LUST
ANTRIEBSTECHNIK

Interconnection of Inverters and Servos on the INTERBUS-S

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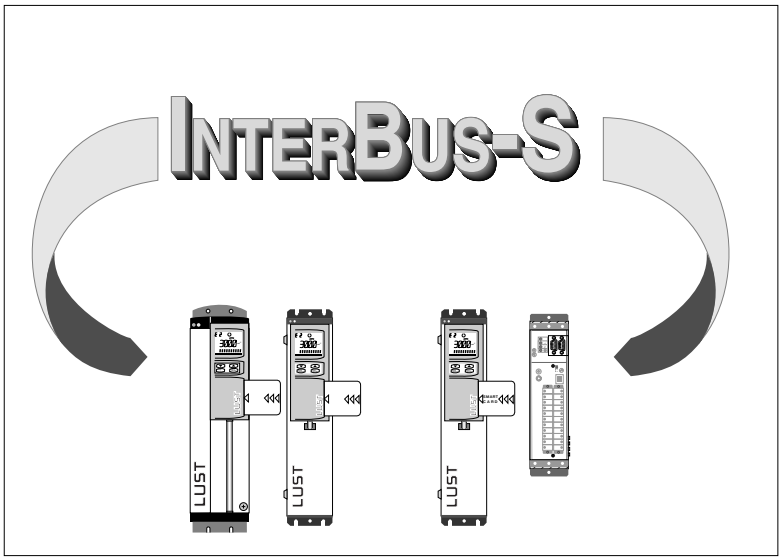


Data Transfer Protocol

INTERBUS-S Data Transfer Protocol

for SMARTDRIVE VF1000 S/M

MASTERDRIVE MC6000

Version: May 1998

Serial no.: 0718.51B.1-00

Table of Contents:

1 General Introduction

1.1 Preface

This INTERBUS-S documentation is applicable to LUST drive units of the SMARTDRIVE VF1000 and MASTERDRIVE MC6000 series.

1.2 Associated Documentation

This document describes only the characteristics of the LUST devices. INTERBUS-S specific functions and characteristics are described in the manuals produced by Phoenix Contact, and in the Profiles drawn up by the DRIVECOM User Group. The individual device parameters are described in detail in the respective operation manuals to the devices.

- Installation manual, IBS SYS INST UM (order no. 27 54 28 6)
- Reference manual, PCP 1.5
- Programming manual, PCP 1.5
- Reference manual, PCP 2.0
- Programming manual, PCP 2.0
- DRIVECOM Profiles nos. 20 and 21
- Description of parameters, VF1000 (order no. 0786.04B.0)
- Operation manual, VF1000, MC6000

1.3 System Requirements

The VF1000S and VF1000M series frequency inverters are executed as remote bus users.

The series MC6000 servocontrollers can be supplied optionally as remote or local bus users.

2 PCP and DRIVECOM Profiles

2.1 General Introduction

The INTERBUS-S specification distinguishes between the process data channel and the parameter channel. The process data channel provides rapid transfer of control commands, status reports, references and actual values. It is served with the maximum possible sampling time of the bus. By way of the parameter channel the parameters of the drive units can be read and altered. The width of the parameter channel can be set to one, two or four words (PCP V1.5 only one word possible !), with one byte controlling the parameter channel. Several INTERBUS-S cycles are required to transfer a parameter.

2.2 Frequency Inverters (Series VF1000S and VF1000M)

The VF1000S and VF1000M series inverters support the state machine from DRIVECOM Profile number 20, which defines only the control of drive units via the process data channel. The parameters for these inverters can be set by way of an additional word in the process data channel (Lust-specific protocol).

2.3 Servocontrollers (Series MC6000)

The MC6000 series servocontrollers support DRIVECOM Profile number 20. Their parameters can be set by way of PCP Version 2.0.

3 Defaults

The parameters of all drive units with INTERBUS-S interface are factory-set for bus operation. Users merely need to set the parameters for their specific motor and application. The following provides a description of the parameters changed by the factory default setting in INTERBUS-S operation.

3.1 Frequency Inverters (Series VF1000)

3.1.1 Modified Factory Default

The inverters of series VF1000 are configured for INTERBUS-S operation with a modificated software package. The modificated software makes the following changes to the standard factory defaults:

Parameter	Value	Meaning
1 MODE	4	Mode select
2 CSEL	5	Control location selector
4 FSSEL	25	Frequency reference selector

With this setting the inverter can no longer be controlled via the terminals.

3.1.2 ID Codes

All inverters occupy three words on the bus. They are signaled by the following ID codes:

Device	ID code	Meaning
VF1000S	$33B_H$	Remote bus user, conforming to profile, 3 words, without PCP
VF1000M	$33B_H$	Remote bus user, conforming to profile, 3 words, without PCP

3.1.3 Bus Monitoring

A watchdog can be configured in the inverter with the aid of parameter *906-IB-WD* to monitor the bus activity (see 4.1.1).

