BETRIEBSANLEITUNG

INSTRUCTION MANUAL

CAN in AUTOMATION

KEB COMBICOM

CANopen-ANSCHALTUNG
CANopen-INTERFACE

CC.F5.0E0-K002

12/2003

The pictographs used in this manual mean:

⚠ **Attention, observe at all costs**

On Page GB - 54 in this Manual you can find a literature list which contains referance books. Standards and statements are described in this reference books. At the corresponding text you can find digits in square brackets [ ].

1. General Information

This manual as well as the specified hardware and software are developments of the Karl E. Brinkmann GmbH. Errors and ommissions excepted! The Karl E. Brinkmann GmbH have prepared the documentation, hardware and software to the best of their knowledge, however, no guarantee is given that the specifications will provide the efficiency aimed at by the user. The Karl E. Brinkmann GmbH reserves the right to change the specifications without prior notification or further obligation. All rights reserved.

This instruction manual describes the new version of the F5-CAN-operator. With regard to the old version we refer you to the instruction manual CC.F5.010-K001.

2. Order Informations

This Instruction Manual:	CC.F5.0D0-K002
F5-CAN-operator with display and keyboard:	00.F5.060-5010
F5-CAN-operator without display and keyboard:	00.F5.060-5110
F5-CAN-operator with display and keyboard (terminal strip):	00.F5.060-5011
F5-CAN-operator without display and keyboard (terminal strip):	00.F5.060-5111
Utilities for the diagnostic interface	
HSP5 cable between Personal Computer and adapter:	00.F5.0C0-0001
Adapter DSUB9 / Western:	00.F5.0C0-0002

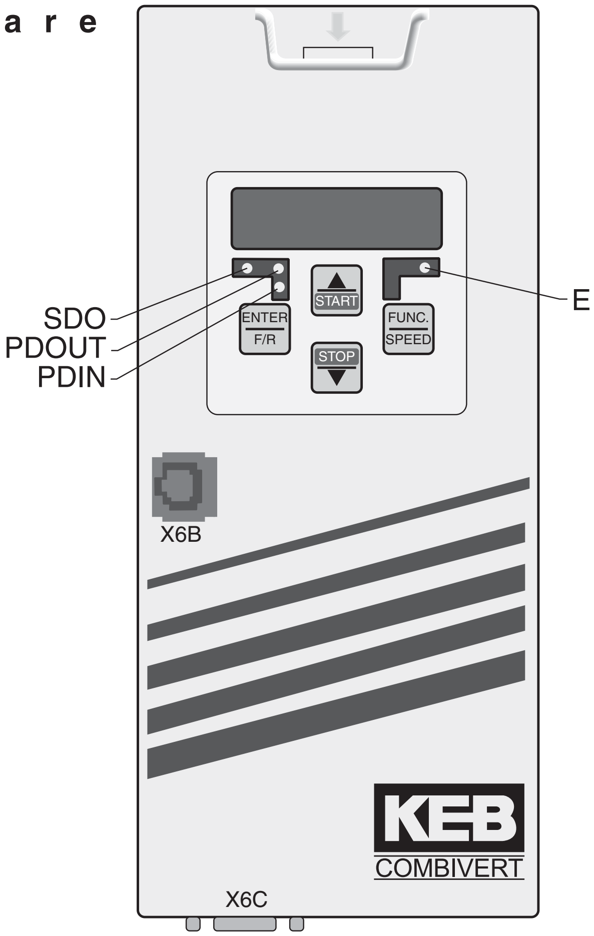
3. F5 CAN Operator

KEB-Antriebstechnik develop, produce and sell static frequency inverters worldwide in the industrial power range. The inverters of type **F5** can be equipped optionally with a **CAN** (**C**ontroller-**A**rea-**N**etwork)-interface. It concerns an intelligent interface, that controls the access to the parameters of the frequency inverter via CAN.

The F5-CAN-operator is integrated into the FI-housing by simple plug-in and fits into all KEB-F5-frequency inverters. Parallel to the fieldbus operation the operation over the integrated display/keyboard as well as another interface for diagnosis/parameterization (KEB Combivis) is possible.

