ebmBUS - Documentation
Protocol 3rd Revision
Version 3.05.04

for CHG485-HB50-01
for CEE485-HB12-02
for CHW050-AA01-70
for CHW050-AA01-72
for CHW050-AA03-73
for CNW015-AB0*-05
for CNW030-AC0*-05
for ECi M3G084-**-****
for ECi M3G112-**-****
for ECi M3G150-**-****

based on RS485

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P R E L I M I N A R Y

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1 Features

Data transmission by means of ebmBus described in this specification is done by a structure defined as **Master - Slave - System**.
This system eliminates data crashes resulting from simultaneous sending of telegrammes.
The master determines systematic data transmission.
A slave reacts to the Master's request/command.
When setting up a system it is important to avoid double-issuance of identical Slave addresses.

For transmission a Twisted-Pair-Line with RS485 - Standard is preferably used.

Each fan or participant is therefore addressed by its individual fan address (1..31) and in addition by its fan group address (1..255)
31 x 255 = 7905 fans can be addressed.

Communication is done via the serial interface to RS485 (PC plug-in card, to be addressed like RS232C) with 8-bit capacity, one start and one stop bit and without parity bit.
The baud rate is 9600 baud (bit per s).

For maximum data security even with many participants at the ebmBUS, a preamble byte was implemented for each telegramme.
This byte includes a Master-Slave identification bit, synchronizing bits, and control bits for more flexible numbers of data bytes.

Request can be made for:

- status per fan
- actual speed
- contents of EEPROM addresses

Outputs are for:

- target speed
- reset command for motor-reset
- data for EEPROM

2 Communication

Every communication process consists of:

2.1 Command from PC (Master) to Fan (Slave)

- **One preamble (Master - Slave - identification etc.)**
- One command byte (includes command and fan address)
- **One address byte "Fan Group"**
- 0-**7** data bytes (depending on type of command) **(number defined in preamble)**
- One byte for checksum

2.2 Response from Fan (Slave) to PC (Master)

- **One preamble (Master - Slave - identification etc.)**
- Repetition of the command byte (command and fan address)
- **Repetition of the address byte "Fan Group"**
- 0-**7** data bytes (depending on type of command) **(number defined in preamble)**
- One byte for checksum

2.3 Synopsis of Communication Processes:

General Communication Sequence:

Command from PC:	Preamble	command + fan address	fan group address	1. Databyte	2. Databyte	Checksum
Response from fan:	Preamble	command + fan address	fan group address	1.Databyte	2. Databyte	Checksum

Synchronization

In the reverse case, there must be no larger time gap than 1.5 times transmission time (1.5 ms @ 9,600 Baud) between the individual bytes.

If there is no transmission for 5 times transmission time of one byte (5 ms @9,600 Baud), the following byte is defined as first byte of a communtcation.
In addition the Master-Slave identification is included in the preamble.

Response-Timing is defined as follows
No information must be sent on the Bus for 5 ms after each communication exchange.
Maximal pause interval between PC command and response from fan is 20ms.
Thus every fan recognizes that the next byte is a command byte.

3 Bit Definitions in the Telegramme Bytes

3.1 Preamble

The preamble serves as an additional identification of the origin of the telegramme.
If sent by the Master the identification bit is MS = 1.
Response of the addressed Slave sets MS = 0.
All other Slaves recognize this condition and do not have to check subsequent bytes.

This protocol includes the Service bit (Svc) as a new feature:
It is set by the Master (PC) in order to read the (unknown) address of a fan.
Bit 4 is reserved as 1.

Bits identified "x" are synchronization bits at the beginning of a message.
d0, d1, d2 identify the number of data bytes sent.

d2	d1	d0	1	Svc	MS	x1	x0

x: synchronization bits
MS: Master - Slave – data direction bit
Svc: service bit
d0..d2: number of data bytes sent

3.2 Command and Fan Addresses – Command from PC

First a codeword is sent out by the PC, which includes the address of the fan and the type of the requested data:

c2	c1	c0	a4	a3	a2	a1	a0

c2..c0 : key for the type of the requested (or sent) data
a4..a0 : fan address

3.2.1 Key to Codewords:

Following commands are possible:

Command c2 c1 c0	Meaning	Number of data bytes PC --> Fan	Number of data bytes Fan --> PC
0 0 0	get status	1	2
0 0 1	get actual speed	0	1
0 1 0	set target speed	1	0
0 1 1	software reset	0	0
1 0 0	no function	0	---
1 0 1	Diagnosis	7	7
1 1 0	write EEPROM	2	0
1 1 1	read EEPROM	1	2

3.3 Fan Group Address

g7	g6	g5	g4	g3	g2	g1	g0

g7..g0: fan group address 1..255

Followed by the respective number of data bytes (see table).

3.4 Determination of Check Sum

Terminated by a Checksum - Byte.
The XOR over all bytes including Checksum must be "11111111":

Example:

Preamble	0011	0101	(preamble)
Command byte	0101	1100	(Target speed fan no. 28)
fan group address	0100	1010	(in fan group 74)
data byte	0110	0100	(target value)
checksum	1011	1000	
XOR	1111	1111	

3.5 Response of the Fan to the PC

If the message is correctly received the addressed fan at first responds to the data sent with a preamble.
Next follow the command byte, the fan group address and the respective number of data bytes (see table).
Last comes the Checksum - Byte. The XOR over all bytes (incl. checksum) must again be "11111111". (3.4)

If the message is not correctly received there is no response to the PC.

4 Data Byte Tables

4.1 Get Status: (Code 000)

By a databyte (Status Variable Id code) the requested status variable can be selected.

4.1.2 Request

preamble	0	0	1	1	0	1	0	1
command byte	0	0	0	a4	a3	a2	a1	a0
group address	g7	g6	g5	g4	g3	g2	g1	g0
data byte	d7	d6	d5	d4	d3	d2	d1	d0
checksum	s7	s6	s5	s4	s3	s2	s1	s0

The data byte of the PC includes the status variable Id Code
Example: status variable "target value" is hex "06" => bin "0000 0110" (d7 – d0)

Response:

preamble	0	1	0	1	0	0	0	1
command byte	0	0	0	a4	a3	a2	a1	a0
group address	g7	g6	g5	g4	g3	g2	g1	g0
1st data byte	d7	d6	d5	d4	d3	d2	d1	d0
2nd data byte	D7	D6	D5	D4	D3	D2	D1	D0
checksum	s7	s6	s5	s4	s3	s2	s1	s0

The 1st data byte of the fan includes the status variable
The 2nd data byte of the fan includes the status variable Id Code

For description of the individual status variables please see Appendix B

4.2 Get Actual Speed: (Code 001)

preamble	0	0	0	1	0	1	0	1
command byte	0	0	1	a4	a3	a2	a1	a0
group address	g7	g6	g5	g4	g3	g2	g1	g0
checksum	s7	s6	s5	s4	s3	s2	s1	s0

Response:

preamble	0	0	1	1	0	0	0	1
command byte	0	0	1	a4	a3	a2	a1	a0
group address	g7	g6	g5	g4	g3	g2	g1	g0
data byte	d7	d6	d5	d4	d3	d2	d1	d0
checksum	s7	s6	s5	s4	s3	s2	s1	s0

The data byte includes the actual speed.

The actual speed is a result of the response speed parameter and the coded maximum speed (nMax) of the fan.
The maximum speed is registered in the EEPROM (08h – 0Ah) and is used as a reference for calculating fan speed (rpm).

Code:

$$\text{actual.speed [rpm]} = \text{Databyte} \cdot \frac{7{,}5 * 10^6}{\text{nMax [dig]}}$$

$$= \frac{\text{Databyte}}{250} * \text{nMax [rpm]}$$

nMax [dig] ... max speed (coded)
nMax [rpm] ... max speed (in rpm)

NB
see also “A.7 Maximum Speed”

4.3 Set Target Value: (Code 010)

Definition:

Target Value: Target value, not considering the rating factor
i.e. the target value corresponds to the operating target value at rating factor = 100%

Rating Factor: Factor (0..100%) by which the set target value can be reduced (e.g. for dropped performance during the night)

Operation
Target Value: Target value, which controls the electronics.
The operation target value results from
operation target value = set target value * rating factor [%]

For definition of rating factor please see section "A.14 Rating Factor".

preamble	0	0	1	1	0	1	0	1
command byte	0	1	0	a4	a3	a2	a1	a0
group address	g7	g6	g5	g4	g3	g2	g1	g0
data byte	d7	d6	d5	d4	d3	d2	d1	d0
checksum	s7	s6	s5	s4	s3	s2	s1	s0

Response:

preamble	0	0	0	1	0	0	0	1
command byte	0	1	0	a4	a3	a2	a1	a0
group address	g7	g6	g5	g4	g3	g2	g1	g0
checksum	s7	s6	s5	s4	s3	s2	s1	s0

The data byte includes the set target value.

