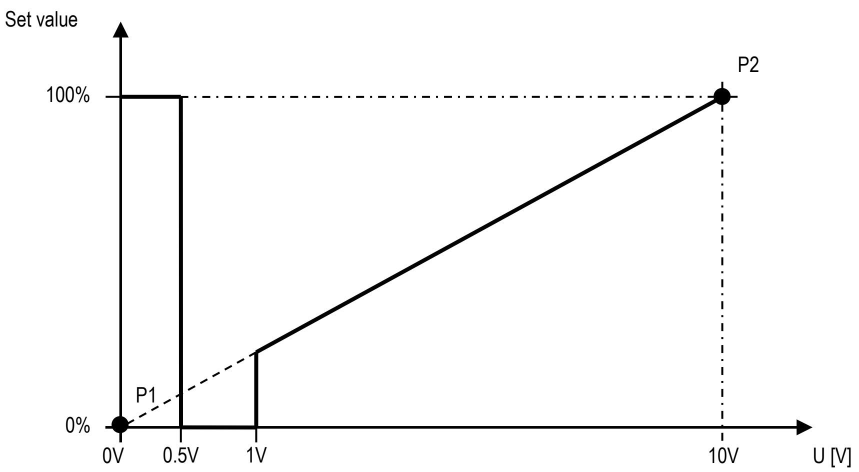
Coding:

$$U\_cable\,break\,[V] \quad = \quad \frac{Data\,bytes}{65536} \cdot 10V$$

<u>Example:</u>

Fail-safe mode	= on
Fail-safe set value	= 100%
Input characteristic curve U_open circuit	= 0.5 V
Input characteristic curve P1	= (0 V | 0%)
Input characteristic curve P2	= (10V | 100%)
Motor stop enable	= 1

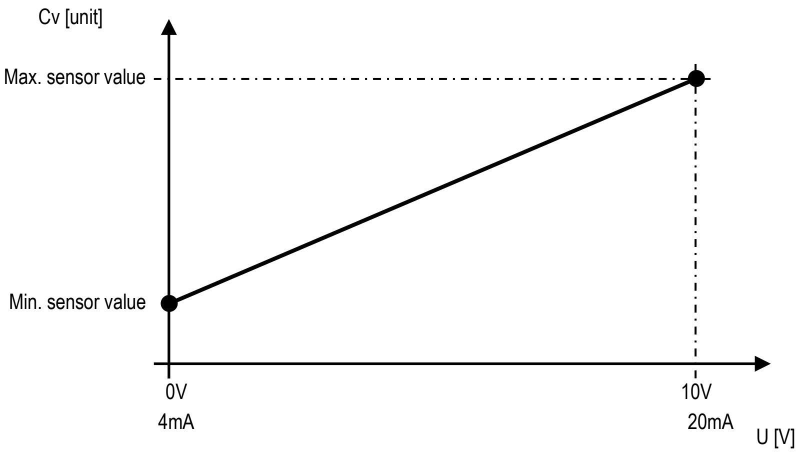
This yields the following characteristic curve:



2.52 Sensor

Min. sensor value address	: D160 / D161
Max. sensor value address	: D162 / D163
Sensor unit address	: D164 – D169
Write authorization	: ebm-papst, customer, end customer

These values define the characteristic curve of the connected sensor as shown in the following graph.



The specifications required for Min. sensor value and Max. sensor value can be found in the sensor data sheet.

These parameters are only intended for processing in the master. Fan action is not influenced by these parameters.

Coding:

a) Minimum sensor value

$$Min.\,sensor\,value[\,phys.unit] \;=\; Data\,bytes$$

The minimum sensor value is stored in "IEEE float" format.

b) Maximum sensor value

$$Max.\,sensor\,value[\,phys.unit] \;=\; Data\,bytes$$

The maximum sensor value is stored in "IEEE float" format.

c) Sensor unit

$$Sensor\,unit\,[ASCII] \;=\; Data\,bytes$$

The sensor unit is stored in "ASCII" format.

2.53 Enable / Disable source

Address : D16A
Write authorization : ebm-papst, customer, end customer

Coding:

This parameter specifies whether the Enable / Disable function is determined by a digital input or by the internal parameter.

Value	Enable / Disable function by...
0	Inactive
1	Parameter "Enable / Disable" (see 2.11 Enable / Disable)
2	Digital input Din1 (Disable input)
3	Digital input Din2 (Disable input)
4	Digital input Din3 (Disable input)
5	Digital input Din1 (Enable input)
6	Digital input Din2 (Enable input)

The MSB has no significance.

Permissible value range: 0..6

Function:

The signal has two states: enabled / disabled

The fan can only be started in "enabled" state.
In "disabled" state the fan is stationary irrespective of any set value specification.

All errors are reset upon transitioning from "enabled" to "disabled" state
This action corresponds to the setting of the "Error" bit in the parameter Reset (see 2.2)

The following table provides an overview of the Enable / Disable signal state

Enable / Disable source	0	1	1	2	2	3	3
Enable / Disable	X	0	1	X	X	X	X
Digital input Din1	X	X	X	Active	Inactive	X	X
Digital input Din2	X	X	X	X	X	Active	Inactive
Digital input Din3	X	X	X	X	X	X	X
Enable state	Enabled	Disabled	Enabled	Disabled	Enabled	Disabled	Enabled

Enable / Disable source	4	4	5	5	6	6
Enable / Disable	X	X	X	X	X	X
Digital input Din1	X	X	Active	Inactive	X	X
Digital input Din2	X	X	X	X	Active	Inactive
Digital input Din3	Active	Inactive	X	X	X	X
Enable state	Disabled	Enabled	Enabled	Disabled	Enabled	Disabled

For definition of active / inactive, see 2.46

2.54 Stored Enable / Disable

Address : D16B
Write authorization : ebm-papst, customer, end customer

If the function "Store set value" is active (see 2.20), the value of the parameter "Enable / Disable" (see 2.11) is copied into the parameter "Stored Enable / Disable" following interruption of the power supply.
Once the power supply has been restored, the value of the parameter "Stored Enable / Disable" is copied into the parameter "Enable / Disable"

As the parameter Enable / Disable is located in the volatile memory, this value (if applicable) has to be saved in the non-volatile memory as well to permit retention of the existing state following interruption and restoration of the power supply. The parameter "Stored Enable / Disable" is intended for this purpose.

Coding:

Value	Enable / Disable
0	Off (no enable)
1	On (enable)

Permissible value range: 0..1

2.55 Voltage output

Address : D16E
Write authorization : ebm-papst, customer, end customer

A fixed voltage value between 3.3 and 24 V can be output at the voltage output, e.g. for supplying sensors. The voltage value can be set with this parameter.

