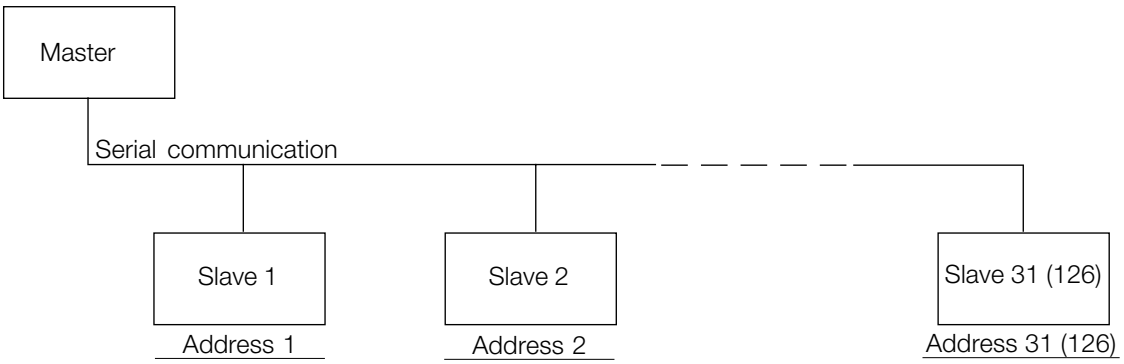
■ Serial communication for FC protocol



■ Protocols

As standard, all VLT 6000 HVAC units have a RS 485 port which enables a choice among three protocols. The three protocols, which can be selected in parameter 500 *Protocol*, are the following:

- Danfoss FC protocol
- Johnson Controls Metasys N2
- Landis/Staefa FLN [1)]

If Danfoss FC protocol is to be selected, set parameter 500 *Protocol* to *FC protocol* [0].

A description of Johnson's Control Metasys N2 and Landis/Staefa FLN is not included in this Design Guide.
For further information on Metasys N2, please order MI.60.XX.XX from your Danfoss supplier.
For further information on FLN, please order MI.60.XX.XX from your Danfoss supplier.

[1)] Available from approx. October 1998.

■ Telegram communication

Control and reply telegrams

The telegram communication in a master/slave system is controlled by the master. A maximum of 31 slaves (VLT 6000 HVAC) can be connected to one master, unless a repeater is used. If a repeater is used, a maximum of 126 slaves can be connected to one master.

The master continuously sends telegrams addressed to the slaves and awaits reply telegrams from these. The response time of the slaves is max. 50 ms.

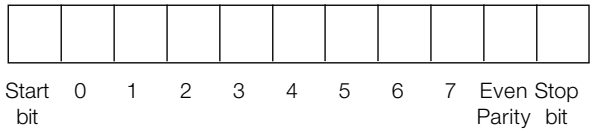
Only a slave that has received a faultless telegram addressed to that slave will response by sending a reply telegram.

Broadcast

A master can send the same telegram at the same time to all slaves connected to the bus. In such *broadcast* communication, the slave does not send a reply telegram to the master, provided the telegram has been correctly received.
Broadcast communication is set up in the address format (ADR), see the next page.

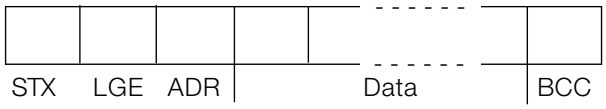
Contents of a character (byte)

Each transferred character begins with a start bit. Subsequently, 8 data-bits are transferred, corresponding to one byte. Each character is secured via a parity bit set to "1" when there is even parity (i.e. an even number of binary 1's in the 8 data-bits and the parity bit combined). A character ends with a stop bite and thus consists of a total of 11 bits.



■ Telegram build-up under FC protocol

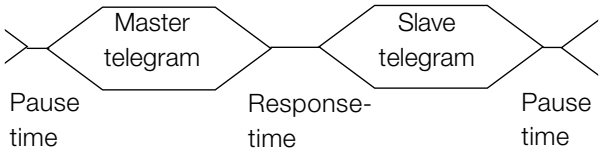
Each telegram begins with a start character (STX) = 02 Hex, followed by a byte that gives the telegram length (LGE) and a byte that gives the VLT address (ADR). Then follows a number of data bytes (variable, depending on telegram type). The telegram ends with a data control byte (BCC).



Telegram times

The speed of communication between a master and a slave depends on the baud rate. The baud rate of the VLT frequency converter must be the same as the baud rate of the master and is selected in parameter 502 *Baudrate*.

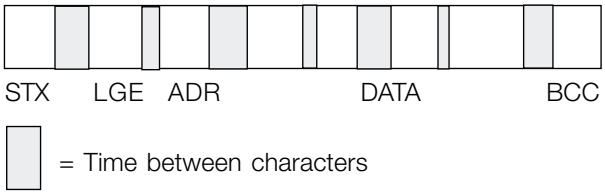
After a reply telegram from the slave, there must be a minimum pause of 2 characters (22 bits) before the master is able to send another telegram. At a baudrate of 9600 baud, there must be a minimum pause of 2.3 msec. After the master has completed the telegram, the response time of the slave back to the master will be max. 50 msec. and there will be a minimum pause of 2 characters.



Pause time, min.:	2 characters
Response time, min.:	2 characters
Response time, max.:	50 msec.

The time between individual characters in a telegram is not to exceed 2 characters and the telegram must be completed within 1.5 times the rated telegram time.

If the baudrate is 9600 baud and the telegram length is 16 bytes, the telegram must be completed within 27.5 msec.



Telegram length (LGE)

The telegram length is the number of data bytes plus address byte ADR plus data control byte BCC.

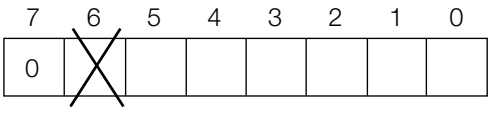
Telegrams with 4 data bytes have a length of:
LGE = 4 + 1 + 1 = 6 bytes
Telegrams with 12 data bytes have a length of:
LGE = 12 + 1 + 1 = 14 bytes
Telegrams that contain text have a length of 10+n bytes. 10 is the fixed characters, while 'n' is variable (depending on the length of the text).

VLT frequency converter address (ADR)

Two different address formats are used, in which the address range of the VLT frequency converter is either from 1-31 or from 1-126.