Code for Operation Mode: Closed-Loop rpm Control

The set target value (rpm) results from the sent speed parameter and the actual maximum speed of the fan, stored in the EEPROM.

set target value [rpm] n target = (data byte * 7,5 * 10^6 / nMax [dig])

= (data byte / 250) * nMax [rpm]

Example:

Set rpm	n target =	1000 rpm
Maximum rpm	nMax =	1400 rpm
	data byte =	n target [rpm] / nMax [rpm] * 250
	data byte =	1000 rpm / 1400 rpm * 250
	data byte =	1000 / 1400 * 250 = 178 (dez) = B2 (hex) = 1011 0010 (bin)

Note: You may use the "Windows" calculator set to "scientific mode" to convert (dez) to (hex) or (bin).

The operation target value results from the set target value and the rating factor.

Op.target value [rpm] = set target value * (rating factor[dig] / 256) * 100%
= ((data byte * rating factor [dig] / 256) * (7,5 * 10^6 / nMax [dig]))
= (data byte / 250) * nMax [rpm] * rating factor [%]

nMax [dig] . max rpm (code)
nMax [rpm] max rpm

Value "zero" means motor standstill.

Code for Operation Mode: Open-Loop PWM Control

The target value corresponds to the PWM-Duty-Cycle, which pulses the output stage. The set target value for the PWM Duty Cycle is

set target value [%] = (data byte / 256) * 100%

The operation target value results from the set target value and the rating factor.

Operation target value [%] = set target value * (rating factor [dig] / 256)
= (data byte / 256) * (rating factor [dig] / 256) * 100%
= (data byte / 256) * rating factor [%] * 100%

Value "zero" means motor standstill.

Code for Operation Mode: Closed loop sensor control

A target value for the output voltage of the used sensor can be entered.

The set target value for the controlled variable results from the target value parameter and the characteristics Rg(U) of the used sensor.

Rg (U) = controlled variable dependent on the voltage

Set target value [V] = (data byte / 256) * 10V

Set target value [unit(Rg)] = Rg (target value[V])
= Rg ((data byte / 256) * 10V)

The operation target value results from the set target value, the rating factor and the direction of force (for example: heating / cooling):

For heating i.e. positive direction of force (operation modes 1.WU = 0) it is:

Operation target value [V] = (data byte / 256) * rating factor [%] *10V

Operation target value [unit(Rg)] = Rg (operation target value [V])
= Rg ((data byte / 256) * rating factor [%] *10V)

For cooling i.e. negative direction of force (operation modes 1.WU = 1) it is:

typical application for cooling are condensers or evaporators

Operation target value [V] =
((255 - (((255-data byte) * rating factor [dig]) / 256)) / 256) * 10V

Operation target value [unit(Rg)] =
Rg (((255 - (((255-data byte) * rating factor[dig]) / 256)) / 256) * 10V)

4.4 Reset Command: (Code 011)

preamble	0	0	0	1	0	1	0	1
command byte	0	1	1	a4	a3	a2	a1	a0
group address	g7	g6	g5	g4	g3	g2	g1	g0
checksum	s7	s6	s5	s4	s3	s2	s1	s0

Response:

preamble	0	0	0	1	0	0	0	1
command byte	0	1	1	a4	a3	a2	a1	a0
group address	g7	g6	g5	g4	g3	g2	g1	g0
checksum	s7	s6	s5	s4	s3	s2	s1	s0

After a reset command the motor will be stopped.

The programme in the fan will start again at the beginning after response to the PC.

In the case of RS-priority and operation modes 1.SWS = 1 the motor will immediately restart with the stored target value (multiplied with the stored rating factor).

4.5 Write EEPROM: (Code 110)

preamble	0	1	0	1	0	1	0	1
command byte	1	1	0	a4	a3	a2	a1	a0
group address	g7	g6	g5	g4	g3	g2	g1	g0
1st data byte	d7	d6	d5	d4	d3	d2	d1	d0
2nd data byte	D7	D6	D5	D4	D3	D2	D1	D0
checksum	s7	s6	s5	s4	s3	s2	s1	s0

Response:

preamble	0	0	0	1	0	0	0	1
command byte	1	1	0	a4	a3	a2	a1	a0
group address	g7	g6	g5	g4	g3	g2	g1	g0
checksum	s7	s6	s5	s4	s3	s2	s1	s0

The 1st data byte includes the EEPROM address
The 2nd data byte includes the data for the EEPROM

For external 500 W electronics:
Within 5 minutes after the last write-command a reset must be released.

If no reset is released, the previous data from the RAM will be written back into the EEPROM, i.e. the write-command has no effect.

After a write-command into the registers
"target value" (03h),
P-factor (05h),
I-factor (06h),
D-factor (07h) and
rating factor (11h)
the data will immediately be transferred into RAM.
A write-command into those registers does not need to be finished with a reset.

4.6 Read EEPROM: (Code 111)

preamble	0	0	1	1	0	1	0	1
command byte	1	1	1	a4	a3	a2	a1	a0
group address	g7	g6	g5	g4	g3	g2	g1	g0
data byte	d7	d6	d5	d4	d3	d2	d1	d0
checksum	s7	s6	s5	s4	s3	s2	s1	s0

Response:

preamble	0	1	0	1	0	0	0	1
command byte	1	1	1	a4	a3	a2	a1	a0
group address	g7	g6	g5	g4	g3	g2	g1	g0
1st data byte	d7	d6	d5	d4	d3	d2	d1	d0
2nd data byte	D7	D6	D5	D4	D3	D2	D1	D0
checksum	s7	s6	s5	s4	s3	s2	s1	s0

The data byte of the PC includes the EEPROM address
The 1st data byte of the fan includes the data of the EEPROM
The 2nd data byte of the fan includes the EEPROM address

4.7 Broadcast Command

With the broadcast command it is possible to address several fans simultaneously. The command is never acknowledged because this would cause a data crash.

Because of the missing acknowledgement the broadcast can only be used for following commands:
- set target value
- reset
- write EEPROM

There are two different types of broadcast
a) general broadcast: addresses all fans in the system
b) group broadcast: addresses all fans of one fan group

4.7.1 General Broadcast

The general broadcast includes the fan address (in command byte) and the fan group address 0.
Fans recognizing this combination will react to the command without acknowledging.

preamble	d2	d1	d0	1	0	1	0	1
command byte	c2	c1	c0	0	0	0	0	0
group address	0	0	0	0	0	0	0	0
1st data byte	d7	d6	d5	d4	d3	d2	d1	d0
2nd data byte	D7	D6	D5	D4	D3	D2	D1	D0
checksum	s7	s6	s5	s4	s3	s2	s1	s0

Acknowledgement: none

4.7.2 Group Broadcast

The group broadcast includes the fan address only (in command byte) = 0.
The fan group address is ≠ 0. Only fans in this group address react to this command.
Group broadcasting is not possible to fans of Fan Group 0 (General Broadcast only).

preamble	d2	d1	d0	1	0	1	0	1
command byte	c2	c1	c0	0	0	0	0	0
group address	g7	g6	g5	g4	g3	g2	g1	g0
1st data byte	d7	d6	d5	d4	d3	d2	d1	d0
2nd data byte	D7	D6	D5	D4	D3	D2	D1	D0
checksum	s7	s6	s5	s4	s3	s2	s1	s0

Acknowledgement: none

4.8 Service Request

The Service Request reads the (unknown) address of a fan and its status.
Every fan connected to the net reacts to the service request and acknowledges it with its status.

Therefore it is mandatory that one fan only is connected to the net when a service request is done in order to avoid a data crash.

Protocol:

The service bit in the preamble is set, followed by the command "get status" with the fan address 0 and the group address 0.
No command with a different combination will be executed with the service bit set.

Upon this request the fan sends its address (a4..a0), its group address (g7..g0) and its status (d7..d0).