3.2 Servocontrollers (Series MC6000)

3.2.1 Modified Factory Default

The MC6000 servocontroller detects the INTERBUS card automatically on power-on. The first time it is detected the following parameters are changed in the MC6000 for INTERBUS operation:

Parameter	Value	Meaning
402 CLSEL	OPT1	Control location selector
417 RSSL1	RCON	Reference selector channel 1
418 RSSL2	RCON	Reference selector channel 2
419 RSSL3	OPT1	Reference selector channel 3
420 RSSL4	RCON	Reference selector channel 4
439 FSI00	OPT1	Function selector input IS00
440 FSI01	OPT1	Function selector input IS01
445 FOS00	OPT1	Function selector output OS00
446 FOS01	OPT1	Function selector output OS01
443 FIF0	OFF	Function selector virtual input F00
444 FIF1	OFF	Function selector virtual input F01

(The OPT1 setting is the one for the INTERBUS card)

With this setting the servo expects control information and the reference via the INTERBUS-S. The reference is carried over the reference channel with a ramp generator.

After the INTERBUS card has been withdrawn from the MC6000 these parameters are reset to their factory defaults the next time the device is powered-up.

3.2.2 ID Codes

The PCP version 2.0 is implemented in the MC6000. This version enables the parameter channel to have different word lengths. Splitting of the maximum of four words on the bus between the parameter channel and the process data channel is set with parameter *405-SUPI*. The parameter is evaluated only on power-on of the device. The following settings are possible:

405 - SUPI	Number of words Process data	Number of words PCP	ID code Local bus (hex)	ID code Remote bus (hex)
0	*)	*)	193	17B
1	0	1	1D3	1DB
2	0	2	2D0	2D8
3	0	4	4D1	4D9
4	1	0	193	17B
5	1	1	2D3	2DB
6	1	2	3D0	3D8
7	2	0	293	27B
8	2	1	3D3	3DB
9	2	2	4D0	4D8
10	3	0	393	37B
11	**3**	**1**	**4D3**	**4DB**
12	4	0	493	47B

*) The setting 'SUPI=0' means the servo does not require INTERBUS operation. The INTERBUS CPU initializes the SUPI with configuration 4, and remains in an endless loop with no data exchange with the servo.

3.2.3 Configuration of the Process Data Channel

The first word in the process data channel contains the control and status words according to DRIVECOM Profile 20. The remaining words in the process data channel are provided for reference transfer and actual value checkback. Interpretation of the reference and actual words can be set with parameter *406-IBCNF*.

406 - IBCNF	Reference	Actual	Possible 'SUPI' settings
0	No reference transfer	All words = 0	1...12
1	16 bits, Torque, speed or position, depending on control mode	16 bits, Torque, speed or position, depending on control mode	7...12
2	**32 bits,** **Torque, speed or position, depending on control mode**	**32 bits,** **Torque, speed or position, depending on control mode**	**10...12**
3	32 bits Speed	16 bits Speed (1st word) 16 bits Torque (2nd word)	10...12
4	Modificated software LISIM	Modificated software LISIM	9

3.2.4 Bus Monitoring

A watchdog is implemented to monitor bus activity. The watchdog is triggered with every INTERBUS cycle. With parameter *409-BUTWD* the monitoring time can be set in ms. The value 0 deactivates the watchdog. The watchdog error number is 16 ('E-OP1'), with error location 1.

4 Parameter Setting

4.1 Frequency Inverters (Series VF1000S and VF1000M)

In the inverters of series VF1000S and VF1000M a simple parameter setting facility was created. Parameters are set by way of the third word in the process data channel, the communication word. All actions on this parameter channel are triggered by the INTERBUS-S master. Transfer of parameters is only possible between the master and the inverter. Data exchange between inverters is not configured.

4.1.1 Parameters for INTERBUS-S

The following additional parameters are set up for INTERBUS-S operation:

Parameter 901 - ICNTL DRIVECOM control word

Control word for activation of the DRIVECOM state machine.

Type:	Unsigned 16
Category:	RAM control variable
Setting range:	0000_H - $FFFF_H$
Default:	0000_H
Unit:	---

Parameter 905 - FDRIV Reference

Frequency reference for the drive unit.

Type:	Integer 16
Category:	RAM control variable
Setting range:	-32768 - +32767
Default:	0
Unit:	Hz

Parameter 906 - IB-WD PD monitoring time

Monitoring time for the process data channel. The maximum value deactivates monitoring. The system only allows the inverter to increment the monitoring time in 50 ms steps (e.g. IB_WD = 65 ⇒ monitoring time = 100 ms)

Type:	Unsigned 16
Category:	EEPROM value
Setting range:	8 - 65535
Default:	200
Unit:	ms

Parameter 907 - IBCOD PD monitoring selection code

Response to expiry of the monitoring time for the process data channel.