1. Address format 1-31

The byte for this address range has the following profile:



Bit 7 = 0 (address format 1-31 active)
Bit 6 is not used
Bit 5 = 1: Broadcast, address bits (0-4), not used
Bit 5 = 0: No Broadcast
Bit 0-4 = VLT frequency converter address 1-31

1. Address format 1-126
The byte for the 1-126 address range has the following profile:

7	6	5	4	3	2	1	0
1							

Bit 7 = 1 (address format 1-126 active)
Bit 0-6 = VLT frequency converter address 1-126
Bit 0-6 = 0 Broadcast

The slave sends the address byte back to the master in the reply telegram in unchanged form.

Example:

A telegram is sent to VLT frequency converter address 22 using address format 1-31:

7	6	5	4	3	2	1	0
0	0	0	1	0	1	1	0

Data control byte (BCC)

The data control byte can be explained by means of an example: Before the first byte of the telegram is received, the calculated check sum (BCS) is 0.

7	6	5	4	3	2	1	0
0	0	0	0	0	0	0	0

After the first byte (02H) has been received:

BCS = BCC EXOR "first byte"	(EXOR = exclusive-or gate)
BCS	= 0 0 0 0 0 0 0 0
	EXOR
"first byte"=	0 0 0 0 0 0 1 0 (02H)
BCC	= 0 0 0 0 0 0 1 0

Each additional, subsequent byte is gated with BCS EXOR and results in a new BCC, such as:

BCS	= 0 0 0 0 0 0 1 0
	EXOR
"second byte"	= 1 1 0 1 0 1 1 0 (D6H)
BCC	= 1 1 0 1 0 1 0 0

■ Data character (byte)

The build-up of data blocks depends on the type of telegram. There are three types of telegram and the telegram type applies to both control telegram (master→slave) and reply telegram (slave→master). The three types of telegram are the following:

1. Parameter block, used for transferring parameters between master and slave. The data block has 12 bytes (6 words) and also contains the process block.

PKE	IND	PWE_{HIGH}	PWE_{LOW}	PCD1	PCD2

Parameter block — Process block

2. Process block, built up as a data block with four bytes (2 words), covering:
   - Control word and reference value (from master to slave)
   - Status word and present output frequency (from slave to master).

PCD 1	PCD 2

Process block

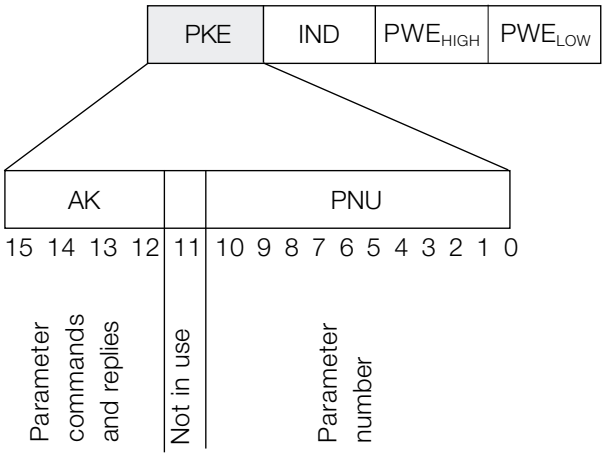
3. Text block, used for reading or writing texts via the data block.

PKE	IND	Ch 1	Ch2	...	Ch n	PCD1	PCD2

Text block — Process block

FC protocol

1. Parameter bytes



Parameter commands and replies (AK)
Bits no. 12-15 are used for transferring parameter commands from master to slave and the slave's processed reply back to the master.

Parameter commands master→slave:

Bit no. 15	14	13	12	Parameter command
0	0	0	0	No command
0	0	0	1	Read parameter value
0	0	1	0	Write parameter value in RAM (word)
0	0	1	1	Write parameter value in RAM (double word)
1	1	0	1	Write parameter value in RAM and EEPROM (double word)
1	1	1	0	Write parameter value in RAM and EEPROM (word)
1	1	1	1	Read/write text

Reply slave→master:

Bit no. 15	14	13	12	Reply
0	0	0	0	No reply
0	0	0	1	Parameter value transferred (word)
0	0	1	0	Parameter value transferred (double word)
0	1	1	1	Command cannot be executed
1	1	1	1	Text transferred

If the command cannot be carried out, the slave will send this reply (0111) *Command cannot be executed* and give the following error message in the parameter value (PWE):

(reply 0111)	Error message
0	The parameter number used does not exist
1	There is no write access to the parameter called
2	The data value exceeds the parameter limits
3	The used sub-index does not exist
4	The parameter is not of the array type
5	The data type does not match the parameter called
17	Data change in the parameter called is not possible in the present mode of the VLT frequency converter. E.g. some parameters can only be changed when the motor has stopped
130	There is no bus access to the parameter called
131	Data change is not possible because factory Setup has been selected

Parameter number (PNU)
Bits no. 0-10 are used for transmitting parameter numbers. The function of a given parameter can be seen from the parameter description in the *Programming* section.

Index

Index is used together with the parameter number for read/write access to parameters with an index, such as parameter 615 *Error code*.
Index has 2 bytes - a lowbyte and a highbyte. However, only the lowbyte is used. See example on the following page.

Example - Index:

The first error code (index [1]) in parameter 615 *Error code* must be read.

PKE = 1267 Hex (read parameter 615 *Error code*).
IND = 0001 Hex - Index no. 1.

1267 H	0001 H		
PKE	IND	PWE	

The VLT frequency converter will respond in the parameter value (PWE) block by means of an error code with a value from 1-99. See *List of warnings and alarms* to identify the error code.

Parameter value (PWE)

PKE	IND	PWE_{HIGH}	PWE_{LOW}

The parameter value block consists of 2 words (4 bytes) and its value depends on the command given (AK). If the master enquires about a parameter value, the PWE block contains no value.
If a parameter value is to be changed by the master (write), the new value is entered in the PWE block and sent to the slave.
If the slave responds to a parameter requirement (read command), the present parameter value is transferred in the PWE block and returned to the master.
If a parameter does not contain a numerical value, but several data selection options, e.g. parameter 001 *Language*, where [0] is *English* and [1] is *Danish*, the data value is selected by writing the value in the PWE block. See example on the following page.

Via the serial communication it is only possible to read parameters with data type 9 (text string). In VLT 6000 HVAC, parameters 621-631 *Nameplate data* have data type 9. For example, it is possible in parameter 621 Unit type to read the unit size and mains voltage range.
When a text string is transferred (read), the telegram length is variable, since the texts have different lengths. The telegram length is stated in the 2nd byte of the telegram, called LGE.
In order to read a text via the PWE block, the parameter command (AK) must be set to 'F' Hex.