Command from PC:

preamble	0	0	0	1	1	1	0	1
command byte	0	0	0	0	0	0	0	0
group address	0	0	0	0	0	0	0	0
checksum	1	1	1	0	0	0	1	0

Response:

preamble	0	0	1	1	0	0	0	1
command byte	0	0	0	a4	a3	a2	a1	a0
group address	g7	g6	g5	g4	g3	g2	g1	g0
data byte	BLK	HLL	tfm	FB	SKF	tft	0	0
checksum	s7	s6	s5	s4	s3	s2	s1	s0

4.9 EEPROM Data

The EEPROM stores all specific fan data.

The data can be read and partly changed via a PC by means of RS485.

The memory section is divided into several blocks.

- Motordata will change motor's characteristics.
- Servicedata are displayed only by the PC.
  They will not change motor's characteristics.
- RAM Data are displayed only by the PC.
  They are mirrored RAM data of motor's controller. Read only.

00 - 17h	Motor data	
18 - 2Fh	Servicedata	Data may be changed and used by LISA (no effect on motor control)
30 - 3Fh	Servicedata	Data for customer definition. Data can used by the customer for writing or reading. No data definition by ebm.
40 - 5Fh	Motordata	Data can only be changed with the correct password. Modification of the data may have a significant impact on the operation behavior of the fan.
60 - 7Fh	Service data	no writing access from LISA to this data. The data can be automatically changed during operation by the motor controller.
80 – 87h	Servicedata	initialized by ebm before shipment. No writing access from LISA to this data. The addresses can only be written if a jumper on the PCB is set (additional protection).
80 - F7h	Motordata:	
F8 – FFh	RAM data	can be read only.

The data of the F8 block are not stored in the EEPROM but in the RAM of the controller. During reading access to this address, the motor controller does not read the contents of the EEPROM register; instead the controller delivers the contents of the respective register in its RAM.

APPENDIX

A. EEPROM Data

The EEPROM contains following data
Addresses not shown are not in use

A.1 Survey

Address	Meaning		
00	fan group address		
01	fan address		
02	operation modes 1		
03	set target value		
04			
05	P-factor for controller		
06	I-factor for controller		
07	D-factor for controller		
08	nMax (max. speed)	MSB	
09	nMax (max. speed)		
0A	nMax (max. speed)	LSB	
0B	max. duty cycle		
0C	min. duty cycle		
0D	start duty cycle / start voltage		
0E	target value 0 (for digital input)		
0F	target value 1 (for digital input)		
10	operation modes 2		
11	rating factor		
18	min sensor value	Byte 1	32 bit floating point
19	min sensor value	Byte 2	
1A	min sensor value	Byte 3	
1B	min sensor value	Byte 4	
1C	max sensor value	Byte 1	32 bit floating point
1D	max sensor value	Byte 2	
1E	max sensor value	Byte 3	
1F	max sensor value	Byte 4	

see “fpv.pdf”

IEEE 754: Standard for Binary Floating-Point Arithmetic
http://www.guidogybels.net/floats.html

Address	Meaning		
20	physical unit of measured quantity		1. character
21	physical unit of measured quantity		2. character
22	physical unit of measured quantity		3. character
23	physical unit of measured quantity		4. character
24	physical unit of measured quantity		5. character
25	physical unit of measured quantity		6. character
26	physical unit of measured quantity		7. character
27	physical unit of measured quantity		8. character
28	physical unit of measured quantity		9. character
29	physical unit of measured quantity		10. character
2A	conversion factor	Byte 1	32 bit floating point
2B	conversion factor	Byte 2	
2C	conversion factor	Byte 3	
2D	conversion factor	Byte 4	
40	EEPROM status		
41	motor design: number of poles		
42	motor design: function		
43	max. admissible duty cycle		
49	min. admissible duty cycle		
4A	identification		
6D	failure display	n High Byte	
6E	failure display	n-1 High Byte	
6F	failure display	n-2 High Byte	
70	failure display	n Low Byte	
71	failure display	n-1 Low Byte	
72	failure display	n-2 Low Byte	
73	counter	hours operated MSB	
74	counter	hours operated LSB	
80	manufacturing date code	day	(DD)
81	manufacturing date code	month	(MM)
82	manufacturing date code	year	(YY)
83	serial no. Byte 2		
84	serial no. Byte 1		
85	serial no. Byte 0		
86	max. DC link current		
87	max. ambient temperature		

Address	Meaning	
95	ramp-up	(acceleration rate)
96	ramp-down	(deceleration rate)
97	min DC-link voltage	
98	min input voltage	
C7	reference DC-link voltage MSB	
C8	reference DC-link voltage LSB	
C9	reference DC-link current MSB	
CA	reference DC-link current LSB	
CB	reference AC line voltage MSB	
CC	reference AC line voltage LSB	
CD	reference AC line current MSB	
CE	reference AC line current LSB	
FB	actual operation mode	
FC	actual max. PWM DutyCycle	
FD	actual min. PWM DutyCycle	
FE	actual target value	
FF	actual sensor value	

A.2 Fan Group Address (00h)

Code = fan group

A.3 Fan Address (01h)

0	0	0	a4	a3	a2	a1	a0

a4 - a0 = fan address 0..31
Code = fan address

A.4 Operation Modes 1 (02h)

SWV	WU	SR	EIR	SWS	SETUP	LR	RSPrio

Meaning:

SWV	set target value (digital / analoguous)	SWS	store target value
WU	inversion of direction of force	SETUP	standard set-up
SR	closed loop/open loop control	LR	counter-clockwise/clockwise
EIR	sensor / c.l. rpm control	RSPrio	RS-priority

Code:

Bit	Meaning Condition 1	Meaning Condition 0	activated if
SWV	target value digital interpretation: U=0..5V --> SW = target value0 (0Eh) U=5..10V --> SW = target valuet1 (0Fh)	target value analog interpretation voltage at target value linear conversion into target value	OpMode1.RSPrio = 0 & OpMode2.EE/DIP=1
WU	inversion of direction of force: i.e. "cooling" control difference = actual value – target value	no inversion of direction of force: i.e. "heating" control difference = target value - actual value	OpMode1.SR = 0 &OpMode1.EIR = 1 &(OpMode1.RSPrio = 1 or OpMode2.EE/Dip=1)
SR	Operation Mode "open loop PWM control"	Operation Mode "Closed loop Control) (sensor or rpm)	OpMode1.RSPrio = 1 or OpMode2.EE/Dip=1
EIR	Operation Mode "sensor control"	Operation Mode "closed loop rpm control)	OpMode1.SR = 0 &(OpMode)1.RSPrio = 1 or OpMode2.EE/Dip=1)
SWS	Target value is stored at each target value setting via command "set target value in EEPROM register "target value" (03h). At reset (Hardware or Software) start with the values stored in "target value" and "rating factor".	no storage of target value. After a reset the target value is always "0" and the rating factor is always 100%	OpMode1.RSPrio = 1
SETUP	Default setting of EEPROM register 02h - 11h after each reset	no new initialization of register 02h - 11h after reset	always
L/R	direction of rotation clockwise	direction of rotation counter-clockwise	MotFunction.Key=0 &(OpMode1.RSPrio = 1 or OpMode2.EE/Dip=1)
RSPrio	RS-priority target value setting of max. duty cycle, min. duty cycle, operation mode via RS-interface or EEPROM. Target value input and the potentiometers for max.- and min. values as well as the DIP switch are deactivated.	potentiometer priority: target value setting via target value input. Setting of max. and min. duty cycle via potentiometers. The contents of register Max. DutyCycle (0Bh) and Min. DutyCycle (0Ch) ares irrelevant.	always

A.5 Set Target Value (03h)

The command "set target value" is automatically written into the register with the new target value setting if operation modes1.RSPrio =1 and operation modes1.SWS = 1

Code for **speed control**: n target [rpm] = data byte * (7,5 * 10^6 / nMax [dig])

that yields

n target [rpm] = (data byte / 250) * nMax [rpm]

data byte = n target [rpm] / nMax [rpm] * 250

Example:

Set speed	n target =	1000 rpm
Maximum speed	nMax =	1400 rpm
	data byte =	n target [rpm] / nMax [rpm] * 250
	data byte =	1000 rpm / 1400 rpm * 250
	data byte =	1000 / 1400 * 250 = 178 (dez) = B2 (hex) = 1011 0010 (bin)

Note: You may use the "Windows" calculator set to "scientific mode" to convert (dez) to (hex) or (bin).