Type:	Unsigned 16	
Category:	EEPROM value	
Setting range:	0	No action
	1	Shutdown with error E-IBS (no. 12)
	2	Device control command: 'Block power'
	3	Device control command: 'Emergency Stop'
Default:	0	
Unit:	---	

Parameter 911 - IBSTA DRIVECOM status word

Status word for the status of the DRIVECOM state machine.

Type:	Unsigned 16
Category:	RAM actual value
Setting range:	0000_H - $FFFF_H$
Default:	0
Unit:	---

Parameter 912 - FIST Actual speed

Actual speed on the motor shaft.

Type:	Integer 16
Category:	RAM actual value
Setting range:	-32768 - +32767
Default:	0
Unit:	Hz

4.1.2 Structure of the Communication Word

In the Low byte of the communication word the parameter numbers and values are transmitted byte-wise (data byte). The High byte controls the transfer (control byte) and serves to extend the number range for parameters.

4.1.2.1 Communication Word from the Master

Byte	Bit	Meaning
High byte	7	Not used, always 0
	6	Not used, always 0
	5	Toggle bit; a change of status indicates to the inverter that new data can be accepted
	4	Bits 2-4 contain the code for the desired parameter action,
	3	Value inquiry, value transfer or scan of parameter description
	2	
	1	Bit 1 from High byte of parameter number
	0	Bit 0 from High byte of parameter number
Low byte	7	
	6	
	5	
	4	Low byte of parameter number, parameter data, telegram type, checksum
	3	or error code
	2	
	1	
	0	

4.1.2.2 Communication Word from the Inverter

Byte	Bit	Meaning
High byte	7	Bit to differentiate RESET state. In operation always 1
	6	Not used, always 0
	5	Toggle bit; a change of status indicates to the INTERBUS-S master that new data can be accepted
	4	NAK bit, last byte from inverter, error occurred
	3	ACK bit, last byte from inverter, no error occurred
	2	Not used, always 0
	1	Not used, always 0
	0	Not used, always 0
Low byte	7	
	6	
	5	
	4	Parameter data, telegram type, checksum
	3	or error code
	2	
	1	
	0	

4.1.3 Telegram Types

Over the parameter channel parameters can be read, written, or their descriptions scanned. The master informs the inverter which function it wants to execute in the first transmitted data byte. The individual parameters may have numbers in the value range from 0 to $3FF_H$.

The following abbreviations are used in describing the telegram types:

Abbreviation	Meaning
CODE	Code for telegram type (bits 2-4 in the control byte)
DAT1	Data byte 1 (High byte)
DAT2	Data byte 2 (Low byte)
PBE1	1st byte of the parameter description
PBE2	2nd byte of the parameter description
PBE18	18th byte of the parameter description
PNR	Parameter number
ERR	Error code

4.1.3.1 Value Inquiry

With the value inquiry the contents of all inverter parameters can be read. The data length in VF1000 inverters is always 2 bytes, even when the parameter contains only one byte. The High byte is then filled with zeroes. This eliminates the need to scan information on the data length based on parameter description I before reading the parameter. The content of the parameter is returned in binary form. If an inquiry is submitted for non-existent parameters, the inverter terminates the protocol on receipt of the parameter number, with the NAK bit set.

CODE = 1

Master ⇒ Inverter:

PNR

Inverter ⇒ Master:

DAT1	DAT2

4.1.3.1.1 Examples

Value inquiry to an existing parameter

Parameter no.: 21-FMAX1
Actual value: $3E8_H$

Cycle number	High byte (Master)	Low byte (Master)	High byte (inverter)	Low byte (inverter)	Remarks
0	00	00	80	00	Master executes no action, inverter parameters can be set
1	24	16	80	00	Start of value inquiry, master sends CODE and parameter number
2	24	16	A0	03	Inverter has read value inquiry and sends High byte of requested parameter
3	04	00	A0	03	Master has read data byte
4	04	00	88	E8	Inverter sends Low byte of requested parameter and sets ACK bit
5	00	00	88	E8	Master returns to starting position and so terminates transmission
6	00	00	80	00	Inverter notices reset in CODE field and switches to Wait mode

(All figures hexadecimal)

Value inquiry to a non-existent parameter

Parameter no.: 40

Cycle number	High byte (Master)	Low byte (Master)	High byte (inverter)	Low byte (inverter)	Remarks
0	00	00	80	00	Master executes no action, inverter parameters can be set
1	24	28	80	00	Start of value inquiry, master sends CODE and parameter number
2	24	28	B0	00	Inverter has read value inquiry, sets NAK bit and thus signals the error
3	00	00	B0	00	Master has read NAK bit and so detected end of transmission. Returns to starting position
4	00	00	80	00	Inverter notices reset in CODE field and switches to Wait mode

(All figures hexadecimal)

4.1.3.2 Value Transfer

With the value transfer all writable parameters can be changed. EEPROM parameters can generally only be written to when the power stage is disabled. When writing single-byte parameters the High byte must be filled with zeroes.