Coding:

$$U\_Output\,[V] \quad = \quad \frac{Data\ bytes}{65536} \cdot 20.7V + 3.3V$$

2.56 RFID access

Address : D16F
Write authorization : ebm-papst, customer

Coding:

LSB							
0	0	0	0	0	0	0	RFID

The MSB has no significance.

RFID = 0 : Access to parameter via RFID interface not approved
RFID antenna is permanently inactive (no RFID reception possible)
RFID = 1 : Access to parameter via RFID interface permitted

2.57 Customer data

Address : D170 – D17F
Write authorization : ebm-papst, customer

A total of 16 parameters (of 16 bits each) are available to the customer in this area.
Any values can be stored here.

Fan action is not influenced by these parameters.

2.58 Operating hours counter (back-up)

Address : D180
Write authorization : ebm-papst

Coding:

$$\textit{Operating time}\,[h] = \textit{Data bytes}$$

This parameter is a back-up copy of the parameter D009 "Operating hours counter" (see 2.7 Operating hours counter). The parameter is constantly updated.

2.59 Error history

Error indicator address	: D182
Address of 1st error	: D184
Address of time of 1st error	: D185
Error history 1..13 address	: D186, D188, D18A, D18C, D18E, D190, D192, D194, D196, D198, D19A, D19C, D19E
Error history 1..13 time address	: D187, D189, D18B, D18D, D18F, D191, D193, D195, D197, D199, D19B, D19D, D19F
Write authorization	: ebm-papst

A) 1st error

The 1st error occurring in the fan life cycle is stored under the parameter "1st error".
At the same time, the count of the operating hours counter at this time is stored in the parameter "1st error time". The parameters are written automatically by the fan.

B) Error history

The last 13 errors that have occurred in the fan are stored in the error history.
The corresponding count of the operating hours counter is stored for each error in the parameter "Error history time". The parameters are written automatically by the fan.

The error indicator (D182) gives the address of the last error to occur in the error history.
The preceding error is then at the preceding address.

Example:

Error indicator = D196

Then:

D196	Last error (error n)	D197	Time of last error (error n)
D194	Error n-1	D195	Time of error n-1
D192	Error n-2	D193	Time of error n-2
D190	Error n-3	D191	Time of error n-3
D18E	Error n-4	D18F	Time of error n-4
D18C	Error n-5	D18D	Time of error n-5
D18A	Error n-6	D18B	Time of error n-6
D188	Error n-7	D189	Time of error n-7
D186	Error n-8	D187	Time of error n-8
D19E	Error n-9	D19F	Time of error n-9
D19C	Error n-10	D19D	Time of error n-10
D19A	Error n-11	D19B	Time of error n-11
D198	Error n-12	D199	Time of error n-12

Each time a new error occurs, the error indicator is incremented by 2 and both the error and the time are stored at the address shown by the error indicator. The addresses are written automatically by the fan in this process.

When the error indicator reaches the last value D19E, it will be reset to the first value D186 when the next error occurs.

Coding:

Error indicator:

$$\textit{Address of error indicator} = \textit{Data bytes}$$

Error:

MSB	0	0	0	0 *)	0	0 *)	0	n_Limit
LSB	BLK	HLL	TFM	0 *)	SKF	TFE	0	0 *)

If bit = 1, the error described below has occurred:

n_Limit: Speed limit exceeded

BLK: Motor blocked
HLL: Hall sensor error
TFM: Motor overheated
SKF: Communication error between bus controller and commutation controller
TFE: Output stage overheated

*) The errors "DC-link undervoltage", "Rotor position sensor calibration error" and "Phase failure" and the general error identifier "Fan Bad" are not stored even if they are set in the motor status (cf. Motor status).

Note:
The errors "Communication error" and "Speed limit exceeded" are only stored if the last error was a different one, as restarting is permitted with this error.

Time of error:

$$\textit{Time of error}\ [h] = \textit{Data bytes}$$

2.60 DC-link voltage reference value

Address : D1A0
Write authorization : ebm-papst

All values for the DC-link voltage are referenced to this reference value to keep the resolution variable.

Coding:

$$Reference\ Uz\,[mV] \quad = \quad Data\ bytes \cdot 20\,mV$$

2.61 DC-link current reference value

Address : D1A1
Write authorization : ebm-papst

All values for the DC-link current are referenced to this reference value to keep the resolution variable.

Coding:

$$Reference\ \ Iz\,[mA] \quad = \quad Data\ bytes \cdot 2\,mA$$

2.62 Manufacturing data

The manufacturing data contain information to be able to identify the device concerned. Fan action is not influenced by these parameters.

2.62.1 Fan serial number and date of manufacture

Serial number address : D1A2 / D1A3
Date of manufacture address : D1A4
Write authorization : ebm-papst

ebm-papst allocates an individual serial number for each fan. The part which customers can read out is made up of the date of manufacture and the consecutive number. This can likewise be used for addressing. Should any unexpected problems arise, please inform us accordingly.

Format: YYWW00XXXX

YY : Year of manufacture
WW : Week of manufacture
00 : Fixed value 00
XXXX : Consecutive number

The first 4 characters contain the date of manufacture (year / week).
The number XXXX starts running at zero at the start of each week of manufacture and is incremented by 1 for each fan. Each character can assume values from 0-9 and from A-Z. This yields a maximum encodable number of 36 characters per position, i.e. 36^4 = 1,679,616 devices / week

a) Serial number (D1A2 / D1A3)

Only the XXXX part (consecutive number) is stored in the parameter "Serial number".
Each character is encoded as an ASCII value.

Coding:

$$Serial\ number\ [ASCII] = Data\ bytes$$

b) Date of manufacture (D1A4)

The YYWW part is stored in the parameter "Date of manufacture".
Each character is encoded as a hex value.

Coding:

$$Production\ year = Data\ bytes\ (MSB)$$

$$Production\ week = Data\ bytes\ (LSB)$$

<u>Example:</u>

ebm-papst serial number: 092300**12GY**
-> D1A2 content: 0x4759 (GY)
D1A3 content: 0x3132 (12)
D1A4 content: 0x0917 (09/23)

2.62.2 Fan type

Address : D1A5 – D1AA
Write authorization : ebm-papst

Coding:
The fan type is stored here in ASCII characters
D1A5 contains the first two characters.
D1AA contains the last two characters.