Code for **PWM control**: PWM [%] = (data byte / 256) * 100%

Code for **sensor control**: target value [V] = (data byte /256) * 10V
target value [unit (Rg)] = Rg (U)
target value [unit (Rg)] = Rg ((data byte / 256) * 10V)

Target value [V] = target value for sensor output voltage
Rg (U) = characteristics of sensor dependent on voltage

Limitation at closed-loop rpm control:
target value < max. speed (08-0A)

Limitation at open-loop PWM control :
min. PWM DutyCycle (0C) < target value < max. PWM DutyCycle (0B)

Limitation at sensor control:
positive direction of force (heating): target value < 250
negative direction of force (cooling): target value > 5

For open-loop and closed-loop control:
target value = 0 --> motor stop,
if min. PWM DutyCycle (0C)
and min. admissible PWM DutyCycle (49) = 0

A Write command to this address has the same effect as the command "set target value", i.e. the motor will immediately run at the set target value.

A.6 P-Factor (05h), I-Factor (06h), D-Factor (07h)

only for closed-loop control (speed / external), no importance for PWM-control

p1	p0	d5	d4	d3	d2	d1	d0

d5..d0 : control parameter
p1 p0 : identification parameter:
00 : P-factor
01 : I-factor
10 : D-factor
11 : not used

Code of control parameters:

Range 0% to 96,875% (d5=0):

Percent	Code d5..d0	Percent	Code d5..d0	Percent	Code d5..d0
0%	000000	34,375%	011010	68,75%	001101
3,125%	010000	37,5%	000110	71,875%	011101
6,25%	001000	40,625%	010110	75%	000011
9,375%	011000	43,75%	001110	78,125%	010011
12,5%	000100	46,875%	011110	81,25%	001011
15,625%	010100	50%	000001	84,375%	011011
18,75%	001100	53,125%	010001	87,5%	000111
21,875%	011100	56,25%	001001	90,625%	010111
25%	000010	59,375%	011001	93,75%	001111
28,125%	010010	62,5%	000101	96,875%	011111
31,25%	001010	65,625%	010101		

Range 100% to 487,5% (d5=1):

Percent	Code d5..d0	Percent	Code d5..d0	Percent	Code d5..d0
100%	100000	237,5%	111010	375%	101101
112,5%	110000	250%	100110	387,5%	111101
125%	101000	262,5%	110110	400%	100011
137,5%	111000	275%	101110	412,5%	110011
150%	100100	287,5%	111110	425%	101011
162,5%	110100	300%	100001	437,5%	111011
175%	101100	312,5%	110001	450%	100111
187,5%	111100	325%	101001	462,5%	110111
200%	100010	337,5%	111001	475%	101111
212,5%	110010	350%	100101	487,5%	111111
225%	101010	362,5%	110101		

By means of the bit "Operation Modes2.PMul" (A.13) the
P-factor can be multiplied with 4, allowing P-ranges from 0 .. 1 950%.
Ranges from 0% ..387,5% in 12,5%-steps
Ranges from 400% .. 1950% in 50%-steps

A.7 Maximum rpm (08h - 0Ah)

This constant contains the maximum speed.
Code of all speeds is in reference to this constant, i.e. modification of this constant results in the modification of the Code of target speed value, the actual speed value and the minimum speed.

Code = $1.875 * 10^9$ / nMax [rpm]

nMax [rpm] = maximum speed

Limitation: 698 rpm < maximum speed < 6000 rpm
i.e. 29 00 00 > maximum speed > 04 C4 B4
(for closed-loop rpm control only)

A.8 Maximum PWM DutyCycle (0Bh)

Contents irrelevant with potentiometer priority (Operation Modes1.RSPrio = 0)

Code:
max. PWM DutyCycle [%] = (data byte / 256) * 100%

Limit: 8% < max. PWM Duty Cycle < max. admissible PWM DutyCycle (43)

A.9 Minimum PWM DutyCycle (0Ch)

Contents irrelevant with potentiometer priority (Operation Modes1.RSPrio = 0)

Code: min PWM DutyCycle [%] = (data byte / 256) * 100%

Limit: min. PWM DutyCycle > min. admissible PWM DutyCycle (49)

With RS-priority (Operation Modes1.RSPrio = 1) the min. PWM DutyCycle activates the motor-stop-function:
Only if the min. PWM DutyCycle = 0, can the motor be stopped via a target value setting.
If min. PWM Duty Cycle ≠ 0 the motor will at least run at min. PWM DutyCycle (even without target value setting).

A.10 Start PWM DutyCycle / Start voltage(0Dh)

The Start PWM DutyCycle states the PWM-factor at which the motor will start up after a start command.

Code: Start PWM DutyCycle [%] = (data byte / 256) * 100%

Limit: 8% < Start PWM DutyCycle < 30%

The motor will always start up with the start PWM DutyCycle.
A high start PWM DutyCycle results in high current values during start-up of the motor !

A.11 Target Value 0 (0Eh)

For potentiometer-priority (Operation Modes1.RSPrio = 0) and digital target value setting only ! ((Operation Modes2.EE/DIP = 0 and DIP-switch target value setting in position ON) or (Operation Modes2.EE/DIP = 1 and Operation Modes1.SWV = 1))

determines a target value for U_{soll} = 0...5V

code (closed-loop rpm control): n target [rpm] = data byte * (7,5 * 10^6 / nMax [dig]

code (PWM-control): PWM [%] = (data byte / 256) * 100%

code (external control): target value [V] = (data byte /256) * 10V
target value [unit (Rg)] = Rg (U)
target value [unit(Rg)] = Rg ((data byte / 256) * 10V)

target value [V] = target value for sensor output voltage
Rg (U) = characteristics of sensor dependent on voltage

Limitation at closed-loop rpm control:
target value < maximum (08-0A)

Limitation at open-loop PWM control:
min. DutyCycle (0C) < target value < max. DutyCycle (0B)

Limitation at sensor control:
positive direction of force (heating): target value < 250
negative direction of force (cooling): target value > 5

For open-loop and closed-loop control:
target value = 0 --> motor stop,
if min. PWM DutyCycle (0C)
and min. admissible PWM DutyCycle (49) = 0

A.12 Target Value 1 (0Fh)

For potentiometer-priority (Operation Modes1.RSPrio = 0) and digital target value setting only ! ((Operation Modes2.EE/DIP = 0 and DIP-switch target value setting in position ON) or (Operation Modes2.EE/DIP = 1 and Operation Modes1.SWV = 1))

determines a target value for U_{soll} = 5...10V

code (closed-loop rpm control): n target [rpm] = data byte * (7,5 * 10^6 / nMax [dig]

code (PWM-control): PWM [%] = (data byte / 256) * 100%

code (sensor control): target value [V] = (data byte /256) * 10V
target value [unit (Rg)] = Rg (U)
target value [unit(Rg)] = Rg ((data byte / 256) * 10V)

target value [V] = target value for sensor output voltage
Rg (U) = characteristics of sensor dependent on voltage

Limitation at closed-loop rpm control:
target value < maximum (08-0A)

Limitation at open-loop PWM control:
min. DutyCycle (0C) < target value < max. PWM DutyCycle (0B)

Limitation at external closed loop control:
without inversion of direction of force: target value < 250
with inversion of direction of force: target value > 5

For open and closed-loop speed control:
target value = 0 --> motor stop, if
min. PWM DutyCycle (0C) = 0 **and**
min admissible PWM Duty Cycle (49) = 0

A.13 Operation Modes 2 (10h)

-	-	-	-	-	-	PMul	EE/DIP

Code:
EE/DIP = 1: DIP-switches are inactive. The functions of these switches are taken over by corresponding bits in the register Operation Modes1.
EE/DIP = 0: DIP-switches are active if potentiometer-priority (Operation Modes1.RSPrio = 0).
The bits in register Operation Modes1 corresponding to these switch functions are not relevant.
With RS-priority (Operation Modes1.RS-Prio = 1) the switches are inactive.
PMul = 1 : P-factor (05h) multiplied by factor 4
PMul = 0 : P-factor (05h) multiplied by factor 1

Recommendation:
If P-controller (e.g. temperature) Pmul = 1 --> P-multiplicator = 4
If PI-controller or PID-controller PMul = 0 --> P-multiplicator = 1

A.14 Rating Factor (11h)

In effect only in conjunction with RS-priority. In operation mode potentiometer priority (Operation Modes1.RSPrio = 0) the EEPROM is not written and command is not acknowledged.
The sent value becomes effective immediately (without reset).