CODE = 2

Master ⇒ Inverter:

PNR	DAT1	DAT2

4.1.3.2.1 Example

Example for existing parameter Parameter no.: 21-FMAX1
Value: $1F4_H$ (25 Hz)

Cycle number	High byte (Master)	Low byte (Master)	High byte (inverter)	Low byte (inverter)	Remarks
0	00	00	80	00	Master executes no action, inverter parameters can be set
1	28	16	80	00	Start of value transfer, master sends CODE and parameter number
2	28	16	A0	00	Inverter has read parameter number and waits for High byte of parameter value
3	08	01	A0	00	Master sends High byte of parameter value
4	08	01	80	00	Inverter has read High byte and waits for Low byte of parameter value
5	28	F4	80	00	Master sends Low byte
6	28	F4	A8	00	Inverter has successfully entered data under parameter number and sets ACK bit
7	00	00	A8	00	Master returns to starting position
8	00	00	80	00	Inverter notices reset in CODE field and switches to Wait mode

(All figures hexadecimal)

4.1.3.3 Scan of Parameter Description

The parameter description contains all information on the parameters. The inverter sends a total of 18 bytes, which are described in the following.

Designation	Number of characters
Parameter name	5 ASCII characters
Parameter unit	5 ASCII characters
Parameter category	1 ASCII character
Parameter type	1 ASCII character
Minimum value	2 binary data bytes (High byte first)
Maximum value	2 binary data bytes (High byte first)
Default	2 binary data bytes (High byte first)

The Parameter name

The parameter name comprises five letters, and is the short designation for the parameter in question. Combinations of digits, capital letters, underlines (_) and dashes (-) are permissible.

The parameter unit

The abbreviation for the unit is entered in the “Parameter unit” field. Where the parameter has no unit the field contains five blanks.

The parameter category

‘0’ RAM control variable (basic parameter)
‘1’ RAM actual value (basic parameter)
‘2’ EEPROM (basic parameter)
‘3’ EEPROM/RAM variable (basic parameter)
‘4’ RAM control variable (inverter-spec. parameter)
‘5’ RAM actual value (inverter-spec. parameter)
‘6’ EEPROM (inverter-spec. parameter)
‘7’ EEPROM/RAM Variable (inverter-spec. parameter)

Basic parameters are parameters present in all VF1000 series. Inverter-specific parameters cannot be present in other inverters, e.g. in other power classes. The inverter stores changes to EEPROM/RAM parameters in the RAM when the power stage is enabled, and additionally in the EEPROM when the power stage is disabled.

The parameter type

The parameter type designates the maximum value range of the parameter. The following data types are supported by the VF1000:

ASCII code	Value range
‘1’	Binary-8, for bit pattern representations, 1 byte
‘2’	Decimal number, scaling 0.05, 2 bytes
‘3’	Integer 2 byte, range 0 - 65535
‘4’	Integer 1 byte, range 0 - 255
‘5’	Error variable, for representation of ERRx parameters, 2 bytes *)
‘6’	Password for representation of passwords, range 0 - 65535, 2 bytes

*) Error variables are coded as follows:
In the High byte the error code is mapped in the Low nibble. The High nibble is always 0. Valid error codes are 00_H-$0E_H$; no error corresponds to value $0F_H$. In the Low nibble of the Low byte the error time is entered in 1/10h. The High nibble is always 0. Here, too, the basic state - if no error has occurred - is $0F_H$. When an error is entered the time since inverter power-on is entered in 6-minute increments (max. 15 ∗ 6 minutes).

Minimum value

Value transfers with values lower than the minimum value are rejected.

Maximum value

Value transfers with values higher than the maximum value are rejected.

Default

This value corresponds to the factory setting of the parameter.

CODE = 3

Master ⇒ Inverter:

PNR

Inverter ⇒ Master:

PBE1	PBE2	•••	PBE18

4.1.3.3.1 Example

Example for parameter no.: 45-VB2

- Parameter name: VB2
- Unit: %
- Parameter category: EEPROM
- Parameter type: Decimal
- Minimum value: 0
- Maximum value: $20*25 = 1F4_H$
- Default: $20*8 = A0_H$

This produces the following parameter set:

‘V’	’B’	’2’	’ ‘	’ ‘	‘%’	’ ‘	’ ‘	’ ‘	’ ‘	‘2’	‘2’	0	0	1	F4	0	A0

(All figures between inverted commas are ASCII characters)