The index character is used to indicate whether the command in question is a read or write command. For a read command, the index must have the following format:

04	00 H
Highbyte	Lowbyte
IND	

VLT 6000 HVAC has two parameters for which a text can be written: parameters 533 and 534 *Display text*, see the description of these under the parameter description. In order to write a text via the PWE block, the parameter command (AK) must be set to 'F' Hex.

For a write command, the index must have the following format:

05	00 H
Highbyte	Lowbyte
IND	

Data types supported by the VLT frequency converter

Datatype	Description
3	Integer 16
4	Integer 32
5	Unsigned 8
6	Unsigned 16
7	Unsigned 32
9	Text string

Unsigned means there is no sign included in the telegram.

Example - Write a parameter value:

Parameter 202 *Output frequency high limit, f_{MAX}* is to be changed to 100 Hz. This value must be remembered after a power failure, so it is written in EEPROM.

PKE = E0CA Hex - Write to parameter 202 *Output frequency high limit, f_{MAX}*
IND = 0000 Hex
PWE_{HIGH} = 0000 Hex
PWE_{LOW} = 03E8 Hex - Data value 1000, corresponding to 100 Hz, see *Conversion*.

E0CA H	0000 H	0000 H	03E8 H
PKE	IND	PWE_{HIGH}	PWE_{LOW}

The reply from the slave to the master will be:

10CA H	0000 H	0000 H	03E8 H
PKE	IND	PWE_{HIGH}	PWE_{LOW}

Example - Choice of a data value:

kW [20] is to be selected in parameter 415 *Process units*. This value must be remembered after a power failure, so it is written in EEPROM.

PKE = E19F Hex - Write to parameter 415 *Process units*
IND = 0000 Hex
PWE_{HIGH} = 0000 Hex
PWE_{LOW} = 0014 Hex - Choose data choice *kW* [20]

E19F H	0000 H	0000 H	0014 H
PKE	IND	PWE_{HIGH}	PWE_{LOW}

The reply from the slave to the master will be:

119F H	0000 H	0000 H	0014 H
PKE	IND	PWE_{HIGH}	PWE_{LOW}

Example - Read a parameter value:

The value in parameter 206 *Ramp-up time* is required. The master sends the following inquiry:

PKE = 10CE Hex - read parameter 206 *Ramp-up time*
IND = 0000 Hex
PWE_{HIGH} = 0000 Hex
PWE_{LOW} = 0000 Hex

10CE H	0000 H	0000 H	0000 H
PKE	IND	PWE_{HIGH}	PWE_{LOW}

If the parameter value in parameter 206 *Ramp-up time* is 10 seconds, the reply from the slave to the master will be as follows:

10CE H	0000 H	0000 H	000A H
PKE	IND	PWE_{HIGH}	PWE_{LOW}

Conversion:

The different attributes for each parameter can be seen in the section on factory settings.
Since a parameter value can only be transferred as a whole number, a conversion factor must be used to transfer decimals.

Example:

Parameter 201: minimum frequency, conversion factor 0.1. If parameter 201 is to be set to 10 Hz, a value of 100 must be transferred, since a conversion factor of 0.1 means that the transferred value will be multiplied by 0.1. A value of 100 will thus be understood as 10.0.

Conversion table:

Conversion index	Conversion factor
74	3.6
2	100
1	10
0	1
-1	0.1
-2	0.01
-3	0.001
-4	0.0001

■ Process word

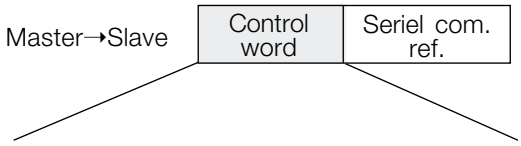
The process word block is divided into two blocks each of 16 bits, which always come in the sequence stated.

PCD1	PCD2

	PCD1	PCD2
Control telegram (master→slave)	Control word	Reference value
Reply telegram (slave→master)	Status word	Given output frequency

■ Control word as per FC protocol

The control word is used for transmitting commands from a master (e.g. a PC) to a slave (VLT 6000 HVAC).



15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 Bit no.

Bit	Bit = 0	Bit =1
00		Preset ref. lsb
01		Preset ref. msb
02	DC braking	
03	Coasting stop	
04	Quick stop	
05	Freeze output frequency	
06	Ramp stop	Start
07		Reset
08		Jog
09	No function	No function
10	Data not valid	Data valid
11		Activate relay 1
12		Activate relay 2
13		Choice of setup lsb
14		Choice of setup msb
15		Reversing

Bit 00/01:

Bits 00 and 01 are used for choosing between the four pre-programmed references (parameters 211-214 *Preset reference*) in accordance with the following table:

Preset ref.	Parameter	Bit 01	Bit 00
1	211	0	0
2	212	0	1
3	213	1	0
4	214	1	1

NB!:
Parameter 508 *Choice of preset reference* is used to choose how bits 00/01 are to be gated with the corresponding functions of the digital inputs.

Bit 02, DC BRAKE:

Bit 02 = 0 leads to DC braking and stop. Set braking current and duration in parameter 114 *DC braking current* and in parameter 115 *DC braking time*. Note: Parameter 504 *DC brake* is used for selecting how bit 02 is to be gated with the corresponding function of terminal 27.

Bit 03, Coasting stop:

Bit 03 = "0" means that the VLT frequency converter immediately "lets go" of the motor (the output transistors are "turned off"), which means that the motor coast until it stops.
Bit 03 = "1" means that the frequency converter is able to start the motor, provided the other conditions for starting are fulfilled. Note: In parameter 503 *Coasting stop* the choice is made of how bit 03 is to be gated with the corresponding function of terminal 27.

Bit 04, Quick stop:

Bit 04 = "0" leads to a stop in which the motor speed is ramped down to stop via parameter 207 *Ramp-down time*.

Bit 05, Freeze output frequency:

Bit 05 = "0" means that the given output frequency (in Hz) is frozen. The frozen output frequency can now only be changed via the digital inputs programmed for *Speed up* and *Speed down*.