Code: rating factor [%] = (data byte / 256) * 100% for 0 ≤ data byte ≤ 254
rating factor [%] = 100% for data byte = 255

The rating factor influences the operation target value of the motor:
operation target value = set target value * rating factor[%]
For calculation of the operation target value see "4.3 Set Target Value"

If Operation Modes1.RSPrio = 1 and Operation Modes1.SWS = 1, the rating factor is read out of the EEPROM after a reset.
Otherwise the rating factor is 100%.

The rating factor can be used to achieve a performance drop (e.g. for lower performance at night) or to set an ON/OFF – function.

A.15 Sensor range (18h - 29h)

For PC only; no meaning for fan

That function allows to customize the sensor, min sensor and max sensor value, as well as physical units and saved to EEPROM.

Code:

a) Min value (18 - 1B)

Min value [phys. unit] = Databytes

b) Max value (1C - 1F)

Max value [phys. unit] = Databytes

c) physical unit (20 - 29)

physical unit [ASCII] = Databytes

20: 1. Character
21: 2. Character
22: 3. Character
23: 4. Character
24: 5. Character
25: 6. Character
26: 7. Character
27: 8. Character
28: 9. Character
29: 10. Character

A.16 Conversion Factor (2Ah – 2Dh)

For PC only; no meaning for fan

That function allows to save a customized conversion factor.

Example
The conversion factor may be used for conversion of rpm to air velocity in FFUs.
Air velocity may be derived from rpm and displayed.
Physical units may be saved in EEPROM (20 - 29).

A.17 EEPROM Status (40h)

-	-	-	-	-	INI	GÜL1	GÜL0

Code:
INI=1 EEPROM is set to default
GÜL1 = 0 and GÜL0 = 1 data in EEPROM are valid

Default setting: 0000 0101

If the register contains different data than "XXXXXX01" after reset, a default setting will take place, i.e. all EEPROM registers in block 1 (address 00-10), 3 (address 40-50) and 6 (address 8A – A3) will be written with the data of the default setting.

A.18 Motor Design – Number of Poles (41h)

Code = number of motor poles

A.19 Motor Design - Function (42h)

1	1	-	-	Strang	KEY	LR	HW

Code:
Bit 7 Reserved (1)
Bit 6 Reserved (1)
Strang = 1 3-core motor
Strang = 0 1-core motor
KEY = 1 The customer must not change direction of rotation
KEY = 0 The customer may change direction of rotation
LR = 1 Direction of rotation clockwise preset by ebm
LR = 0 Direction of rotation counter-clockwise preset by ebm
HW = 1 Hall angle 120°
HW = 0 Hall angle 60°

A.20 Max. admissible PWM DutyCycle (43h)

Code: max. admissible PWM DutyCycle [%] = (data byte / 256) * 100%

A.21 Min. admissible PWM DutyCycle (49h)

Code: min. admissible PWM DutyCycle [%] = (data byte / 256) * 100%

A.22 Identification (4Ah)

The identification identifies the type of electronics or protocol

Code:	value	electronics
	0	external 500W electronics
	6	SMPS
	9	3kW Elektronik Sinus-U

A.23 Failure Display (6Dh - 72h)

a) High Byte
Adress 6Dh indicates the failure that happened last
Adresse 6Eh und 6Fh indicate the 2nd and 3rd last two failures
The controller writes these these messages into EEPROM in case of failure

Brake	0	UeLow	UzLow	UzHigh	DRV	TFEI	IzHigh

Code: A set bit displays a failure:

Brake: Brake, if applied during reversed operation at higher rpm for extended time
UeLow: low mains voltage
UzLow: low DC link voltage
UzHigh: high DC link
DRV: driver error
TFEI: high temperature of electronic box
IzHigh: high current DC-link

b) Low Byte
Address 70h indicates the failure that happened last
Addresses 71h and 72h indicate the last two failures
The controller writes these EEPROM addresses if a failure occurs.

BLK	HLL	TFM	FB	SKF	TFE	KFN	PHA

Code: A set bit displays a failure:

BLK : locked motor
HLL: Hall failure
TFM : thermal overload of motor
FB : Fan-Bad
SKF : communication error between Master-PIC and Slave-PIC
TFE: thermal overload of electronics heat sink
KFN: Communications error with remote unit
PHA: Phase failure

A.24 Hour Meter (73 /74h)

For each full hour the fan is in operation, the hour meter will rise by 1. The motor controller writes the addresses 73h (MSB) and 74h (LSB) autonomously.

With 2 bytes a maximum count of 65 535 hours (approx. 7.5 years) is possible. The High-byte is no longer written upon overflow, i.e. it remains at FFh.

Code: run time[h] = data bytes

A.25 Manufacturing Date Code (80-82h)

For PC only, irrelevant to the fan

Code: Code (80h) = day of shipment
Code (81h) = month of shipment
Code (82h) = year of shipment

A.26 Serial Number (83h-85h)

For PC only, irrelevant to the fan

Code = serial number

The serial number is a 3 Byte figure --> up to 16 777 215 can be issued.

A.27 Max. DC link current (86h)

Code: Iz, max [A] = (data byte / 256) * reference Iz [A]

Reference DC-link current (reference Iz) = EEPROM variable # C9 / CA

A.28 Max. ambient temperature (87h)

For PC only, irrelevant to the fan

Code = $T_{u, max}$ [°C]

A.32 Acceleration rate / Deceleration rate (95h / 96h)

These addresses define minimal time for (internal) set-value changes.
Address “acceleration rate (95h)” defines the time for positve change of set value;
address “deceleration rate (96h)” definies the time for negative change of set value.
Set-value range is 250 increments (closed loop control) or
255 increments (open loop control).

Each increment will change rpm by : nMax [rpm] / 250

Each increment will change PWM by : 0,39%

Code: time in msec for change of set value by one increment = databyte * 10 msec

A.33 minimal DC-link voltage (97h)

Low DC-link voltage alarm is activated if DC-link voltage is less then U_{zMin}
Code:

$$UzMin\ [V] = \frac{Databyte}{256} \cdot reference\ Uz\ [V]$$

Referenced DC-link voltage is (reference Uz) = EEPROM variable # C7 / C8

A.34 minimal line voltage (98h)

Low line voltage alarm is activated if line voltage is less then U_{eMin}

Code:

$$UeMin\ [V] = \frac{Databyte}{256} \cdot reference\ Ue\ [V]$$

Referenced line voltage (reference Ue) = EEPROM variable # CB / CE

A.45 Reference DC-link voltage (C7 / C8h)

All values are referenced to that DC-link voltage in order to adapt the resolution

EEPROM C7 = MSB
EEPROM C8 = LSB

Code: reference Uz [mV] = Databytes · 20mV

A.46 Reference DC-link current (C9 / CAh)

All values are referenced to that DC-link current in order to adapt the resolution

EEPROM C9 = MSB
EEPROM CA = LSB

Code: reference Iz [mA] = Databytes · 2mA

A.47 Reference AC line voltage (CB / CCh)

All values are referenced to that line current in order to adapt the resolution

EEPROM variable # CB = MSB
EEPROM variable # CC = LSB

Code: reference Ue [mV] = Databytes · 20mV

A.48 Reference AC line current (CD / CEh)

All values are referenced to that line voltage in order to adapt the resolution

EEPROM variable # CD = MSB
EEPROM variable # CE = LSB

Code: reference Ie [mA] = Databytes · 2mA

A.49 Actual Operation Mode (FBh)

Issues the actual contents of the register in RAM.