2.63 Rotor position sensor

2.63.1 Rotor position sensor calibration

Address : D1F8
Write authorization : ebm-papst

Coding:

MSB	0	0	0	0	0	0	0	0
LSB	0	0	0	0	0	0	0	Cal

Cal .... Trigger rotor position sensor calibration process

Calibration procedure:

When Cal = 1 a rotor position sensor calibration process is triggered.
This calibration process is displayed

- in the input register Warning bit 8 RL_Cal (see 3.10)

The following parameters are automatically set to defined values at the start of the calibration process:
The settings of the corresponding parameters are ignored during the calibration process

- Limitation Control = 0 (all limitations are inactive) – see 2.38
- Operating mode = 2 (open-loop control) – see 2.23
- Set value = Rotor position sensor calibration set value (see 2.63.2)

Set value specifications from other sources are ignored during the calibration process.
When the calibration process is active, the fan may start up unexpectedly even if the set value specified by the selected set value source is 0.

During the calibration process, make sure the motor is always enabled via a defined Enable / Disable signal if applicable (see 2.53). Otherwise it will not be possible to successfully implement the calibration process.

If the calibration process was successful

- The request in the holding register Rotor position sensor calibration (bit 0, Cal) is reset
- The display in the input register Warning bit 8 RL_Cal is reset

The altered settings of the parameters (Limitation Control, Operating mode, Set value, see above) are reset to their previous values.

If the calibration process was unsuccessful, an error message is set in the input register Motor status bit 10, RL_Cal (see 3.9).
The request in the holding register Rotor position sensor calibration (bit 0, Cal) is retained.
Another calibration process cannot be started until the error message has been reset (power supply off / on or via holding register for reset, see 2.2 or via Enable / Disable signal).

While ever the rotor position sensor has not been successfully calibrated, the fan can only be operated in calibration mode. In this case an error message is always generated outside calibration mode.

2.63.2 Rotor position sensor calibration set value

Address : D1F7
Write authorization : ebm-papst

During the rotor position sensor calibration process, the fan runs with the rotor position sensor calibration set value. Set value specifications from other sources are ignored during the calibration process.

Coding:

During the calibration process the operating mode is automatically set to "Open-loop control".
The set value thus always designates a modulation level:

$$Setvalue\ calibration\,[\%] \quad = \quad \frac{Databytes}{65536} \cdot 100\%$$

The value zero signifies motor standstill

2.64 Mirror function for holding registers

The mirror function for holding registers can be used to select up to 32 holding registers from all the fan holding registers and arrange these in an individual order in a contiguous address area. These individually compiled holding registers can then be addressed with a single read or write command. The transmission speed for all the information required for an application can be optimized using this function.

The mirror function is made up of two register ranges:
- Original addresses of mirrored holding registers (D480 – D49F) – see 2.64.2
- Mirrored holding registers (D380 – D39F) – see 2.64.1

A holding register from one of these ranges is always assigned to one from the other range:

Original address of mirrored holding registers	Mirrored holding registers
D480	D380
D481	D381
D482	D382
D483	D383
D484	D384
D485	D385
D486	D386
D487	D387
D488	D388
D489	D389
D48A	D38A
D48B	D38B
D48C	D38C
D48D	D38D
D48E	D38E
D48F	D38F
D490	D390
D491	D391
D492	D392
D493	D393
D494	D394
D495	D395
D496	D396
D497	D397
D498	D398
D499	D399
D49A	D39A
D49B	D39B
D49C	D39C
D49D	D39D
D49E	D39E
D49F	D39F

The addresses of the holding registers which are mirrored are specified in the original address (D480 – D49F). The holding registers which are defined in the corresponding original address can be accessed via the mirrored holding registers (D380 – D39F).

Write access to a holding register of the mirror range (D380 – D39F) also changes the corresponding holding register of the original range (D000 – D37F).

Write access to a holding register of the original range (D000 – D37F) also changes the corresponding holding register of the mirror range (D380 – D39F).

Example:

Holding register address	Content
D480	D001 (setpoint)
D481	D106 (operating mode for parameter set 1)
D482	D000 (reset)
D483	D009 (operating hours counter)

With read access to the holding register D380, the setpoint is obtained.
With write access to the holding register D380, the setpoint is set.
At the same time the content of the holding register D001 (setpoint) is set to the same value

With read access to the holding register D381, the operating mode (parameter set 1) is obtained
With write access to the holding register D381, the operating mode (parameter set 1) is set
At the same time the content of the holding register D106 (operating mode (parameter set 1)) is set to the same value

The same applies accordingly to the holding registers that follow.

With joint read access to the holding registers D380 – D383, the content of the holding registers Setpoint, Operating mode (parameter set 1), Reset and Operating hours counter is obtained with a single command.

Joint write access to the holding registers D380 – D383 makes it possible to write the content of the holding registers Setpoint, Operating mode (parameter set 1), Reset and Operating hours counter with a single command.

2.64.1 Mirrored holding registers

Address : D380 – D39F
Write authorization : see original registers

Coding : see original registers

The content of the holding registers defined in D480 – D49F is mirrored here
See above for further information on the function.

2.64.2 Original addresses of mirrored holding registers

Address : D480 – D49F
Write authorization : ebm-papst, customer

Coding:

$$\text{Original address} = \text{Data bytes}$$

The addresses of the holding registers which are mirrored in the range D380 – D39F are defined here.
See above for further information on the function.

2.65 Mirror function for input registers

The mirror function for input registers can be used to select up to 16 input registers from all the fan input registers and arrange these in an individual order in a contiguous address area. These individually compiled input registers can then be addressed with a single read command. The transmission speed for all the information required for an application can be optimized using this function.

The mirror function is made up of two register ranges:
- Original addresses of mirrored input registers (**holding** registers D400 – D40F) – see 2.65.1
- Mirrored input registers (**input** registers D100 – D10F) – see 3.29

One holding register and one input register from each of these ranges are assigned to one another:

Original address of mirrored input registers (holding registers)	Mirrored input registers (input registers)
D400	D100
D401	D101
D402	D102
D403	D103
D404	D104
D405	D105
D406	D106
D407	D107
D408	D108
D409	D109
D40A	D10A
D40B	D10B
D40C	D10C
D40D	D10D
D40E	D10E
D40F	D10F

The addresses of the input registers which are mirrored are specified in the original address (D400 – D40F). The input registers which are defined in the corresponding original address can be accessed via the mirrored input registers (D100 – D10F).

Example:

Holding register address	Content
D400	D011 (motor status)
D401	D010 (actual speed)
D402	D019 (current modulation level)
D403	D021 (current power)

With read access to the input register D100, the motor status is obtained.
With read access to the input register D101, the actual speed is obtained.
The same applies accordingly to the input registers that follow.

With joint read access to the input registers D100 – D103, the content of the input registers Motor status, Actual speed, Current modulation level and Current power is obtained with a single command.

2.65.1 Original addresses of mirrored input registers

Address : D400 – D40F
Write authorization : ebm-papst, customer

Coding:

$$\text{Original address} = \text{Data bytes}$$

The addresses of the input registers which are mirrored in the input register range D100 – D10F (see 3.29) are defined here. See above for further information on the function.