NB!:
If *Freeze output* is active, the VLT frequency converter cannot be stopped via Bit 06 *Start* or via terminal 18. The VLT frequency converter can only be stopped in the following ways:

- Bit 03 *Coasting stop*
- Terminal 27
- Bit 02 *DC braking*
- Terminal 19 programmed for *DC braking*

Bit 06, Ramp stop/start:

Bit 04 = "0" leads to a stop in which the motor speed is ramped down to stop via parameter 207 *Ramp-down time*.
Bit 06 = "1" means that the frequency converter is able to start the motor, provided the other conditions for starting are fulfilled. Note: In parameter 505 *Start* a choice is made of the way bit 06 *Ramp stop/ start* is to be gated with the corresponding function of terminal 18.

Bit 07, Reset:

Bit 07 = "0" leads to no reset.
Bit 07 = "1"means that a trip is reset.
Reset is activated on the leading edge of the signal, i.e. at the change from logic '0' to logic '1'.

Bit 08, Jog:

Bit 08 = "1" means that the output frequency is determined by parameter 209 Jog frequency.

Bit 09, No function:

Bit 09 has no function.

Bit 10, Data not valid/Data valid:

Used for telling the VLT 6000 HVAC whether the control is to be used or ignored. Bit 10 = "0" means that the control word is ignored. Bit 10 = "1" means that the control word is used. This function is relevant because the control word is always contained in the telegram, regardless of the type of telegram used, i.e. it is possible to disconnect the control word if it is not to be used in connection with updating or reading of parameters.

Bit 11, Relay 1:

Bit 11 = "0": Relay 1 is not activated.
Bit 11 = "1": Relay 1 is activated, provided *Control word bits 11/12* has been selected in parameter 323 *Relay outputs*.

Bit 12, Relay 2:

Bit 12 = "0": Relay 2 is not activated.
Bit 12 = "1": Relay 2 is activated, provided *Control word bits 11/12* has been selected in parameter 326 *Relay outputs*.

NB!:
If the time-out period set in parameter 556 *Bus time interval function* is exceeded, relays 1 and 2 will lose their voltage if they have been activated via serial communication.

Bits 13/14, Choice of Setup:

Bits 13 and 14 are used to choose among the four menu Setups in accordance with the following table:

Setup	Bit 14	Bit 13
1	0	0
2	0	1
3	1	0
4	1	1

This function is only possible if *Multi-setups* has been selected in parameter 004.
Note: In parameter 507 *Choice of Setup* a choice is made of the way bits 13/14 are to be gated with the corresponding function of the digital inputs.

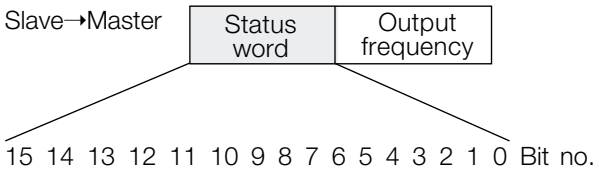
Bit 15, No function/reversing:

Bit 15 = "0" leads to no reversing.
Bit 15 = "1" leads to reversing.

Please note that, in the factory setting, reversing has been selected as digital in parameter 506 *Reversing*, which means that bit 15 only leads to reversing, if *bus, logic or* or *logic and* has been selected (however, *logic and* only together with terminal 19).

■ Status word as per FC protocol

The status word is used to inform the master (e.g. a PC) of the condition of the slave (VLT 6000 HVAC).



Bit	Bit = 0	Bit =1
00	Trip	Control ready
01		Drive ready
02		Stand by
03	No trip	Trip
04	Not in use	
05	Not in use	
06	Not in use	
07	No warning	Warning
08	Speed ≠ ref.	Speed = ref.
09	Local operation	Serial com. control
10	Out of frequency range	
11		Running
12	No function	No function
13		Voltage warning high/low
14		Current limit
15		Thermal warning

Bit 00, Control ready:
Bit 00 = "1". The VLT frequency converter is ready for operation.
Bit 00 = "0". The VLT frequency converter has tripped.

Bit 01, Drive ready:
Bit 01 = "1". The VLT frequency converter is ready for operation, but terminal 27 is a logic '0' and/or a *coasting command* has been received via serial communication.

Bit 02, Stand by:
Bit 02 = "1". The VLT frequency converter is able to start the motor when a start command is given.

Bit 03, No trip/trip:
Bit 03 = "0" means that the VLT 6000 HVAC is not in an error state.
Bit 03 = "1" means that the VLT 6000 HVAC has tripped and needs a reset signal in order for operation to be resumed.

Bit 04, Not in use:
Bit 04 is not used in the status word.

Bit 05, Not in use:
Bit 05 is not used in the status word.

Bit 06, Not in use:
Bit 06 is not used in the status word.

Bit 07, No warning/warning:
Bit 07 = "0" means there is no warning.
Bit 07 = "1" means a warning has occurred.

Bit 08, Speed ≠ ref./speed = ref.:
Bit 08 = "0" means that the motor is running, but that the present speed is different from the preset speed reference. This may be the case, i.e. when the speed is ramped up/down at start/stop.
Bit 08 = "1" means that the present motor speed equals the preset speed reference.

Bit 09, Local operation/serial communication control:
Bit 09 = "0" means that OFF/STOP has been activated on the control unit, or that the VLT 6000 HVAC is in Hand mode. It is not possible to control the VLT frequency converter via serial communication.
Bit 09 = "1" means that it is possible to control the frequency converter via serial communication.

Bit 10, Out of frequency range:
Bit 10 = "0" if the output frequency has reached the value in parameter 201 *Output frequency low limit* or parameter 202 *Output frequency high limit.*
Bit 10 = "1" means that the output frequency is within the limits stated.

Bit 11, Not running/running:
Bit 11 = "0" means that the motor is not running.
Bit 11 = "1" means that the VLT 6000 HVAC has a start signal, or that the output frequency is greater than 0 Hz.

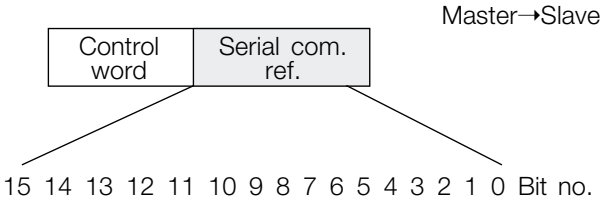
Bit 12, No function:
Bit 12 has no function.

Bit 13, Voltage warning high/low:
Bit 13 = "0" means that there is no voltage warning.
Bit 13 = "1" means that the DC voltage of the VLT 6000 HVAC intermediate circuit is too low or too high.