⚠ For programming the KEB-F5-inverter by CAN the user requires in additon to this manual the instruction manual of the respective frequency inverter control [1].

4. Hardware Description



<u>Keyboard and display only at 00.F5.060-5010 and 00.F5.060-5011</u>

SDO: (green) SDO-communication active

PDOUT: (green)
- PDOUT-data are written to the FI-control.

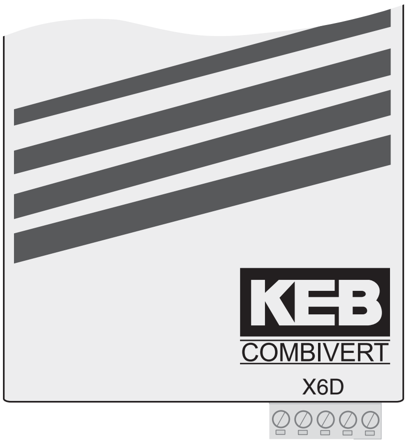
PDIN: (green)
- PDIN-data are read by the FI-control.
- Flashes up briefly after a Reset-command via CAN.

E (red):

ON	==>	inverter ready for operation
Flashing	==>	inverter in error
OFF	==>	no supply voltage

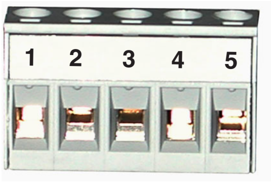
X6B: Diagnostic interface to the PC (see chapter 4.1)

X6C: CAN-interface (female connector)



<u>Alternativley available with teminal strip</u>

X6D: CAN interface as 5pole terminal strip (optional available)



Pin assignment X6D:

Pin	Signal
1	V- (reference potential for external power supply)*
2	CAN_L
3	Shield
4	CAN_H
5	V+ (external power supply) *

* not connected here

4.1 Diagnostic Interface

⚠ To prevent the desctruction of the PC-interface, the diagnostic interface must be connected to the PC with a special HSP5-cable with voltage adaption only!

A HSP5-cable is connected to the diagnostic interface via an adapter (see chapter 2 order designation). Over the PC software KEB COMBIVIS 5 normal access to all inverter parameters exists now. The internal Operator-Parameters can also be read and, in part, adjusted or parameterized by means of Download. Also the operator internal parameters can be read out and partly adjusted or parameterized with download.

4.2 CAN Interface

The CAN-interface consists off a D-SUB-9-pole-pin connector (according to DIN41652 part 1). Assignment of the CAN-connector according to [2]:

Pin	Signal	Description
1	-	reserved
2	**CAN_L**	**CAN-Bus signal dominant low**
3	CAN_GND	not connected here
4	-	reserved
5	(CAN_SHLD)	not connected here
6	(GND)	not connected here
7	**CAN_H**	**CAN-Bus signal dominant high**
8	-	reserved
9	(CAN_V+)	not connected here

Transmission level on CAN: according to ISO/DIS 11898, ISO-High Speed

Transmission rate on CAN: adjustable via CAN (10, 20, 25, 50, 100, 125, 250, 500, 800, 1000 Kbit/s)

Potential separation: Safe disconnection according to VDE0160.

Bus termination: 124 Ohm , must be made externally (between Pin 2 and 7).

5. Basics of the CAN-BUS

Here we like to introduce the system of the **CAN** (**C**ontroller-**A**rea-**N**etwork)-BUS and also explain some terms that are frequently used in the following.

The CAN is a **Multi-Master-System**, i.e. each user has access to the BUS and can send telegrams. So that no invalid conditions occur during the simultaneous access of two users, the CAN-BUS knows a so-called arbitration phase, that defines the telegram beginning. In the case of access conflicts all users recognize during this arbitration, who is sending the lowest telegram number (identifier). That user can then continue to send his telegram completely, without having to start from the beginning again. Now all other (willing-to-send) users pass over into the status receive and abort their telegram for the time being. Thus it is specified that the lower telegram numbers automatically have priority over higher numbers. The number of telegram numbers is limited to 2032 identifier (0...2031) at the CAN version 2.0A.