Code:

SWV	WU	LIRE	0	JUST	BA2	BA1	BA0

SWV = 1 1-bit-input
SWV = 0 analog input
WU = 1 negative direction of force (cooling)
WU = 0 positive direction of force (heating)
LIRE = 1 clockwise rotation
LIRE = 0 counter clockwise rotation
JUST = 1 adjustment of max. speed

BA2	BA1	BA0	operation mode
0	0	0	not defined
0	0	1	closed loop rpm control
0	1	0	open loop PWM control
0	1	1	not defined
1	0	0	closed loop sensor control
1	0	1	reserved
1	1	0	not defined
1	1	1	not defined

A.50 Actual max. DutyCycle (FCh)

Issues the actual max. DutyCycle for the fan

Code: actual max. DutyCycle [%] = (data byte / 256) * 100 %

A.51 Actual min. DutyCycle (FCh)

Issues the actual min. DutyCycle for the fan
At min. DutyCycle < 8 % during operation the order is for 8 %

Code: actual min. DutyCycle [%] = (data byte / 256) * 100 %

A.52 Actual target value (FEh)

Issues the actual target value for the fan; value can be set by either RS485, analog or digital setting via target value input.
If the target value is limited (by min./max. speed, min./max. DutyCycle, rating factor), the limited target value is issued.

code (closed-loop rpm control): n target [rpm] = data byte * (7,5 * 10^6 / nMax [dig]

code (PWM-control): PWM [%] = (data byte / 256) * 100%

Code for external control:
target value [V] = (data byte /256) * 10V
target value [unit (Rg)] = Rg (U)
target value [unit (Rg)] = Rg ((data byte / 256) * 10V)

target value [V] = target value for sensor output voltage
Rg (U) = characteristics of sensor dependent on voltage

Limitation for closed-loop rpm control:
target value < max. rpm (08-0A)

Limitation for open-loop PWM control:
min. PWM DutyCycle (0C) < target value < max. PWM DutyCycle (0B)

Limitation for external sensor control:
without inversion of direction of force: target value < 250
with inversion of direction of force: target value > 5

For open-loop PWM and closed-loop rpm control:
actual target value = 0 --> motor stop, if
min PWM DutyCycle (0C) **and**
min admissible PWM DutyCycle (49) = 0

A.53 Actual Sensor Value (FFh)

Issues the actual value of the external sensor

Code:
actual value [V] = (data byte /256) * 10V
actual value [unit (Rg)] = Rg (U)
actual value [unit (Rg)] = Rg ((data byte / 256) * 10V)

actual value [V] = sensor output voltage
Rg (U) = characteristics of sensor dependent of voltage

B STATUS VARIABLES

B.1 Survey Status Variables

Id Code	meaning
00	motor status (Low Byte only)
01	motor status (High Byte only)
02	Warning
03	DC-link voltage
04	DC-link current
05	Temperature of electronic power module
06	target value
07	actual value
08	closed loop control / open loop control
09	sense of direction
0B	PWM duty cycle
10	motor temperature
11	line voltage
13	line current
20	temperature within electronic box

B.2 Motor status (00)

Code:

a) Low Byte (00h)

BLK	HLL	TFM	FB	SKF	TFE	KFN	PHA

Code: A set bit displays a failure:

BLK : locked motor
HLL: Hall failure
TFM : thermal overload of motor
FB : Fan-Bad
SKF : communication error between Master-PIC and Slave-PIC
TFE: thermal overload of electronic power module
KFN: Communications error with remote unit
PHA: Phase failure

*) "Fan Bad" is set with any error
**) for example from commutation unit to external unit

b) High Byte (01h)

Brake	0	UeLow	UzLow	UzHigh	DRV	TFEI	IzHigh

Brake: Brake, if applied during reversed operation at higher rpm for extended time
UeLow: low line voltage
UzLow: low DC-link voltage
UzHigh: high DC-link voltage
DRV: driver problem
TFEI: electronic box over heat
IzHigh: excessive DC-link current

B.3 Warning (02h)

Code:
warnings are activated by:

0	UzLow	TEI_high	TM_high	TE_high	0	f_Err	IzLim

UzLow: low DC-link voltage
TEI_high: electronic box high temperature
TM_high: motor high temperature
TE_high: electronic power module high temperature
f_ERR: set value not reached
IzLim: Dc-link current limit

B.4 DC-link voltage (03h)

Code: $Uz\,[V] = \frac{Databyte}{256} \cdot reference\,Uz\,[V]$

Referenced DC-link voltage (reference Uz) = EEPROM -Variable C7 (MSB) / C8 (LSB)

Reference Uz[mV] = Databytes * 20mV

Example:

EEPROM Address C7 = 0xAF
EEPROM Address C8 = 0xC8

0xAFC8 = 45000 (decimal)

reference Uz = 45000 * 20mV = 900V

Statusvariable 03 = 0x80 (=128 dezimal)

DC-Linkvoltage = (128 / 256) * 900V = 450V

B.5 DC-link current (04h)

Code: $Iz\,[A] = \frac{Databyte}{256} \cdot reference\ Iz\ [A]$

Referenced DC-link current (reference Iz) = EEPROM - Variable C9 (MSB) / CA (LSB)

Reference Iz[mA] = Databytes * 2mA

Example:

EEPROM Address C9 = 0x01
EEPROM Address CA = 0xF4

0x01F4 = 500 (decimal)

reference Iz = 500 * 2mA = 1A

Statusvariable 04 = 0x80 (=128 dezimal)

DC-Linkcurrent = (128 / 256) * 1A = 500mA

B.6 Temperature of electronic power module (05h)

Code: T [°C] = Data byte

B.7 Target value (06h)

The status variable "target value" refers to the operation target value of the fan, i.e. the product out of set target value and rating factor.

Code:

a) Operation mode closed-loop rpm control:

target speed [rpm] = data byte * $7{,}5 * 10^6$ / nMax [dig]
= (data byte / 250) * nMax [rpm]

b) Operation mode open loop PWM control

The target value in operation mode control corresponds to the PWM duty cycle that pulses the output stage.

Duty Cycle [%] = (data byte / 256) * 100%

c) Operation mode sensor control

target value [V] = (data byte /256) * 10V
target value [unit (Rg)] = Rg (U)
target value [unit (Rg)] = Rg ((data byte / 256) * 10V)

B.8 Actual value (07h)

Code:

a) Operation mode closed-loop rpm control:

actual speed [rpm] = data byte * $7{,}5 * 10^6$ / nMax [dig]
= (data byte / 250) * nMax [rpm]

nMax [dig].... maximum speed (coded)

b) Operation mode open loop PWM control

The target value in operation mode control corresponds to the PWM duty cycle that pulses the output stage.

Duty Cycle [%] = (data byte / 256) * 100%

c) Operation mode sensor control

The target value in operation mode sensor control corresponds to the output voltage of the sensor.

actual value [V] = (data byte /256) * 10V
actual value [unit (Rg)] = Rg (U)
actual value [unit (Rg)] = Rg ((data byte / 256) * 10V)

actual value [V] = sensor output voltage
Rg (U) = characteristics of sensor dependent on voltage

B.9 closed loop / open loop control (08h)

Code: Databyte = 0 --> open loop PWM control
Databyte = 1 --> closed loop rpm control
Databyte = 2 --> closed loop sensor control

B.10 sense of direction (09h)

Code: Databyte = 0 --> counter clock wise
Databyte = 1 --> clock wise

B.12 PWM Duty Cycle (0Bh)

Code: PWM Duty Cycle [%] = (Databyte / 256) * 100%

B.13 Motor temperature (10h)

Code:
T [°C] = Databyte

B.14 AC-Line voltage (11h)

Code

$$Ue\ [V] = \frac{Databyte}{256} \cdot reference\ Ue\ [V]$$

Reference Ue[mV] = Databytes * 20mV

Referenced AC-line voltage (reference Ue) = EEPROM -Variable CB (MSB) / CC (LSB)
Example:

EEPROM Address CB = 0xAF
EEPROM Address CC = 0xC8

0xAFC8 = 45000 (decimal)

reference Ue = 45000 * 20mV = 900V

Statusvariable 11 = 0x80 (=128 dezimal)

AC-line voltage = (128 / 256) * 900V = 450V

B.15 Line current (13h)

Code:

$$Ie\ [A] = \frac{Databyte}{256} \cdot reference\ Ie\ [A]$$

Reference Ie[mA] = Databytes * 2mA

Referenced AC-line current (reference Ie) = EEPROM - Variable CD (MSB) / CE (LSB)
Example:

EEPROM Address CD = 0x01
EEPROM Address CE = 0xF4

0x01F4 = 500 (decimal)

reference Ie = 500 * 2mA = 1A

Statusvariable 13 = 0x80 (=128 dezimal)

AC-line current = (128 / 256) * 1A = 500mA

B.24 Temperature in elektronic box (20h)

Code: T [°C] = Databyte

C FUNCTION SURVEY

Each of the registers described above corresponds to a function. The following table shows which registers are activated in the different electronics. The white areas show the active registers; the inactive registers are shown in the grey areas.