Bit 14, Current limit:
Bit 14 = "0" means that the output current is smaller than the value in parameter 215 *Current limit I_{LIM}*.
Bit 14 = "1" means that the output current is higher than the value in parameter 215 *Current limit I_{LIM}* and the VLT frequency converter will trip after the time set in parameter 412 *Trip delay overcurrent, I_{LIM}* has passed.

Bit 15, Thermal warning:
Bit 15 = "0" means there is no thermal warning.
Bit 15 = "1" means that the temperature limit has been exceeded either in the motor, in the VLT frequency converter or from a thermistor connected to an analogue input.

■ Serial communication reference



The serial communication reference is transmitted to the frequency converter in the form of a 16-bit word. The value is transmitted as whole numbers 0 - ±32767 (±200 %).
16384 (4000 Hex) corresponds to 100 %.

The serial communication reference has the following format:

0-16384 (4000 Hex) - 0-100 % (par. 204 *Minimum ref.* - Par. 205 *Maximum ref.*).

It is possible to change the direction of rotation via the serial reference. This is done by converting the binary reference value to 2's complement.
See example.

Example - control word and serial communication ref.:
The VLT frequency converter must receive a start command, and the reference is to be set to 50 % (2000 Hex) of the reference range.

Control word = 047F Hex. Start command
Reference = 2000 Hex. 50 % reference

047F H	2000 H
Control word	Reference

The VLT frequency converter is to receive a start command, and the reference is to be set to -50 % (-2000 Hex) of the reference range.
The reference value is first converted to the first complement; then 1 binary is added to get 2's complement:

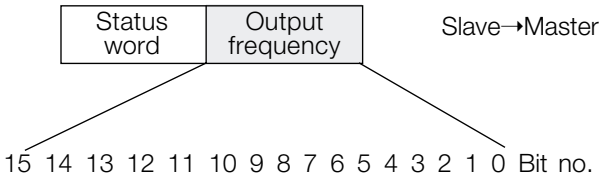
2000 Hex = 0010 0000 0000 0000 binary

1´ complement = 1101 1111 1111 1111 binary
+ 1 binary
2´ complement = 1110 0000 0000 0000 binary

Control word = 047F Hex. Start command
Reference = E000 Hex. -50 % reference

047F H	E000 H
Control word	Reference

■ Present output frequency



The value of the present output frequency of the frequency converter at any given time is transmitted as a 16-bit word. The value is transmitted in the form of whole numbers 0 - ±32767 (±200 %). 16384 (4000 Hex) corresponds to 100 %.

The output frequency has the following format:

0-16384 (4000 Hex) ≅ 0-100 % (Par. 201 *Output frequency low limit* - Par. 202 *Output frequency high limit*).

Example - Status word
and present output frequency:

The master receives a status message from the VLT frequency converter saying that the present output frequency is 50 % of the output frequency range.

Par. 201 *Output frequency low limit* = 0 Hz
Par. 202 *Output frequency high limit* = 50 Hz

Status word = 0F03 Hex. Status message
Output frequency = 2000 Hex. 50 % of the frequency range, corresponding to 25 Hz.

0F03 H	2000 H
Status word	Output frequency

FC protocol

■ Serial communication 500 - 536

In this parameter group, the serial communication of the VLT frequency converter is set up.
There is a choice of three protocols: FC protocol, Metasys N2 and Landis/Staefa. In order to use serial communication, address and baudrate must always be set. In addition, such present operational data as reference, feedback and motor temperature can be read via serial communication.

500 Protocol (PROTOCOL)

Value:

★FC protocol (FC PROTOCOL)	[0]
Metasys N2 (METASYS N2)	[1]
Landis/Staefa FLN (LS FLN)	[2]

Function:

There is a choice of three different protocols.

Description of choice:

Select the required control word protocol.

501 Address (ADDRESS)

Value:

Parameter 500 *Protocol = FC protolcol* [0]

0 - 126	★ 1

Parameter 500 *Protocol = Metasys N2* [1]

1 - 255	★ 1

Parameter 500 *Protocol = LS FLN* [3]

0 - 98	★ 1

Function:

In this parameter it is possible to allocate an address in a serial communication network to each VLT frequency converter.

Description of choice:

The individual VLT frequency converter must be given a unique address.
If the number of units connected (VLT frequency converters + master) exceeds 31, an amplifier (repeater) must be used.
Parameter 501 *Address* cannot be chosen via serial communication, but must be set via the LCP control unit.

502 Baudrate (BAUDRATE)

Value:

300 Baud (300 BAUD)	[0]
600 Baud (600 BAUD)	[1]
1200 Baud (1200 BAUD)	[2]
2400 Baud (2400 BAUD)	[3]
4800 Baud (4800 BAUD)	[4]
★ 9600 Baud (9600 BAUD)	[5]

Function:

In this parameter, the speed is programmed at which data is transmitted via serial communication. Baudrate is defined as the number of bits transmitted per second.

Description of choice:

The transmission speed of the VLT frequency converter must be set at a value that corresponds to the transmission speed of the master. Parameter 502 *Baudrate* cannot be selected via serial communication; it must be set via the LCP control unit.
The data transmission time itself, which is determined by the baudrate selected, is only part of the total communication time.

503 Coasting stop (COASTING)

Value:

Digital input (DIGITAL INPUT)	[0]
Serial communication (SERIAL PORT)	[1]
Logic and (LOGIC AND)	[2]
★ Logic or (LOGIC OR)	[3]

Function:

In parameters 503-508, a choice can be made to control the VLT frequency converter via the digital inputs and/or via serial communication.
If *Serial communication* [1] is selected, the command in question can only be activated if a command is given via serial communication.
If *Logic and* [2] is selected, the function must in addition be activated via a digital input.

★ = factory setting. ( ) = parameter window text. [ ] = value for use in communication via serial communication port

Description of choice:

The table below shows when the motor is running and is coasting when *Digital input* [0], *Serial communication* [1], *Logic and* [2] or *Logic or* [3] has been selected.

NB!:
Please note that terminal 27 and bit 03 of the control word are active in the case of logic '0'.