2.66 Masking-out set values

Increased vibration noise and impermissible fan loads may occur at operating points with higher vibration velocities. The "Masking-out set values" function can be used to avoid such operating points.

Up to 5 mask-out ranges each can be defined for the "Speed control" and "Open-loop control" operating modes (see 2.23). No set value ranges are masked out in the "Sensor control" operating mode.
If the operating set value in the corresponding operating mode is within a mask-out range, the set value of the fan is set to a boundary value of the range until the set value moves out of the range again.

The operating set value corresponds to the setpoint corrected via the ramp-up curve / ramp-down curve (see 2.35), i.e. a set value may be temporarily masked out during ramp-up if the set value ramp passes through a mask-out range. The fan operates in the identified mask-out range for the shortest possible time.

2.66.1 Mask-out Control

Address : D603
Write authorization : ebm-papst, customer, end customer

Coding:

MSB	0	0	0	0	0	0	0	0
LSB	0	0	0	0	0	0	Step-change	Enable

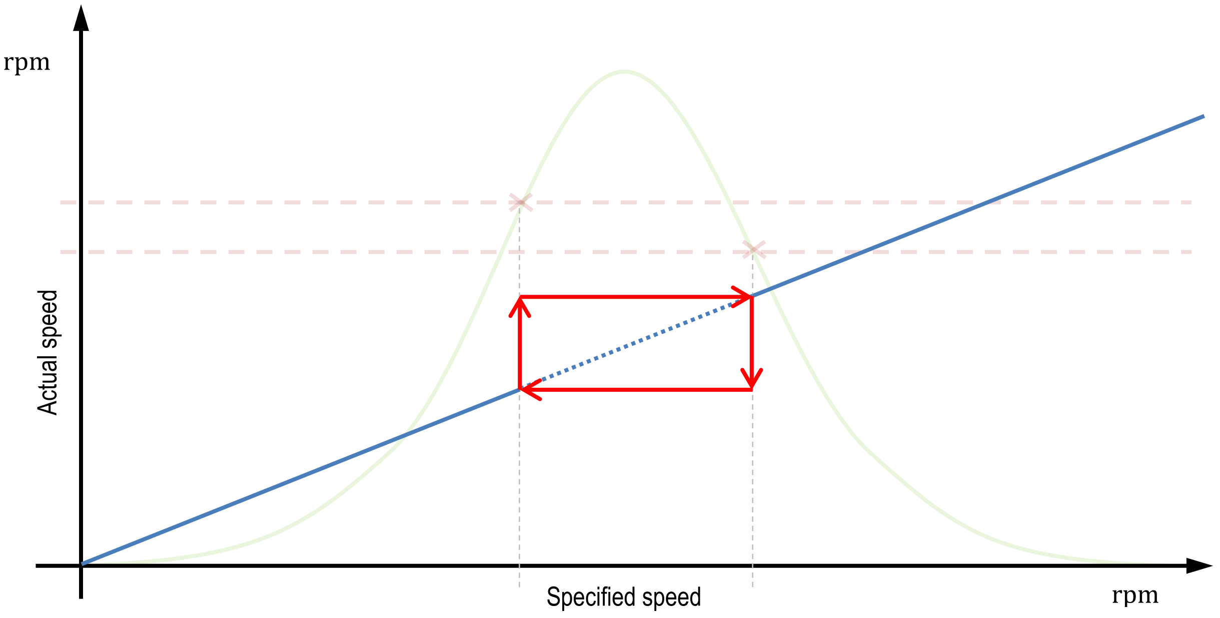
Enable: Bit = 1: Masking-out of set values active
Bit = 0: Masking-out of set values inactive

Step-change: Bit = 1: Pre-step-change
Bit = 0: Post-step-change

Pre-step-change:

If the set value exceeds the limit of a mask-out range, the set value is set to the opposite limit until it leaves the range again.

This gives rise to the following procedure
- Set value below mask-out range: Actual value = Set value
- Set value moves into mask-out range from below: Actual value = Upper limit value of mask-out range
- Set value just exceeds mask-out range: Actual value = Upper limit value of mask-out range
- Set value above mask-out range: Actual value = Set value
- Set value moves into mask-out range from above: Actual value = Lower limit value of mask-out range
- Set value just drops below mask-out range: Actual value = Lower limit value of mask-out range



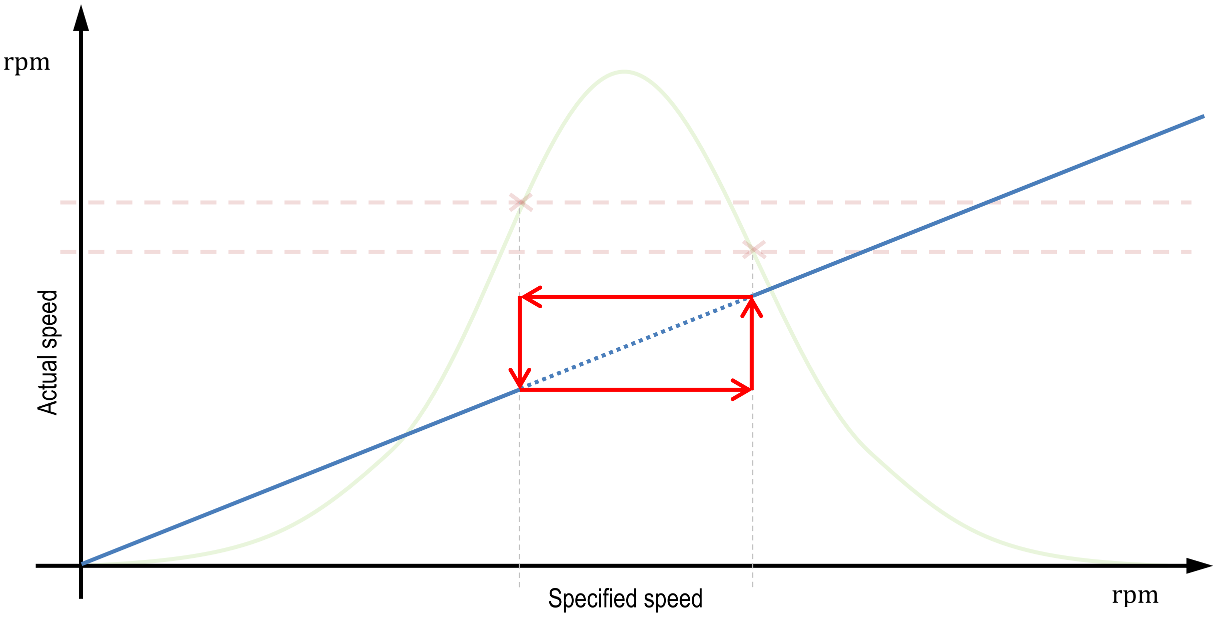
Example of speed mask-out – Pre-step-change

Post-step-change

If the set value exceeds the limit of a mask-out range, the set value remains at this limit value until it leaves the range again.