C.1 External Electronics (CHW050-AA0-70/72/73,CHG485-HB50-01)*

Identification = 0

a) EEPROM register

Addr	Register	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
00	fan group	X	X	X	X	X	X	X	X
01	fan address	-	-	-	X	X	X	X	X
02	operation modes 1	SWV	WU	SR	EIR	SWS	SETUP	LR	RSPrio
03	target value	X	X	X	X	X	X	X	X
05	P-factor	X	X	X	X	X	X	X	X
06	I-factor	X	X	X	X	X	X	X	X
07	D-factor	X	X	X	X	X	X	X	X
08	max. speed MSB	X	X	X	X	X	X	X	X
09	max. speed	X	X	X	X	X	X	X	X
0A	max. speed LSB	X	X	X	X	X	X	X	X
0B	max. Duty Cycle	X	X	X	X	X	X	X	X
0C	min. Duty Cycle	X	X	X	X	X	X	X	X
0D	start Duty Cycle	X	X	X	X	X	X	X	X
0E	target value 0	X	X	X	X	X	X	X	X
0F	target value 1	X	X	X	X	X	X	X	X
10	operation modes 2	-	-	-	-	-	-	PMul	EE/DIP
11	rating factor	X	X	X	X	X	X	X	X
40	EEPROM status	-	-	-	-	-	INI	GÜL1	GÜL0
41	motor design number of poles	X	X	X	X	X	X	X	X
42	motor design function	-	-	-	-	Strang	KEY	LR	HW
43	max. admissible Duty Cycle	X	X	X	X	X	X	X	X
49	min. admissible Duty Cycle	X	X	X	X	X	X	X	X
4A	identification	X	X	X	X	X	X	X	X
6D	failure display n High Byte	Brake	-	UeLow	UzLow	UzHigh	DRV	TFEI	IzHigh
6E	failure display n-1 High Byte	Brake	-	UeLow	UzLow	UzHigh	DRV	TFEI	IzHigh
6F	failure display n-2 High Byte	Brake	-	UeLow	UzLow	UzHigh	DRV	TFEI	IzHigh
70	failure display n Low Byte	BLK	HLL	TFM	FB	SKF	TFT	KFN	PHA
71	failure display n-1 Low Byte	BLK	HLL	TFM	FB	SKF	TFT	KFN	PHA
72	failure display n-2 Low Byte	BLK	HLL	TFM	FB	SKF	TFT	KFN	PHA
73	operation hour counter MSB	X	X	X	X	X	X	X	X
74	operation hour counter LSB	X	X	X	X	X	X	X	X
86	max. DC link current	X	X	X	X	X	X	X	X
95	acceleration ramp	X	X	X	X	X	X	X	X
96	deceleration ramp	X	X	X	X	X	X	X	X
97	min. DC link voltage	X	X	X	X	X	X	X	X
98	min. input voltage	X	X	X	X	X	X	X	X

C7	reference Uz MSB	X	X	X	X	X	X	X	X
C8	reference Uz LSB	X	X	X	X	X	X	X	X
C9	reference Iz MSB	X	X	X	X	X	X	X	X
CA	reference Iz LSB	X	X	X	X	X	X	X	X
CB	reference Ue MSB	X	X	X	X	X	X	X	X
CC	reference Ue LSB	X	X	X	X	X	X	X	X
CD	reference Ie MSB	X	X	X	X	X	X	X	X
CE	reference Ie LSB	X	X	X	X	X	X	X	X
FB	actual operation mode	SWV	WU	LIRE	-	JUST	BA2	BA1	BA0
FC	actual max. duty cycle	X	X	X	X	X	X	X	X
FD	actual min. duty cycle	X	X	X	X	X	X	X	X
FE	actual target value	X	X	X	X	X	X	X	X
FF	actual sensor value	X	X	X	X	X	X	X	X

b) Status variables : External Electronics (CHW050-AA0*-70/72/73,CHG485-HB50-01)

Id	Status variable	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
00	motor status Low Byte	BLK	HLL	TFM	FB	SKF	TFT	KFN	PHA
01	motor status High Byte	Brake		UeLow	UzLow	UzHigh	DRV	TFEI	I_{zHigh}
02	alarm	-	UzLow	Tei_high	TM_high	TE_high	OFF	f_Err	IzLim
03	DC link voltage	X	X	X	X	X	X	X	X
04	DC link current	X	X	X	X	X	X	X	X
05	Electronic power module temp	X	X	X	X	X	X	X	X
06	target value	X	X	X	X	X	X	X	X
07	actual value	X	X	X	X	X	X	X	X
08	closed-loop/open-loop control	X	X	X	X	X	X	X	X
09	direction of rotation	X	X	X	X	X	X	X	X
0B	PWM duty cycle	X	X	X	X	X	X	X	X
10	motor temperature	X	X	X	X	X	X	X	X
11	input voltage	X	X	X	X	X	X	X	X
13	input current	X	X	X	X	X	X	X	X
20	Electronic box temperature	X	X	X	X	X	X	X	X

C.4 Switch Mode Power Supply (CNW015-AB0-05, CNW030-AC0*-05)*

Identifikation = 6

a) EEPROM – Register

Adr	Register	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
00	fan group	X	X	X	X	X	X	X	X
01	fan address	-	-	-	X	X	X	X	X
02	operation modes 1	SWV	WU	SR	EIR	SWS	SETUP	LR	RSPrio
03	target value	X	X	X	X	X	X	X	X
05	P-factor	X	X	X	X	X	X	X	X
06	I-factor	X	X	X	X	X	X	X	X
07	D-factor	X	X	X	X	X	X	X	X
08	max. speed MSB	X	X	X	X	X	X	X	X
09	max. speed	X	X	X	X	X	X	X	X
0A	max. speed LSB	X	X	X	X	X	X	X	X
0B	max. Duty Cycle	X	X	X	X	X	X	X	X
0C	min. Duty Cycle	X	X	X	X	X	X	X	X
0D	start Duty Cycle	X	X	X	X	X	X	X	X
0E	target value 0	X	X	X	X	X	X	X	X
0F	target value 1	X	X	X	X	X	X	X	X
10	operation modes 2	-	-	-	-	-	-	PMul	EE/DIP
11	rating factor	X	X	X	X	X	X	X	X
40	EEPROM status	-	-	-	-	-	INI	GÜL1	GÜL0
41	motor design number of poles	X	X	X	X	X	X	X	X
42	motor design function	-	-	-	-	Strang	KEY	LR	HW
43	max. admissible Duty Cycle	X	X	X	X	X	X	X	X
49	min. admissible Duty Cycle	X	X	X	X	X	X	X	X
4A	identification	X	X	X	X	X	X	X	X
6D	failure display n High Byte	Brake	-	UeLow	UzLow	UzHigh	DRV	TFEI	IzHigh
6E	failure display n-1 High Byte	Brake	-	UeLow	UzLow	UzHigh	DRV	TFEI	IzHigh
6F	failure display n-2 High Byte	Brake	-	UeLow	UzLow	UzHigh	DRV	TFEI	IzHigh
70	failure display n Low Byte	BLK	HLL	TFM	FB	SKF	TFE	KFN	PHA
71	failure display n-1 Low Byte	BLK	HLL	TFM	FB	SKF	TFE	KFN	PHA
72	failure display n-2 Low Byte	BLK	HLL	TFM	FB	SKF	TFE	KFN	PHA
73	operation hour counter MSB	X	X	X	X	X	X	X	X
74	operation hour counter LSB	X	X	X	X	X	X	X	X
86	max. DC link current	X	X	X	X	X	X	X	X
95	acceleration ramp	X	X	X	X	X	X	X	X
96	deceleration ramp	X	X	X	X	X	X	X	X
97	min. DC link voltage	X	X	X	X	X	X	X	X
98	min. input voltage	X	X	X	X	X	X	X	X
C7	reference Uz MSB	X	X	X	X	X	X	X	X
C8	reference Uz LSB	X	X	X	X	X	X	X	X
C9	reference Iz MSB	X	X	X	X	X	X	X	X
CA	reference Iz LSB	X	X	X	X	X	X	X	X
CB	reference Ue MSB	X	X	X	X	X	X	X	X