Cycle number	High byte (Master)	Low byte (Master)	High byte (inverter)	Low byte (inverter)	Remarks
0	00	00	80	00	Master executes no action, inverter parameters can be set
1	2C	2D	80	00	Start of value inquiry, master sends CODE and parameter number
2	2C	2D	A0	56	Inverter has read value inquiry and sends 1st byte of parameter name
3	0C	00	A0	56	Master has read byte
4	0C	00	80	42	Inverter has read value inquiry and sends 2nd byte of parameter name
5	2C	00	80	42	Master has read byte
4	2C	00	A0	32	Inverter has read value inquiry and sends 3rd byte of parameter name
5	0C	00	A0	32	Master has read byte
6	0C	00	80	20	Inverter has read value inquiry and sends 4th byte of parameter name
7	2C	00	80	20	Master has read byte
8	2C	00	A0	20	Inverter has read value inquiry and sends 5th byte of parameter name
9	0C	00	A0	20	Master has read byte
12	0C	00	80	25	Inverter sends 1st byte of parameter unit
13	2C	00	80	25	Master has read byte
14	2C	00	A0	20	Inverter sends 2nd byte of parameter unit
15	0C	00	A0	20	Master has read byte
16	0C	00	80	20	Inverter sends 3rd byte of parameter unit
17	2C	00	80	20	Master has read byte
18	2C	00	A0	20	Inverter sends 4th byte of parameter unit
19	0C	00	A0	20	Master has read byte
20	0C	00	80	20	Inverter sends 5th byte of parameter unit
21	2C	00	80	20	Master has read byte
22	2C	00	A0	32	Inverter sends byte for parameter category
23	0C	00	A0	32	Master has read byte
24	0C	00	80	32	Inverter sends byte for parameter type
25	2C	00	80	32	Master has read byte.
26	2C	00	A0	30	Inverter sends High byte of minimum value
27	0C	00	A0	30	Master has read value
28	0C	00	80	30	inverter sends Low byte of minimum value
29	2C	00	80	30	Master has read value
30	2C	00	A0	30	Inverter sends High byte of maximum value
31	0C	00	A0	30	Master has read value
32	0C	00	80	31	Inverter sends Low byte of maximum value
33	2C	00	80	31	Master has read value
34	2C	00	A0	32	Inverter sends High byte of default
35	0C	00	A0	32	Master has read value
36	0C	00	88	32	Inverter sends Low byte of default. Last byte, ACK bit is set
37	00	00	88	32	Master has read value
38	00	00	80	00	Inverter notices reset in CODE field and switches to Wait mode

4.1.4 Error Handling

If the frequency inverter does not receive usable characters, it signals the fact by setting the NAK bit, and immediately terminates the protocol after acknowledgment by the master. The following errors may occur:

- Parameter value outside permissible limits
- Parameter number does not exist
- Unintended control bits or power-on

If one of these errors has occurred during a *value transfer*, an error bit is set in parameter *85-SIOF* (see parameter description). This bit is reset when parameter *85-SIOF* is read. As long as *85-SIOF* is <> 0 any further value transfer is answered with the NAK bit. But a value inquiry is possible without restriction. This means it is necessary to read parameter *85-SIOF* after every value transfer answered with NAK. Faulty *value inquiries* bring about no entry in parameter *85-SIOF* .

4.2 Servocontrollers (Series MC6000)

The index of the parameters in the MC6000 is calculated from the parameter number plus an offset of $5C00_H$.

When the servocontroller parameters have been changed, parameter *15-PLRDY* should be set to 1 to trigger recalculation of the controller parameters and set the servocontroller to 'READY' mode.

4.2.1 Parameters for INTERBUS-S

The DRIVECOM control word and the DRIVECOM status word are set up as special parameters for INTERBUS-S operation in addition to the two parameters ***405 - SUPI*** and ***406 - IBCNF*** (see "ID Codes" and "Configuration of the Process Data Channel").

Parameter 407 - IBSTU DRIVECOM status word

Status word for the status of the DRIVECOM state machine.

Index:	$5D97_H$
Type:	Unsigned 16
Category:	RAM control value
Setting range:	0000_H - $FFFF_H$
Default:	0
Unit:	---

Parameter 408 - IBSTA DRIVECOM status word

Status word for the status of the DRIVECOM state machine.

Index: $5D98_H$
Type: Unsigned 16
Category: RAM actual value
Setting range: 0000_H - $FFFF_H$
Default: 0
Unit: ---

4.2.2 KBL Settings

For communication with the master the communication links list of the MC6000 contains the following entries:

```
/* ------ PMS - part ------------- */
        0,          /* max. PDU length for req./resp. - high      */
        134,        /* max. PDU length for req./resp. - low       */
        0,          /* max. PDU length for ind./conf. - high      */
        134         /* max. PDU length for ind./conf. - low       */
        /* supported services, for client functionality first     */
        GET_OV_LONG_NOT_SUP | PUT_OV_NOT_SUP | DOM_NOT_SUP,   /* byte 1 */
        PI_NOT_SUP | READ_NOT_SUP | WRITE_NOT_SUP,                    /* byte 2 */
        INFO_REP_NOT_SUP | VAR_LIST_NOT_SUP | ALARM_NOT_SUP,     /* byte 3 */
        /* now server functionality */
        GET_OV_LONG_SUP | PUT_OV_NOT_SUP | DOM_NOT_SUP,          /* byte 4 */
        PI_NOT_SUP | READ_SUP | WRITE_SUP,                        /* byte 5 */
        INFO_REP_SUP | VAR_LIST_NOT_SUP | ALARM_NOT_SUP,         /* byte 6 */
        /* symbol name */
```