Digital input [0]			*Serial communication* [1]		
Kl. 27	Serial com.	Function	Kl. 27	Serial com.	Function
0	0	Coasting	0	0	Coasting
0	1	Coasting	0	1	Motor run.
1	0	Motor run.	1	0	Coasting
1	1	Motor run.	1	1	Motor run.
Logic and [2]			*Logic or* [3]		
Kl. 27	Serial com.	Function	Kl. 27	Serial com.	Function
0	0	Coasting	0	0	Coasting
0	1	Motor run.	0	1	Coasting
1	0	Motor run.	1	0	Coasting
1	1	Motor run.	1	1	Motor run.

504 DC brake (DC BRAKE)

Value:

Digital input (DIGITAL INPUT)	[0]
Serial communication (SERIAL PORT)	[1]
Logic and (LOGIC AND)	[2]
★ Logic or (LOGIC OR)	[3]

Function:

See functional description under parameter 503 *Coasting*.

Description of choice:

The table below shows when the motor is running and is DC-braking when *Digital input* [0], *Serial communication* [1], *Logic and* [2] or *Logic or* [3] has been selected.

NB!:
Please note that *DC braking inverse* [3] via terminal 19, terminal 27 and bit 03 of the control word is active in the case of logic '0'.

Digital input [0]			*Serial communication* [1]		
Term. 19/27	Serial com.	Function	Term.Seriel 19/27	com.	Function
0	0	DC-brake	0	0	DC-brake
0	1	DC-brake	0	1	Motor run.
1	0	Motor run.	1	0	DC-brake
1	1	Motor run.	1	1	Motor run.
Logic and [2]			*Logic or* [3]		
Term. 19/27	Serial com.	Function	Term.Serial 19/27	com.	Function
0	0	DC-brake	0	0	DC-brake
0	1	Motor run.	0	1	DC-brake
1	0	Motor run.	1	0	DC-brake
1	1	Motor run.	1	1	Motor run.

505 Start (START)

Value:

Digital input (DIGITAL INPUT)	[0]
Serial communication (SERIAL PORT)	[1]
Logic and(LOGIC AND)	[2]
★ Logic or (LOGIC OR)	[3]

Function:

See the functional description under parameter 503 *Coasting*.

Description of choice:

The table below shows when the motor has stopped and gives the situations in which the VLT frequency converter has a start command when *Digital input* [0], *Serial communication* [1], *Logic and* [2] or *Logic or* [3] has been selected.

Digital input [0]			*Serial communication* [1]		
Kl. 18	Serial com.	Function	Kl. 18	Serial com.	Function
0	0	Stop	0	0	Stop
0	1	Stop	0	1	Start
1	0	Start	1	0	Stop
1	1	Start	1	1	Start
Logic and [2]			*Logic or* [3]		
Kl. 18	Serial com.	Function	Kl. 18	Serial com.	Function
0	0	Stop	0	0	Stop
0	1	Stop	0	1	Start
1	0	Stop	1	0	Start
1	1	Start	1	1	Start

FC protocol

★ = factory setting. ( ) = parameter window text. [ ] = value for use in communication via serial communication port

506 Reversering (REVERSING)

Value:

★ Digital input (DIGITAL INPUT)	[0]
Serial communication (SERIAL PORT)	[1]
Logic and (LOGIC AND)	[2]
Logic or (LOGIC OR)	[3]

Function:

See the functional description under parameter 503 *Coasting*.

Description of choice:

The table below shows when the motor is running clockwise and anti-clockwise when *Digital input* [0], *Serial communication* [1], *Logic and* [2] or *Logic or* [3] has been selected.

Digital input [0]			*Serial communication* [1]		
Kl. 19	Serial com.	Function	Kl. 19	Serial com.	Function
0	0	Clockwise	0	0	Clockwise
0	1	Clockwise	0	1	Clockwise
1	0	Anti-clock.	1	0	Clockwise
1	1	Anti-clock.	1	1	Anti-clock.
Logic and [2]			*Logic or* [3]		
Kl. 19	Serial com.	Function	Kl. 19	Serial com.	Function
0	0	Clockwise	0	0	Clockwise
0	1	Clockwise	0	1	Anti-clock.
1	0	Clockwise	1	0	Anti-clock.
1	1	Anti-clock.	1	1	Anti-clock.

507 Selection of Setup (SELECTING OF SETUP)

508 Selection of preset reference (SELECTING OF SPEED)

Value:

Digital input (DIGITAL INPUT)	[0]
Serial communication (SERIAL PORT)	[1]
Logic and (LOGIC AND)	[2]
★ Logic or (LOGIC OR)	[3]

Function:

See the functional description under parameter 503 *Coasting*.

Description of choice:

The table below shows the Setup (parameter 002 *Active Setup*) that has been selected via *Digital input* [0], *Serial communication* [1], *Logic and* [2] or *Logic or* [3].
The table also shows the preset reference (parameters 211-214 *Preset reference*) that has been selected via *Digital input* [0], *Serial communication* [1], *Logic and* [2] or *Logic or* [3].

Digital input [0]				
Bus msb	Bus lsb	Setup/Preset msb	Setup/Preset lsb	Setup nr. Preset ref. no.
0	0	0	0	1
0	0	0	1	2
0	0	1	0	3
0	0	1	1	4
0	1	0	0	1
0	1	0	1	2
0	1	1	0	3
0	1	1	1	4
1	0	0	0	1
1	0	0	1	2
1	0	1	0	3
1	0	1	1	4
1	1	0	0	1
1	1	0	1	2
1	1	1	0	3
1	1	1	1	4

★ = factory setting. ( ) = parameter window text. [ ] = value for use in communication via serial communication port

Description, cont.:

Serial communication [1]				
Bus msb	Bus lsb	Setup/Preset msb	Setup/Preset lsb	Setup no. Preset ref. no.
0	0	0	0	1
0	0	0	1	1
0	0	1	0	1
0	0	1	1	1
0	1	0	0	2
0	1	0	1	2
0	1	1	0	2
0	1	1	1	2
1	0	0	0	3
1	0	0	1	3
1	0	1	0	3
1	0	1	1	3
1	1	0	0	4
1	1	0	1	4
1	1	1	0	4
1	1	1	1	4

Logic and [2]				
Bus msb	Bus lsb	Setup/Preset msb	Setup/Preset lsb	Setup no. Preset ref. no.
0	0	0	0	1
0	0	0	1	1
0	0	1	0	1
0	0	1	1	1
0	1	0	0	1
0	1	0	1	2
0	1	1	0	1
0	1	1	1	2
1	0	0	0	1
1	0	0	1	1
1	0	1	0	3
1	0	1	1	3
1	1	0	0	1
1	1	0	1	2
1	1	1	0	3
1	1	1	1	4