This gives rise to the following procedure:

- Set value below mask-out range: Actual value = Set value
- Set value moves into mask-out range from below: Actual value = Lower limit value of mask-out range
- Set value just exceeds mask-out range: Actual value = Upper limit value of mask-out range
- Set value above mask-out range: Actual value = Set value
- Set value moves into mask-out range from above: Actual value = Upper limit value of mask-out range
- Set value just drops below mask-out range: Actual value = Lower limit value of mask-out range



Example of speed mask-out – Post-step-change

2.66.2 Speed mask-out ranges

Speed mask-out range 1 min address	: D604
Speed mask-out range 1 max address	: D605
Speed mask-out range 2 min address	: D606
Speed mask-out range 2 max address	: D607
Speed mask-out range 3 min address	: D608
Speed mask-out range 3 max address	: D609
Speed mask-out range 4 min address	: D60A
Speed mask-out range 4 max address	: D60B
Speed mask-out range 5 min address	: D60C
Speed mask-out range 5 max address	: D60D
Write authorization	: ebm-papst, customer, end customer

Coding:

$$n\left[\frac{1}{min}\right] = Data\ bytes$$

Attention:
The speed values are coded as absolute values and not referenced to the maximum speed!

If the operating set value in Speed control operating mode (see 2.23) is within a mask-out range defined here, the set value is corrected accordingly to a limit of the range (see 2.66.1). The values have no function in the Sensor control and Open-loop control operating modes.

2.66.3 Modulation level mask-out ranges

Modulation level mask-out range 1 min address	: D60E
Modulation level mask-out range 1 max address	: D60F
Modulation level mask-out range 2 min address	: D610
Modulation level mask-out range 2 max address	: D611
Modulation level mask-out range 3 min address	: D612
Modulation level mask-out range 3 max address	: D613
Modulation level mask-out range 4 min address	: D614
Modulation level mask-out range 4 max address	: D615
Modulation level mask-out range 5 min address	: D616
Modulation level mask-out range 5 max address	: D617
Write authorization	: ebm-papst, customer, end customer

Coding:

$$Modulation\ level\ [\%] = \frac{Data\ bytes}{65535} \cdot 100\%$$

If the operating set value in Open-loop control operating mode (see 2.23) is within a mask-out range defined here, the set value is corrected accordingly to a limit of the range (see 2.66.1). The values have no function in the Speed control and Sensor control operating modes.

2.66.4 Speed mask-out ranges (back-up)

Speed mask-out range 1 min (back-up) address	: D342
Speed mask-out range 1 max (back-up) address	: D343
Speed mask-out range 2 min (back-up) address	: D344
Speed mask-out range 2 max (back-up) address	: D345
Speed mask-out range 3 min (back-up) address	: D346
Speed mask-out range 3 max (back-up) address	: D347
Speed mask-out range 4 min (back-up) address	: D348
Speed mask-out range 4 max (back-up) address	: D349
Speed mask-out range 5 min (back-up) address	: D34A
Speed mask-out range 5 max (back-up) address	: D34B
Write authorization	: ebm-papst

Coding:

$$n\ \left[\frac{1}{min}\right] = Data\ bytes$$

Attention:
The speed values are coded as absolute values and not referenced to the maximum speed!

The holding register "Mask-out Back-up Control" (see 2.14) can be used to overwrite all speed mask-out ranges (see 2.66.2) with the back-up values stored here.

2.66.5 Modulation level mask-out ranges (back-up)

Modulation level mask-out range 1 min (back-up) address	: D34C
Modulation level mask-out range 1 max (back-up) address	: D34D
Modulation level mask-out range 2 min (back-up) address	: D34E
Modulation level mask-out range 2 max (back-up) address	: D34F
Modulation level mask-out range 3 min (back-up) address	: D350
Modulation level mask-out range 3 max (back-up) address	: D351
Modulation level mask-out range 4 min (back-up) address	: D352
Modulation level mask-out range 4 max (back-up) address	: D353
Modulation level mask-out range 5 min (back-up) address	: D354
Modulation level mask-out range 5 max (back-up) address	: D355
Write authorization	: ebm-papst

Coding:

$$Modulation\ level\ [\%] = \frac{Data\ bytes}{65535} \cdot 100\%$$

The holding register "Mask-out Back-up Control" (see 2.14) can be used to overwrite all modulation level mask-out ranges (see 2.66.3) with the back-up values stored here.

2.67 Device internal bus slave select

Address : D61A
Write authorization : ebm-papst

Coding:

MSB	0	0	0	0	0	0	0	0
LSB	0	0	0	0	Reserved	0	Reserved	VS

The communication with a slave of the device internal bus can be activated (bit = 1) or deactivated (bit = 0) for the participant by setting the relevant bit:

VS vibration sensor

If a participant has been deactivated, all values for this participant will no longer be updated.

2.68 Test run for set value mask-out

The device enables a test run to be performed to determine the speed and modulation level ranges with excessively high vibration velocities. The test run can be activated using the holding register "Test run Control" (see 2.13).

2.68.1 Test run time stamp

Address : D356
Write authorization : ebm-papst

Coding:

$$Time\ stamp\ [h] = Data\ bytes$$

In a test run (see 2.13), the operating hours counter (see 2.7) is stored here at the time of the test run. The data determined in a test run are valid for 6 months (4380 h). After this period, the data are no longer reliable.

If the operating hours counter exceeds the time stamp stored here by more than 4380 h (= 6 months), a status message is generated to indicate that the test run interval has elapsed (see 3.28).

2.68.2 Number of mask-out ranges

Address : D357
Write authorization : ebm-papst

Coding:

$$Number\ of\ ranges\ =\ Data\ bytes$$

In a test run (see 2.13), the number of ranges detected with impermissible vibration velocities (mask-out ranges) is stored here.
If the register contains a value > 5, this means that it was not possible to store all ranges with impermissible vibration velocities in the test run, as only 5 mask-out ranges (see 2.66.2, 2.66.3) are available. A status message is additionally generated in this case (see 3.28)

2.69 Error output (delay)

Address : D620
Write authorization : ebm-papst, customer, end customer

An error detected by the device is output on the input register Motor status (see 3.9) delayed by the time defined here. Short-term faults can therefore be suppressed.

Coding:

$$Delay\ [s]\ =Data\ bytes$$

The MSB has no significance.

2.70 Warning output

2.70.1 Mask

Address : D622
Write authorization : ebm-papst, customer, end customer

A warning detected by the device is only output on the input register Warning (see 3.10) if the corresponding bit has been set in this mask. Undesired warnings can therefore be suppressed.