4	‘L’	’u’	’s’	’t’	’ ‘	’ ‘	’ ‘	’ ‘	’ ‘	’ ‘	’ ‘

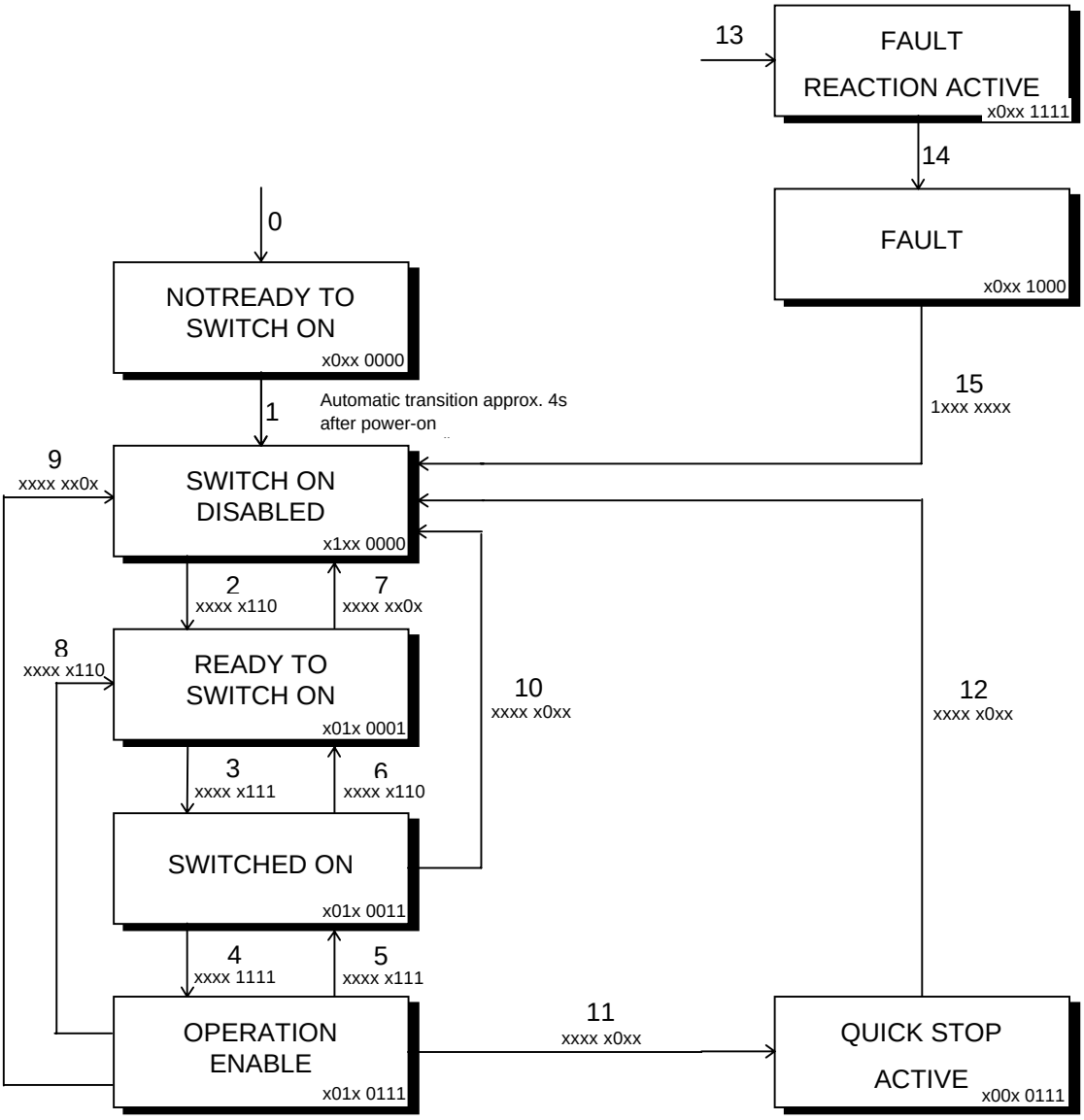
```
        (usign8*) 0         /* vfd-pointer */
```

5 Control Functions and Reference Input

5.1 Extract from the DRIVECOM Profiles

5.1.1 State Machine

All INTERBUS-S drive units from LUST Antriebstechnik GmbH can be controlled by way of the DRIVECOM state machine based on Profile 20.



5.1.2 Control Word

The first IN data word in the process data channel is always as interpreted as the control word. By means of logic links, the 16 bits of the control word produce control commands which act on the state machine. The DRIVECOM Profiles assign the individual bits the following functions:

Bit	Name
0	Power-on
1	Block power
2	Emergency stop
3	Enable operation
4	Mode-dependent
5	Mode-dependent
6	Mode-dependent
7	Reset fault
8	Reserve
9	Reserve
10	Reserve
11	Manufacturer-specific
12	Manufacturer-specific
13	Manufacturer-specific
14	Manufacturer-specific
15	Manufacturer-specific

The reserve bits 8-10 are intended for profile extensions, and must always be set to 0. The function of the manufacturer-specific bits is explained in the descriptions to the control words of the individual devices.