CC	reference Ue LSB	X	X	X	X	X	X	X	X
CD	reference Ie MSB	X	X	X	X	X	X	X	X
CE	reference Ie LSB	X	X	X	X	X	X	X	X
FB	actual operation mode	SWV	WU	LIRE	-	JUST	BA2	BA1	BA0
FC	actual max. duty cycle	X	X	X	X	X	X	X	X
FD	actual min. duty cycle	X	X	X	X	X	X	X	X
FE	actual target value	X	X	X	X	X	X	X	X
FF	actual sensor value	X	X	X	X	X	X	X	X

b) Statusvariables Switch Mode Power Supply (CNW015-AB0*-05, CNW030-AC0*-05)

Id	Statusvariable	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
00	motor status Low Byte	BLK	HLL	TFM	FB	SKF	TFE	KFN	PHA
01	motor status High Byte	Brake	-	UeLow	UzLow	UzHigh	DRV	TFEI	IzHigh
02	alarm	-	UzLow	Tei_high	TM_high	TE_high	-	f_Err	IzLim
03	DC link voltage	X	X	X	X	X	X	X	X
04	DC link current	X	X	X	X	X	X	X	X
05	Electronic power module temp	X	X	X	X	X	X	X	X
06	target value	X	X	X	X	X	X	X	X
07	actual value	X	X	X	X	X	X	X	X
08	closed-loop/open-loop control	X	X	X	X	X	X	X	X
09	direction of rotation	X	X	X	X	X	X	X	X
0B	PWM duty cycle	X	X	X	X	X	X	X	X
10	motor temperature	X	X	X	X	X	X	X	X
11	input voltage	X	X	X	X	X	X	X	X
13	input current	X	X	X	X	X	X	X	X
20	Electronic box temperature	X	X	X	X	X	X	X	X

C.7 Electronics integrated "Sinus-U" (M3G084, M3G112, M3G150)

Identifikation = 9

a) EEPROM –Register

Adr		Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
00	fan group	X	X	X	X	X	X	X	X
01	fan address	-	-	-	X	X	X	X	X
02	operation modes 1	SWV	WU	SR	EIR	SWS	SETUP	LR	RSPrio
03	target value	X	X	X	X	X	X	X	X
05	P-factor	X	X	X	X	X	X	X	X
06	I-factor	X	X	X	X	X	X	X	X
07	D-factor	X	X	X	X	X	X	X	X
08	max. speed MSB	X	X	X	X	X	X	X	X
09	max. speed	X	X	X	X	X	X	X	X
0A	max. speed LSB	X	X	X	X	X	X	X	X
0B	max. Duty Cycle	X	X	X	X	X	X	X	X
0C	min. Duty Cycle	X	X	X	X	X	X	X	X
0D	start Duty Cycle	X	X	X	X	X	X	X	X
0E	target value 0	X	X	X	X	X	X	X	X
0F	target value 1	X	X	X	X	X	X	X	X
10	operation modes 2	-	-	-	-	-	-	PMul	EE/DIP
11	rating factor	X	X	X	X	X	X	X	X
40	EEPROM status	-	-	-	-	-	INI	GÜL1	GÜL0
41	motor design number of poles	X	X	X	X	X	X	X	X
42	motor design function	-	-	-	-	Strang	KEY	LR	HW
43	max. admissible Duty Cycle	X	X	X	X	X	X	X	X
49	min. admissible Duty Cycle	X	X	X	X	X	X	X	X
4A	identification	X	X	X	X	X	X	X	X
6D	failure display n High Byte	Brake	-	UeLow	UzLow	UzHigh	DRV	TFEI	IzHigh
6E	failure display n-1 High Byte	Brake	-	UeLow	UzLow	UzHigh	DRV	TFEI	IzHigh
6F	failure display n-2 High Byte	Brake	-	UeLow	UzLow	UzHigh	DRV	TFEI	IzHigh
70	failure display n Low Byte	BLK	HLL	TFM	FB	SKF	TFE	KFN	PHA
71	failure display n-1 Low Byte	BLK	HLL	TFM	FB	SKF	TFE	KFN	PHA
72	failure display n-2 Low Byte	BLK	HLL	TFM	FB	SKF	TFE	KFN	PHA
73	operation hour counter MSB	X	X	X	X	X	X	X	X
74	operation hour counter LSB	X	X	X	X	X	X	X	X
86	max. DC link current	X	X	X	X	X	X	X	X
95	acceleration ramp	X	X	X	X	X	X	X	X
96	deceleration ramp	X	X	X	X	X	X	X	X
97	min. DC link voltage	X	X	X	X	X	X	X	X
98	min. input voltage	X	X	X	X	X	X	X	X
C7	reference Uz MSB	X	X	X	X	X	X	X	X
C8	reference Uz LSB	X	X	X	X	X	X	X	X
C9	reference Iz MSB	X	X	X	X	X	X	X	X
CA	reference Iz LSB	X	X	X	X	X	X	X	X
CB	reference Ue MSB	X	X	X	X	X	X	X	X
CC	reference Ue LSB	X	X	X	X	X	X	X	X

CD	reference le MSB	X	X	X	X	X	X	X	X
CE	reference le LSB	X	X	X	X	X	X	X	X
FB	actual operation mode	SWV	WU	LIRE	-	JUST	BA2	BA1	BA0
FC	actual max. duty cycle	X	X	X	X	X	X	X	X
FD	actual min. duty cycle	X	X	X	X	X	X	X	X
FE	actual target value	X	X	X	X	X	X	X	X
FF	actual sensor value	X	X	X	X	X	X	X	X

b) Statusvariables Electronics integrated "Sinus-U" (M3G084, M3G112, M3G150)

Id	Statusvariable	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
00	motor status Low Byte	BLK	HLL	TFM	FB	SKF	TFE	KFN	PHA
01	motor status High Byte	Brake	-	UeLow	UzLow	UzHigh	DRV	TFEI	IzHigh
02	alarm	-	UzLow	Tei_high	TM_high	TE_high	-	f_Err	IzLim
03	DC link voltage	X	X	X	X	X	X	X	X
04	DC link current	X	X	X	X	X	X	X	X
05	Electronic power module temp	X	X	X	X	X	X	X	X
06	target value	X	X	X	X	X	X	X	X
07	actual value	X	X	X	X	X	X	X	X
08	closed-loop/open-loop control	X	X	X	X	X	X	X	X
09	direction of rotation	X	X	X	X	X	X	X	X
0B	PWM duty cycle	X	X	X	X	X	X	X	X
10	motor temperature	X	X	X	X	X	X	X	X
11	input voltage	X	X	X	X	X	X	X	X
13	input current	X	X	X	X	X	X	X	X
20	Electronic box temperature	X	X	X	X	X	X	X	X

D WRITE – READ ACCESS

Write access to the data is enabled in the following cases:

1. EEPROM – write command via RS485
2. Default setting, if – after reset – data are identified by the PIC as invalid (see address EEPROM status 40h):
   During a default setting the data in block 1 and block 3 are rewritten. The data are stored in the PIC. The data for the default setting have been listed for each register ("Default setting: .....")
3. SETUP (when the bit Operation Mode1.SETUP is set after a reset condition). During a SETUP the data in block 1 (with the exception of: addresses 0 and 1) are rewritten. The data are stored in the PIC.
4. If the PIC recognizes a failure, the failure display is rewritten (70 – 72)
5. Every hour the operation hour meter (73 – 74) is written
6. Target value – Set command and Operation modes1.RSPrio and Operation modes1.SWS set: sent target value is stored (in register Target value (03))
7. If no reset is released within 5 minutes after the EEPROM write-command, the respective data of the RAM are written back in the EEPROM again.

Read access is enabled in following cases:

1. EEPROM – read command via RS485
2. At reset: read the complete motor data file (block 1 and block 3)
3. If a failure occurs, registers 70 and 71 of failure survey are read
4. Every hour the operation hour meter is read

E INHERITANCE OF DATA FROM EEPROM

The data in the EEPROM are inherited by the PIC immediately after a hardware or a software – reset only.

F NET ERROR

If data transmission is not possible, the PC issues a Net-Error-message ("RS485 not active"):

Failure	Failure causes:
Net-Error	a: PC is not connected to ebm-Bus (RS485-Bus) b: communication breakdown c: wrong fan address d: addressed fan not connected or defective