Coding:

MSB	LRF	UeHigh	0	UzHigh	0	OpenCir.	n_Low	RL_Cal
LSB	Braking	UzLow	TEI_high	TM_high	TE_high	P_Limit	L_high	I_Limit

LRF : Shedding function active – (see 2.45 Shedding function)
UeHigh : Line voltage high
UzHigh : DC-link voltage high
OpenCir. : Open circuit at analog input or PWM input for the set value (voltage at analog input < open circuit limit value – see 2.51, or signal at PWM input statically high)
n_Low : Actual speed is lower than speed limit for running monitoring (see 2.42 Speed limit for running monitoring).
RL_Cal : Calibration of rotor position sensor in progress (see 2.63.1)

Braking : Braking mode: set in the case of external drive in opposite direction at high speed for lengthy period
UzLow : DC-link voltage low
TEI_high : Temperature inside electronics high
TM_high : Motor temperature high
TE_high : Output stage temperature high
P_Limit : Power limiter in action
L_high : Line impedance too high (DC-link voltage unstable)
I_Limit : Current limitation in action

2.70.2 Delay

Address : D621
Write authorization : ebm-papst, customer, end customer

A warning detected by the device is output on the input register Warning (see 3.10) delayed by the time defined here. Short-term faults can therefore be suppressed.

Coding:

$$Delay\ [s] = Data\ bytes$$

The MSB has no significance.

2.71 Relay actuation

2.71.1 Error mask

Address : D623
Write authorization : ebm-papst, customer, end customer

This mask can be used to select which errors (see 3.9) lead to the dropping out of the status relay and thus to the opening of the relay contact. An error causes the status relay to drop out if the corresponding bit has been set.

Coding:

MSB	0	0	0	UzLow	0	RL_Cal	0	n_Limit
LSB	BLK	HLL	TFM	FB	SKF	TFE	0	PHA

If a bit has been set, the error described below has occurred:

UzLow: DC-link undervoltage
RL_Cal: Rotor position sensor calibration error (see also 2.63.1)
n_Limit: Speed limit exceeded

BLK: Motor blocked
HLL: Hall sensor error
TFM: Motor overheated
FB: Fan Bad (general error)
SKF: Communication error between master controller and slave controller
TFE: Output stage overheated
PHA: Phase failure (3-phase devices) or line undervoltage (single-phase devices)

2.71.2 Warning mask

Address : D624
Write authorization : ebm-papst, customer, end customer

This mask can be used to select which warnings (see 3.10) lead to the dropping out of the status relay and thus to the opening of the relay contact. A warning causes the status relay to drop out if the corresponding bit has been set.

Coding:

MSB	LRF	UeHigh	0	UzHigh	0	OpenCir.	n_Low	RL_Cal
LSB	Braking	UzLow	TEI_high	TM_high	TE_high	P_Limit	L_high	I_Limit

LRF : Shedding function active – (see 2.45 Shedding function)
UeHigh : Line voltage high

UzHigh : DC-link voltage high
OpenCir. : Open circuit at analog input or PWM input for the set value (voltage at analog input < open circuit limit value – see 2.51, or signal at PWM input statically high)
n_Low : Actual speed is lower than speed limit for running monitoring (see 2.42 Speed limit for running monitoring).
RL_Cal : Calibration of rotor position sensor in progress (see 2.63.1)

Braking : Braking mode: set in the case of external drive in opposite direction at high speed for lengthy period
UzLow : DC-link voltage low
TEI_high : Temperature inside electronics high
TM_high : Motor temperature high
TE_high : Output stage temperature high
P_Limit : Power limiter in action
L_high : Line impedance too high (DC-link voltage unstable)
I_Limit : Current limitation in action

2.71.3 Relay dropout delay

Address : D153
Write authorization : ebm-papst, customer, end customer

The status relay dropout is delayed by the time specified here if the device detects an error or warning selected in the mask (see 2.71.1, 2.71.2).
The display of short-term faults on the status relay can therefore be suppressed.

Coding:

$$Dropout\ delay\ [s] = Data\ byte$$

The MSB has no significance.

3 Input registers

3.1 Overview

The input registers are stored in the RAM of the fan.
The input registers have read access only.

The following list provides an overview of all parameters.
The function of the parameters is described in the following sections

Modbus address	Designation
D000	Identification
D001	Max. number of bytes
D002	Bus controller software name
D003	Bus controller software version
D004	Commutation controller software name
D005	Commutation controller software version
D006	Reserved
D010	Actual speed
D011	Motor status
D012	Warning
D013	DC-link voltage
D014	DC-link current
D015	Module temperature
D016	Motor temperature
D017	Electronics temperature
D018	Current direction of rotation
D019	Current modulation level
D01A	Current set value
D01B	Sensor actual value
D01C	Enable / Disable input state
D01D	Current parameter set
D01E	Current direction of action
D01F	Reserved
D020	Not assigned
D021	Current power
D022	Reserved
D023	Sensor actual value 1
D024	Sensor actual value 2
D025 to D026	Reserved
D027	Current power [W]
D028	Current set value source
D029 to D02A	Energy consumption counter
D02B	Reserved
D02C	Reserved
D02D	Actual speed [rpm]
D02E to D039	Not assigned
D03A	Reserved
D03B	Reserved

Modbus address	Designation
D03C	Reserved
D03D	Line voltage
D03E to D03F	Not assigned
D040	Vibration sensor time stamp
D041	Vibration sensor speed
D042	Vibration sensor harmonic vibration velocity X
D043	Vibration sensor harmonic vibration velocity Y
D044	Vibration sensor harmonic vibration velocity Z
D045	Reserved
D046	Reserved
D047	Reserved
D048	Vibration sensor RMS vibration velocity X
D049	Vibration sensor RMS vibration velocity Y
D04A	Vibration sensor RMS vibration velocity Z
D04B	Vibration status
D04C	Vibration sensor harmonic vibration velocity sum
D04D	Reserved
D04E	Vibration sensor RMS vibration velocity sum
D04F to D0F5	Not assigned
D0F6 to D0FF	Reserved
D100 to D10F	Mirrored input registers
D110 to D1FF	Not defined
D200 to D2FE	Reserved

3.2 Identification

Identification address : D000

The identification specifies the type of electronics/protocol concerned.

Coding:

Identification:

Value	Device	Specification version
00 13	ebm-papst product range	6.3

Devices with identification ≠ 0x0013 do not correspond to this specification.
In such cases use is to be made of the applicable document.

3.3 Maximum number of bytes

Address : D001

This parameter specifies the maximum number of bytes which can be contained in a telegram via Modbus.

Coding:

$$Max.\ number\ of\ bytes = Data\ bytes$$

3.4 Bus controller software name

Address : D002

This parameter specifies the bus controller software number (without version).