Logic or [3]				
Bus msb	Bus lsb	Setup/Preset msb	Setup/Preset lsb	Setup no. Preset ref. no.
0	0	0	0	1
0	0	0	1	2
0	0	1	0	3
0	0	1	1	4
0	1	0	0	2
0	1	0	1	2
0	1	1	0	4
0	1	1	1	4
1	0	0	0	3
1	0	0	1	4
1	0	1	0	3
1	0	1	1	4
1	1	0	0	4
1	1	0	1	4
1	1	1	0	4
1	1	1	1	4

★ = factory setting. ( ) = parameter window text. [ ] = value for use in communication via serial communication port

509 - 532 Data read-out

Value:

Parameter no.	Description	Display text	Unit	Updating interval
509	Resulting reference	(REFERENCE %)	%	80 msec.
510	Resulting reference [unit]	(REFERENCE [UNIT])	Hz, rpm	80 msec.
511	Feedback [unit]	(FEEDBACK)	Par. 415	80 msec.
512	Frequency [Hz]	(FREQUENCY)	Hz	80 msec.
513	User-defined read-out	(CUSTOM READOUT)	Hz x scaling	80 msec.
514	Motor current [A]	(CURRENT)	Amp	80 msec.
515	Power [kW]	(POWER KW)	kW	80 msec.
516	Power [HP]	(POWER HK)	HP	80 msec.
517	Motor voltage [V]	(MOTOR VOLT)	VAC	80 msec.
518	DC link voltage [V]	(DC LINK VOLTAGE)	VDC	80 msec.
519	Thermal load, motor [%]	(MOTOR TEMPERATURE)	%	80 msec.
520	Thermal load, VLT [%]	(VLT TEMPERATURE)	%	80 msec.
521	Digital input	(DIGITAL INPUT)	Binary	80 msec.
522	Terminal 53, analog input [V]	(TERMINAL 53, ANALOG INPUT)	Volt	20 msec.
523	Terminal 54, analog input [V]	(TERMINAL 54, ANALOG INPUT)	Volt	20 msec.
524	Terminal 60, analog input [mA]	(TERMINAL 60, ANALOG INPUT)	mA	20 msec.
525	Pulse reference [Hz]	(PULSE REFERENCE)	Hz	20 msec.
526	External reference [%]	(EXTERNAL REFERENCE)	%	20 msec.
527	Status word	(STATUS WORD HEX)	Hex	20 msec.
528	Heat sink temperature [°C]	(HEAT SINK TEMP.)	°C	1.2 sec.
529	Alarm word	(ALARM WORD, HEX)	Hex	20 msec.
530	Control word	(VLT CONTROL WORD, HEX)	Hex	2 msec.
531	Warning word	(WARNING WORD)	Hex	20 msec.
532	Extended status word	(STATUS WORD)	Hex	20 msec.

Function:

These parameters can be read out via the serial communication port and via the display. See also parameters 007-010 *Display read-out.*

Description of choice:

Resulting reference, parameter 509:
Gives a percentage for the resulting reference in the range from *Minimum reference, Ref_{MIN}* to *Maximum reference, Ref_{MAX}*. See also reference handling, pages 55-56.

Resulting reference [unit], parameter 510:
Gives the resulting reference by means of the unit Hz in *Open loop* (parameter 100). In *Closed loop*, the reference unit is selected in parameter 415 *Units with closed loop*.

Feedback [unit], parameter 511:
Gives the resulting feedback value by means of the unit/scaling selected in parameters 413, 414 and 415. See also feedback handling, pages 55-56.

Frequency [Hz], parameter 512:
Gives the output frequency from the VLT frequency converter.

★ = factory setting. ( ) = parameter window text. [ ] = value for use in communication via serial communication port

Description of choices under parameters 509-523, cont.:

User-defined read-out, parameter 513:
Gives a user-defined value calculated on the basis of the present output frequency and unit, as well as the scaling in selected in parameter 005 *Max. value of user-defined read-out*. The unit is selected in parameter 006 *Unit for user-defined read-out.*

Motor current [A], parameter 514:
Gives the motor phase current measured as an effective value.

Power [kW], parameter 515:
Gives the present power absorption of the motor in kW.

Power [HP], parameter 516:
Gives the present power absorption of the motor in HP.

Motor voltage, parameter 517:
Gives the voltage fed to the motor.

DC link voltage, parameter 518:
Gives the intermediate circuit voltage of the VLT frequency converter.

Thermal load, motor [%], parameter 519:
Gives the calculated/estimated thermal load on the motor. 100 % is the cut-out limit. See also parameter 117 *Motor thermal protection.*

Thermal protection, VLT [%], parameter 520:
Gives the calculated/estimated thermal load on the VLT frequency converter. 100 % is the cut-out limit.

Digital input, parameter 521:
Gives the signal status of the 8 inputs (16, 17, 18, 19, 27, 29, 32 and 33). Input 16 corresponds to the bit to the extreme left.
'0' = no signal, '1' = signal connected.

Terminal 53, analog input [V], parameter 522:
Gives the voltage value of the signal on terminal 53.

Terminal 54, analog input [V], parameter 523:
Gives the voltage value of the signal on terminal 54.

Terminal 60, analog input [mA], parameter 524:
Gives the current value of the signal on terminal 60.

Pulse reference [Hz], parameter 525:
Gives a pulse frequency in Hz connected to one of the terminals 17 and 29.

External reference, parameter 526:
Gives the sum of external references as a percentage (sum of analog/pulse/serial communication) in the range from *Minimum reference, Ref_{MIN}* to *Maximum reference, Ref_{MAX}.*

Status word, parameter 527:
Gives the present status word of the VLT frequency converter in Hex.

Heat sink temperature, parameter 528:
Gives the present heat sink temperature of the VLT frequency converter. The cut-out limit is 90 ± 5 °C, while cutting back in is effected at 60 ± 5 °C.

Alarm word, parameter 529:
Gives a Hex code for the alarm on the VLT frequency converter. See page 20 for further information.

Control word, parameter 530:
Gives the present control word of the VLT frequency converter in Hex.

Warning word, parameter 531:
Indicates in Hex whether there is a warning on the VLT frequency converter. See page 20 for further information.

Extended status word, parameter 532:
Indicates in Hex code whether there is a warning on the VLT frequency converter. See page 20 for further information.