Device Control Commands

The following bit combinations of control bits 0-3 and 7 form the device control commands for the state transition of the state machine:

	Control bit					
Command:	**7**	**3**	**2**	**1**	**0**	**Transitions:**
SHUTDOWN	X	X	1	1	0	2, 6, 8
POWER-ON	X	X	1	1	1	3
BLOCK POWER	X	X	X	0	X	7, 9, 10, 12
EMERGENCY STOP	X	X	0	1	X	7, 10, 11
DISABLE	X	0	1	1	1	5
ENABLE	X	1	1	1	1	4
RESET FAULT	0⇨1	X	X	X	X	15

5.1.3 Status Word

The status word is always written to the first OUT data word of the process data channel. The status word shows the current status of the device and additional messages.

The following bits of the DRIVECOM status word are supported:

Bit	Name
0	Ready
1	On
2	Enabled
3	Fault
4	Power blocked
5	Emergency stop
6	Start-up inhibit
7	Alarm
8	Message
9	Remote
10	Reference reached
11	Limit value
12	Mode-dependent
13	Mode-dependent
14	Manufacturer-specific
15	Manufacturer-specific

Device States

The following bit combinations map the individual states of the state machine in the status word:

	Status bit					
State:	**6**	**5**	**3**	**2**	**1**	**0**
NOT READY	0	X	0	0	0	0
START-UP INHIBIT	1	X	0	0	0	0
READY	0	1	0	0	0	1
ON	0	1	0	0	1	1
ENABLED	0	1	0	1	1	1
FAULT	0	X	1	0	0	0
FAULT RESPONSE ACTIVE	0	X	1	1	1	1
EMERGENCY STOP ACTIVE	0	0	0	1	1	1

Description of the remaining bits in the status word

Bit 4 Power blocked:
The ‘Block power’ request has been received when bit 4 = 0.

Bit 5 Emergency Stop:
The ‘Emergency Stop’ request is displayed when bit 5 = 0.

Bit 7 Alarm:
Collective display for manufacturer-specific or standardized alarms. An alarm is present when bit 7 = 1.

Bit 8 Message:
Collective display for manufacturer-specific or standardized messages. A message is present when bit 8 = 1.

Bit 9 Remote:
“Remote” indicates that parameters can be changed via the bus.

Bit 10 Reference reached:
This bit indicates that the pre-set reference value has been reached.

Bit 11 Limit value:
This bit indicates that a limitation is active.

Bits 12, 13 The function of the mode-dependent bits is explained in the descriptions to the control words of the individual devices.

Bits 14, 15 The function of the manufacturer-specific bits is explained in the descriptions to the control words of the individual devices.

5.2 Frequency Inverters (Series VF1000S and VF1000M)

5.2.1 Control Word

Bit	Name
0	Power-on
1	Block power
2	Emergency stop
3	Enabled
4	Disable acceleration encoder
5	Stop acceleration encoder
6	Acceleration encoder zero
7	Reset fault
8	Reserve
9	Reserve
10	Reserve
11	Unoccupied
12	S2IND
13	S1IND
14	STL
15	STR

Bit 4 Disable acceleration encoder, bit 4 = 0. The inverter executes the parameter-set stop function (*36-RSTOP*, disable power stage or stop ramp). When bit 4 is reset to 1 the inverter runs up to the frequency reference with the programmed ramp.

Bit 5 Stop acceleration encoder, bit 5 = 0. The ramp is stopped at the current value. When the status of bit 5 changes back to 1 the acceleration encoder resumes.

Bit 6 Acceleration encoder zero, bit 4 = 0. The acceleration encoder moves the reference with the pre-set ramp to 0 Hz. When bit 6 is reset to 1 the acceleration encoder restarts.

Bit 7 Reset fault. The inverter performs a software reset !

Bit 12 Activates the parameter-set function of input S2IND

Bit 13 Activates the parameter-set function of input S1IND

Bit 14 Function as input STL (start counter-clockwise)

Bit 15 Function as input STR (start clockwise)

The control command EMERGENCY STOP only causes the motor to brake when a stop ramp (*36- RSTOP* <> 0) is programmed. The inverter automatically switches to START-UP INHIBIT mode as soon as the programmed stop ramp has been worked through.

5.2.2 Status Word

Bit	Name
0	Ready
1	On
2	Enabled
3	Fault
4	Power blocked
5	Emergency stop
6	Start-up inhibit
7	Alarm
8	Not implemented
9	Remote
10	Reference reached
11	Limit value
12	Reserved
13	Reserved
14	S2OUT
15	S1OUT

Bit 14 Status of output S2OUT, dependent on programmed function
Bit 15 Status of output S1OUT, dependent on programmed function

5.2.3 Reference Input

The reference is transferred by default in the second IN word of the process data channel. The pre-set reference is always interpreted as an absolute value. The direction of rotation is determined by way of the control word.