Coding:

$$\textit{Software name} = \textit{Data bytes}$$

3.5 Bus controller software version

Address : D003

This parameter specifies the bus controller software version.

Coding:

$$\textit{Software version} = \textit{Data bytes LSB}$$

The MSB is always 0.

3.6 Commutation controller software name

Address : D004

This parameter specifies the commutation controller software number (without version).

Coding:

$$\textit{Software name} = \textit{Data bytes}$$

3.7 Commutation controller software version

Address : D005

This parameter specifies the commutation controller software version.

Coding:

$$\textit{Software version} = \textit{Data bytes LSB}$$

The MSB is always 0.

3.8 Actual speed

3.8.1 Relative coding

Address : D010

Coding:

The actual speed is obtained from the speed parameter and the maximum speed:

$$Actual\ speed\ \left[\frac{1}{min}\right] = \frac{Data\ bytes}{64000}\ nMax\ [\frac{1}{min}]$$

nMax [rpm] ... maximum speed (in revolutions per minute) – see 2.33 Maximum speed

Note:
If the actual speed exceeds the value "1.02 * Maximum speed", the display is limited to the value "1.02 * Maximum speed" (0xFFF0)

3.8.2 Absolute coding

Address : D02D

Coding:

$$Actual\ speed\ \left[\frac{1}{min}\right] = Data\ bytes$$

The numerical value of the input register corresponds directly to the actual speed in revolutions per minute. Further calculation using the reference value "Maximum speed" is not necessary.

3.9 Motor status

Motor status address : D011

The motor status indicates errors that are currently present on the fan.

Coding:

MSB	0	0	0	UzLow	0	RL_Cal	0	n_Limit
LSB	BLK	HLL	TFM	FB	SKF	TFE	0	PHA

If a bit has been set, the error described below has occurred:

UzLow: DC-link undervoltage
RL_Cal: Rotor position sensor calibration error (see also 2.63.1)
n_Limit: Speed limit exceeded

BLK: Motor blocked
HLL: Hall sensor error
TFM: Motor overheated
FB: Fan Bad (general error) *)
SKF: Communication error between master controller and slave controller
TFE: Output stage overheated
PHA: Phase failure (3-phase devices) or line undervoltage (single-phase devices)

*) "Fan Bad" is set for every error

3.10 Warning

Warning address : D012

A warning is a precursor to the error message, i.e. the limit value for the error message has almost been reached.

Coding:
The setting of a bit activates the warning:

MSB	LRF	UeHigh	0	UzHigh	0	OpenCir.	n_Low	RL_Cal
LSB	Braking	UzLow	TEI_high	TM_high	TE_high	P_Limit	L_high	I_Limit

LRF : Shedding function active – (see 2.45 Shedding function)
UeHigh : Line voltage high
UzHigh : DC-link voltage high
OpenCir. : Open circuit at analog input or PWM input for the set value (voltage at analog input < open circuit limit value – see 2.51, or signal at PWM input statically high)
n_Low : Actual speed is lower than speed limit for running monitoring (see 2.42 Speed limit for running monitoring).
RL_Cal : Calibration of rotor position sensor in progress (see 2.63.1)

Braking : Braking mode: set in the case of external drive in opposite direction at high speed for lengthy period
UzLow : DC-link voltage low
TEI_high : Temperature inside electronics high
TM_high : Motor temperature high
TE_high : Output stage temperature high
P_Limit : Power limiter in action
L_high : Line impedance too high (DC-link voltage unstable)
I_Limit : Current limitation in action

3.11 DC-link voltage

Address : D013

Coding:

$$Uz\,V = \frac{Data\ byte}{256} \cdot Reference\ Uz\,V$$

Reference Uz ....DC-link voltage reference (see 2.60 DC-link voltage reference value)

3.12 DC-link current

Address : D014

Coding:

$$Iz\ A = \frac{Data\ byte}{256} \cdot Reference\ Iz\ A$$

Reference Iz .... DC-link current reference (see 2.61 DC-link current reference value)

3.13 Module temperature

Address : D015

Coding:

$$T\_Module\ [°C] \quad = \quad Data\ bytes$$

Format: signed integer

3.14 Motor temperature

Address : D016

Coding:

$$T\_Motor\ [°C] \quad = \quad Data\ bytes$$

Format: signed integer

3.15 Temperature inside electronics

Address : D017

Coding:

$$T\_EI\ [°C] \quad = \quad Data\ bytes$$

Format: signed integer

3.16 Current direction of rotation

Address : D018

Coding:

Value	Current direction of rotation
0	Counterclockwise
1	Clockwise

3.17 Current modulation level

Address : D019

Coding:

$$Modulation\,level = \frac{Data\ bytes}{65536} \cdot 100\%$$

3.18 Current set value

Address : D01A

Coding:

a) In speed control operating mode

The set value designates a speed:

$$Set\ value\ rpm = \frac{Data\ bytes}{64000} \cdot nMax\ rpm$$

nMax [rpm] ... maximum speed in revolutions per minute (see 2.33 Maximum speed)

The value zero signifies motor standstill

b) In open-loop control operating mode

The set value designates a modulation level:

$$Set\ value\ \% = \frac{Data\ bytes}{65536} \cdot 100\%$$

The value zero signifies motor standstill

c) In sensor control operating mode

The set value designates a sensor quantity:

A sensor which converts the control variable into a voltage of 0..10 V or 4..20 mA must be connected to the fan.

A set value can be entered for the output voltage or output current of the sensor used.
The set value for the control variable is then obtained from the set value parameter and the characteristic curve Cv (U/I) of the sensor used.

Cv (U) = Control variable as a function of voltage

$$Set\ value\ V = \frac{Data\ bytes}{65536} \cdot 10V$$

$$\begin{aligned} Set\ value\,[unit(Cv)] &= Cv\,(Set\ value\,[V]) \\ &= Cv\,(\frac{Data\ bytes}{65536} \cdot 10V) \end{aligned}$$

or

Cv (I) = Control variable as a function of current

$$Set\ value\ mA = \frac{Data\ bytes}{65536} \cdot 16mA + 4mA$$

$$\begin{aligned} Set\ value\,[unit(Cv)] &= Cv\,(set\ value\,[V]) \\ &= Cv\,(\frac{Data\ bytes}{65536} \cdot 16mA + 4mA) \end{aligned}$$

3.19 Sensor actual values

Sensor actual value address : D01B
Sensor actual value 1 address : D023
Sensor actual value 2 address : D024

2 sensors can be connected to the fan.
The sensor actual value 1 outputs the current actual value of the external sensor at the analog input Ain1.
The sensor actual value 2 outputs the current actual value of the external sensor at the analog input Ain2.