★ = factory setting. ( ) = parameter window text. [ ] = value for use in communication via serial communication port

533 Display text 1 (DISPLAY TEXT ARRAY 1)

Value:

Max. 8 characters [XXXXXXXX]

Function:

Here, a text of max. 8 characters can be written that will be shown in display line 2, provided *LCP display text* [27] has been selected in parameter 007 *Large display read-out*. Example of display text.

Description of choice:

Write the required text via serial communication.

---

534 Display text 2 (DISPLAY TEXT ARRAY 2)

Value:

Max. 20 characters [XXXXXXXXXXXXXXXXXXXX]

Function:

Here, a text of max. 20 characters can be written that will be shown in display line 1, provided *LCP display text* [27] has been selected in parameter 007 *Large display read-out.*

Description of choice:

Write the required text via serial communication.

---

535 Bus feedback 1 (BUS FEEDBACK1)

Value:

0 - 16384 decimal (0 - 4000 Hex) ★ 0

Function:

Via the serial communication port, this parameter allows writing of a bus feedback value which will then form part of the feedback handling. Bus feedback 1 will be added to any feedback value registered on terminal 53.

Description of choice:

Write the required bus feedback value via serial communication.

---

536 Bus feedback 2 (BUS FEEDBACK 2)

Value:

0 - 16384 decimal (0 - 4000 Hex) ★ 0

Function:

Via serial communication, a bus feedback value could be written in this parameter that would subsequently become part of the feedback handling system. Bus feedback 2 will be added to any feedback value on terminal 54.

Description of choice:

Write the required bus feedback value via the serial communication.

★ = factory setting. ( ) = parameter window text. [ ] = value for use in communication via serial communication port

NB!:
Parameters 555 *Bus time interval* and 556 *Bus time interval function* are only active when *FC protocol* [0] has been selected in parameter 500 *Protocol.*

555 Bus time interval (BUS TIME INTERVAL)

Value:

1 - 65534 sec. ★ 1 sec.

Function:

In this parameter, the time is set which is expected to pass as a maximum between the receipt of two telegrams in a row. If this time is exceeded, the serial communication is assumed to have stopped and the required reaction is set in parameter 556 *Bus time interval function.*

Description of choice:

Set the required time.

556 Bus time interval function (BUS TIME INTERVAL FUNCTION)

Value:

★ Off (OFF)	[0]
Freeze output (FREEZE OUTPUT)	[1]
Stop (STOP)	[2]
Jogging (JOG FREQUENCY)	[3]
Max. output frequency (MAX FREQUENCY)	[4]
Stop and trip (STOP AND TRIP)	[5]

Function:

In this parameter, the required reaction from the VLT frequency converter is selected when the time set in parameter 555 *Bus time interval* has been exceeded.

Description of choice:

The output frequency of the VLT frequency converter can be frozen at the present value at any given time, frozen at parameter 211 *Preset reference 1*, frozen at parameter 202 *Max. output frequency*, or stop and activate a cut-out.

★ = factory setting. ( ) = parameter window text. [ ] = value for use in communication via serial communication port

■ Warning words 1+2 and Alarm word

Warning word, extended status word and alarm word are shown in Hex format on the display. If there is more than one warning or alarm, a sum of the total warnings or alarms will be shown.
The descriptions relating to the extended status word can be seen from page 9, and with respect to warning word, extended status word and alarm word, the descriptions can also be read out via the serial bus in parameter 531 *Warning word*, 532 *Extended status word* and 529 *Alarm word.*

Hex code	Extended status word
00000001	Overvoltage control active
00000002	Start delay
00000004	Sleep boost active
00000008	Sleep mode active
00000010	Automatic motor adaptation completed
00000020	Automatic motor adaptation running
00000040	Reversing and start
00000080	Ramp operation
00000100	Reversing
00000200	Speed = reference
00000400	Running
00000800	Local ref. = 0, Remote controlled ref. = 1
00001000	OFF mode = 1
00002000	Auto mode = 0, Hand mode = 1
00004000	Start blocked
00008000	Start blocked signal missing
00010000	Freeze output
00020000	Freeze output blocked
00040000	Jogging
00080000	Jog blocked
00100000	Stand by
00200000	Stop
00400000	DC stop
00800000	Drive ready
01000000	Relay 123 active
02000000	Drive ready
04000000	Control ready
08000000	Start prevented
10000000	Profibus OFF3 active
20000000	Profibus OFF2 active
40000000	Profibus OFF1 active
80000000	Reserved

Hex code	Warning word
00000001	Reference high
00000002	Fault in EEprom on control card
00000004	Fault in EEprom on power card
00000008	HPFB bus timeout
00000010	Serial communication timeout
00000020	Overcurrent
00000040	Current limit
00000080	Motor thermistor
00000100	Motor overtemperature
00000200	Inverter overtemperature
00000400	Undervoltage
00000800	Overvoltage
00001000	Voltage warning low
00002000	Voltage warning high
00004000	Mains phase fault
00008000	Live zero fault
00010000	Under 10 Volt (terminal 50)
00020000	Reference low
00040000	Feedback high
00080000	Feedback low
00100000	Output current high
00200000	Out of frequency range
00400000	Profibus communication fault
00800000	Output current low
01000000	Output frequency high
02000000	Output frequency low
04000000	AMA - motor too small
08000000	AMA - motor too big
10000000	AMA - check par. 102, 103, 105
20000000	AMA - check par. 102, 104, 106
40000000	Reserved
80000000	Reserved

Bit (Hex)	Alarm word
00000001	Unknown fault
00000002	Trip locked
00000004	Auto-optimisation not OK
00000008	HPFB bus timeout
00000010	Serial communication timeout
00000020	ASIC fault
00000040	HPFP bus timeout
00000080	Standard bus timeout
00000100	Short-circuiting
00000200	Switchmode fault
00000400	Earth fault
00000800	Current limit
00001000	Overcurrent
00002000	Motor thermistor
00004000	Motor overheated
00008000	Inverter overheated
00010000	Undervoltage
00020000	Overvoltage
00040000	Mains phase fault
00080000	Live zero fault
00100000	Heat sink temperature too high
00200000	Motor phase W missing
00400000	Motor phase V missing
00800000	Motor phase U missing
01000000	Profibus communication fault
02000000	Inverter fault
04000000	Output current low
08000000	Safety stop
10000000	Reserved