The reference transferred over the process data channel is interpreted as a rotating field frequency (hexadecimal). The rotating field frequency is scaled to 0.05 Hz.

Important: At a reference value of 0 Hz the inverter shuts down the motor if DC-Stop is not programmed !

5.3 Servocontrollers (Series MC6000)

5.3.1 Control Word

Bit	Name
0	Power-on
1	Block power
2	Emergency stop
3	Enabled
4	No function
5	No function
6	No function
7	Reset Fault
8	Reserve
9	Reserve
10	Reserve
11	Unoccupied
12	Unoccupied
13	Unoccupied
14	Reference state output OS00
15	Reference state output OS01

Bit 14 Bit 14 controls the reference state of output OS00 directly when parameter *445-FOS00* = ROPT1

Bit 15 Bit 15 controls the reference state of output OS01 directly when parameter *446-FOS01* = ROPT1

5.3.2 Status Word

Bit	Name
0	Ready
1	On
2	Enabled
3	Fault

4	Power blocked
5	Emergency stop
6	Start-up inhibit
7	Alarm
8	Not implemented
9	Remote
10	Reference reached
11	Limit value
12	Reserved
13	Reserved
14	Actual state input IS00
15	Actual state input IS01

Bit 14 Bit 14 reflects the actual state of input IS00 when parameter *439-FIS00* = ROPT1
Bit 15 Bit 15 reflects the actual state of input IS01 when parameter *440-FIS01* = ROPT1

5.3.3 Reference Input

The reference is transferred in the second and third IN words of the process data channel. Parameter *405-IBCNF* defines the significance of the reference (see 3.2.3). In the factory default setting the servo expects the reference as a 32-bit value in Q16 format. The reference always relates to the set control mode.

5.3.4 Example

Control and reference input via INTERBUS-S, at 2500.25 rpm, speed control, no ramp

Where the factory default has been changed, this configuration requires the following parameter settings:

402-CLSEL	= OPT1 (4)	(Control location: control via option 1, INTERBUS-S)
417-RSSL1	= OPT1 (6)	(Reference source 1: option 1, INTERBUS-S)
418-RSSL2	= RCON (0)	(Reference source 2: off)
419-RSSL3	= RCON (0)	(Reference source 3: off)
420-RSSL4	= RCON (0)	(Reference source 4: off)
406-IBCNF	= 2	(32 bits reference and actual)
405-SUPI	= 11	(1 word PCP, 3 words process data)

Reference calculation:
2500.25 rpm $\Rightarrow$ 2500.25 * 65536 = $09C44000_H$

The drive unit can then be started with the following control sequence (process data channel):

Master ⇒ Servo		**Servo ⇒ Master**		**Remarks**
Control word	Reference	Status word	Actual	
0000_H	00000000_H	0240_H	00000000_H	Servo state: START-UP INHIBIT
0006_H	$09C44000_H$	0240_H	00000000_H	Command: Shutdown
0006_H	$09C44000_H$	0231_H	00000000_H	Servo state: READY
$000F_H$	$09C44000_H$	0231_H	00000000_H	Command: Enable
$000F_H$	$09C44000_H$	0237_H	X_H	Servo state: ENABLED, Motor accelerates up to reference value
$000F_H$	$09C44000_H$	0437_H	$09C44000_H$	Servo state: ENABLED, Motor has reached reference

6 Commissioning Instructions

6.1 Series VF1000S and VF1000M

After power-on the inverter requires around four seconds for its initialization and the self-test. During that time it signals a module error on the INTERBUS-S. A module error is also signaled when the inverter is shut off again.

During operation on the INTERBUS-S (*01-MODE* = 4) the serial interface of the inverter cannot be used. The serial interface is available as soon as *01-MODE* <> 4 and no supply voltage (24 V) is applied to the INTERBUS-S connection.

While the SMARTCARD is being read and written to bus operation is disabled.

After inverter power-on the Power-On flag is set in parameter *85-SIOF*. Only when the flag is reset - by reading of parameter 85 - does the inverter accept value transfer telegrams.

7 Time Response

7.1 Series VF1000S and VF1000M

Transfer times for the various telegram types in different operating states:

	Unit	Value transfer	Value inquiry	Parameter description
With KEYPAD, motor running	ms	192*)	115	490
Without KEYPAD, motor running	ms	131*)	100	490
Without KEYPAD, motor stopped	ms	124*), (250)	100	490

*) Write to a RAM variable or a EEPROM variable which already contains the current value.

Value in brackets applies when a different value is written to the EEPROM than was previously stored.
The values cited require that the INTERBUS-S transfer times are significantly shorter than the internal sampling time in the inverter (8.2 ms).

The control and status words are processed every 8.2 ms.

7.2 Series MC6000

The transfer time for value inquiries and value transfers is between 10 ms and 35 ms, depending on processor workload.

The control and status words are processed every 1 ms.

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