The sensor actual value valid for the controller (D01B) is determined from these two values on the basis of the sensor actual value source (see 2.43 Sensor actual value source). Only this actual value is used in "Sensor control" operating mode.

Coding:

$$Actual\ value\ V = \frac{Data\ bytes}{65536} \cdot 10V$$

$$\begin{aligned} Actual\ value\,[unit(Cv)] &= Cv\,(U) \\ &= Cv\,(\frac{Data\ byte}{65536} \cdot 10V) \end{aligned}$$

Actual value [V] = Sensor output voltage
Cv (U) = Characteristic curve of sensor as a function of voltage

or

$$Actual\ value\ mA = \frac{Data\ bytes}{65536} \cdot 16mA + 4mA$$

$$\begin{aligned} Actual\ value\ [unit(Cv)] &= Cv\ (I) \\ &= Cv\ (\frac{Data\ byte}{65536} \cdot 16mA + 4mA) \end{aligned}$$

Actual value [mA] = Sensor output current
Cv (I) = Characteristic curve of sensor as a function of current

3.20 Enable / Disable input state

Address : D01C

This parameter indicates the state of the Disable input.

The state of the Enable / Disable input depends on the holding registers Enable / Disable source (see 2.53) and Enable / Disable (see 2.11) as well as the digital inputs Din1, Din2 and Din3.
For the logic table for the selection, see 2.53

Coding:

Value	Enable / Disable
0	Enable off (motor stop)
1	Enable on (motor start permitted)

3.21 Current parameter set

Address : D01D

This parameter indicates which parameter set (1 or 2) is currently being used.

The parameter set depends on the holding registers Parameter set source (see 2.21) and Parameter set internal (see 2.22) as well as the digital inputs Din1, Din2 and Din3.
For the logic table for the selection, see 2.21

Coding:

Value	Parameter set
0	Parameter set 1
1	Parameter set 2

3.22 Current direction of action

Address : D01E

This parameter indicates which direction of action is currently being used.

The direction of action depends on the holding registers Direction of action source (see 2.24) and Direction of action (see 2.25) as well as the digital inputs Din1, Din2 and Din3.
For the logic table for the selection, see 2.24.

Coding:

Value	Direction of action
0	Positive: Control deviation = set value – actual value
1	Negative: Control deviation = actual value – set value

Notes:

For sensor control with a temperature sensor, a positive direction of action is synonymous with "Heating" and a negative direction of action is synonymous with "Cooling".

3.23 Current power

3.23.1 Relative coding

Address : D021

Coding:

$$P\ [W] = \frac{Data\ bytes}{65535} \cdot Reference\ Uz\ [V] \cdot Reference\ Iz\ [A]$$

Reference Uz ....DC-link voltage reference (see 2.60 DC-link voltage reference value)
Reference Iz .... DC-link current reference (see 2.61 DC-link current reference value)

3.23.2 Absolute coding [W]

Address : D027

Coding:

$$P\ [W] \quad = \quad Data\ bytes$$

The numerical value of the input register corresponds directly to the current power in W
Further calculation using the reference values for DC-link voltage and DC-link current is not necessary.

3.24 Current set value source

Address : D028

This parameter indicates which set value source is currently being used.

The set value source depends on the holding registers Set value source switching (see 2.17) and Set value source (see 2.16) as well as the digital inputs Din1, Din2 and Din3.
For the logic table for the selection, see 2.17.

The set value source can also be influenced by the fail-safe mode (see 2.47).

Coding:

Value	Set value source
0	Analog input Ain1
1	RS485 (parameter Setpoint D001)
2	Analog input Ain2
3	PWM input PWMin3
255	Fail-safe set value (see 2.48)

3.25 Energy consumption counter

Address : D029 (MSB) / D02A (LSB)

Coding:

$$Energy\ consumption\ kWh = Data\ bytes$$

These input registers indicate the energy consumption of the fan since its delivery.

3.26 Line voltage

Address : D03D

Coding:

$$U_{Supply}[V] = \frac{Data\ byte}{256}\ Reference\ Uz\ [V]$$

Reference Uz ....DC-link voltage reference (see 0)

3.27 Vibration sensor data

3.27.1 Time stamp

Address : D040

Coding:

$$Time\ stamp = Data\ bytes$$

A time stamp is generated for each measurement process carried out by the vibration sensor.
The value is increased by 1 with each measurement.

3.27.2 Speed

Address : D041

Coding:

$$n\left[\frac{1}{min}\right] = 60 \cdot \frac{Data\ bytes}{64}$$

The register contains the speed determined by the vibration sensor.
This speed is required by the vibration sensor to calculate the vibration velocities.

3.27.3 Harmonic vibration velocity

Harmonic vibration velocity X address : D042
Harmonic vibration velocity Y address : D043
Harmonic vibration velocity Z address : D044
Harmonic vibration velocity sum address : D04C

Coding:

$$Vibration\ velocity = 3.066\ \frac{mm}{s} \cdot \frac{Data\ bytes}{256}$$

The vibration velocity (harmonic evaluation) is stated separately for each coordinate (X, Y, Z).

The (geometric) sum is also stated and is formed as follows:

$$Vibration\ velocity\ sum = \sqrt{(Vibration\ velocity\ X)^2 + (Vibration\ velocity\ Y)^2 + (Vibration\ velocity\ Z)^2}$$

3.27.4 RMS vibration velocity

RMS vibration velocity X address : D048
RMS vibration velocity Y address : D049
RMS vibration velocity Z address : D04A
RMS vibration velocity sum address : D04E

Coding:

$$Vibration\ velocity\ =\ 3.066\ \frac{mm}{s} \cdot \frac{Data\ bytes}{256}$$

The vibration velocity (RMS evaluation) is stated separately for each coordinate (X, Y, Z).

The (geometric) sum is also stated and is formed as follows:

$$Vibration\ velocity\ sum = \sqrt{(Vibration\ velocity\ X)^2 + (Vibration\ velocity\ Y)^2 + (Vibration\ velocity\ Z)^2}$$

3.28 Vibration status

Address : D04B

Coding:

MSB	0	0	0	0	0	0	0	0
LSB	0	0	0	Ranges	Gl_Err	Test run	Limit	Mask-out

The setting of a bit activates the warning:

Ranges : More than 5 ranges were detected in the test run (see 2.13)
Gl_Err : Break in communication with vibration sensor
Test run : Test run interval elapsed (more than 6 months since last test run)
Limit : Vibration velocity limit value exceeded
Mask-out : Set value is masked-out (operating set value is within a mask-out range)

3.29 Mirrored input registers

Address : D100 – D10F

Coding : see original registers

The content of the input registers defined in the holding registers D400 – D40F is mirrored here.
For further information on the function, see 2.65 Mirror function for input registers.