The CAN telegrams can contain max. 8 byte user data.

The term **logical CAN-Master** used in the following, refers to the CAN-user, who is responsible for the control of the entire CAN-System. Even if there are physically only Masters at CAN, in most applications there will be one or several users who exercise control. In this combination the KEB-frequency inverter is considered as recipient of orders (logical Slave).

6. Functions

The CAN-protocol is uniformly standardized for the data backup layer. The processing of this protocol is taken over completely by a CAN-controller. Furthermore, the **C**AN **i**n **A**utomation association **(CiA)** has passed a standard for the higher protocol layer that was named **C**AN **A**pplication **L**ayer **(CAL)**. Based on this standard the **„CAL-based Communication Profile“** (CiA,DS301) was published in September 1995. This standard provides the basis for all **CANopen**-Unit-Profiles. In this standard a certain subset of the CAL-standard is selected. The communication profile defines, among other things, a **Minimum Capability Device**. That is the minimum required functionality, which a CANopen-node must make available. The present CAN-interface connection realizes such a Minimum Capability Device.

An important point for every CAN-network is the assignment of the telegram numbers (Identifier), especially since the numbers are limited to 2032 CAN V2.0 A. In the CAL-standard an own procedure has been defined, which processes this assignment dynamically over an own protocol. This relative complex procedure for the assignment of identifiers is not mandatory for a Minimum Capabiltity Device and is not integrated into the KEB-CAN-interface connection . For this case a more simpler procedure for the arrangement of the identifier assignment is defined in the communication profile. This procedure is also supported by the KEB-CAN-interface connection and looks as follows:

Each frequency inverter receives an explicit CAN-address, the **Node_Id.** KEB provides two possibililties for the source of this Node_Id.

- If the value of the parameter OP_Node_Id has the value 255(dec):
  ==> Node_Id = inverter address (SY.06) +1
- In all other cases the value of the parameter OP_Node_Id itself specifies the value of the Node_Id:
  ==> Node_Id = OP_Node_Id

On delivery all KEB-frequency inverters have the inverter address = 1. In case several KEB-frequency inverters shall be networked over CAN, they all must first receive different inverter addresses . This is done, e.g. over the keyboard of the Operator.

Six identifiers are assigned to each frequency inverter.

Over an identifier any CAN-node can request the reading or writing of a parameter value **(Request-Identifier)**.

A further identifier is reserved for the appropriate response of the frequency inverter **(Response-Identifier)**. The mechanism of request and response is also referred to as **acknowledged service**. TheCANopen-communication profile combines these functions under the term **Service-Data-Object (SDO)**:

SDO(rx) = Request-Identifier	= 1536+Node_Id
SDO(tx) = Response-Identifier	= 1408+Node_Id

Example:	Node_Id= 30	==>	Write/read requests over Identifier = 1566(dec)
		==>	Write/read requests over Identifier = 1438(dec)

Note: Basically the function of the SDO is completely sufficient to control the KEB F5 - frequency inverter by CAN. Each parameter value in the inverter can be changed or inquired herewith.

Over the 3rd identifier the CAN-Master can give the frequency inverter unaddressed and unacknowledged data . In dependence on the data direction from the Master to the Slave, it is referred to in the following as **OUT1-Identifier**.
Over the 4th identifier the frequency inverter now passes new data unadressed and unacknowledged to the CAN-Master **(IN1-Identifier)**. This function is called **Process-Data-Object (PDO)** by the communication profil. The two object parts are named PDO1(rx) and PDO1(tx).
Diese Funktionalität wird vom Kommunikationsprofil als **Process-Data-Object (PDO)** bezeichnet. Die beiden Objektteile werden mit PDO1(rx) und PDO1(tx) benannt.

PDO1(rx) = Out-Identifier	= 512 + Node_Id
PDO1(tx) = IN-Identifier	= 384 + Node_Id

Starting with the Software-version 1.3 the PDO-functionality exists twice in the KEB F5-CAN-interface connection. This so-called 2. PDO occipies the identifier five to six:

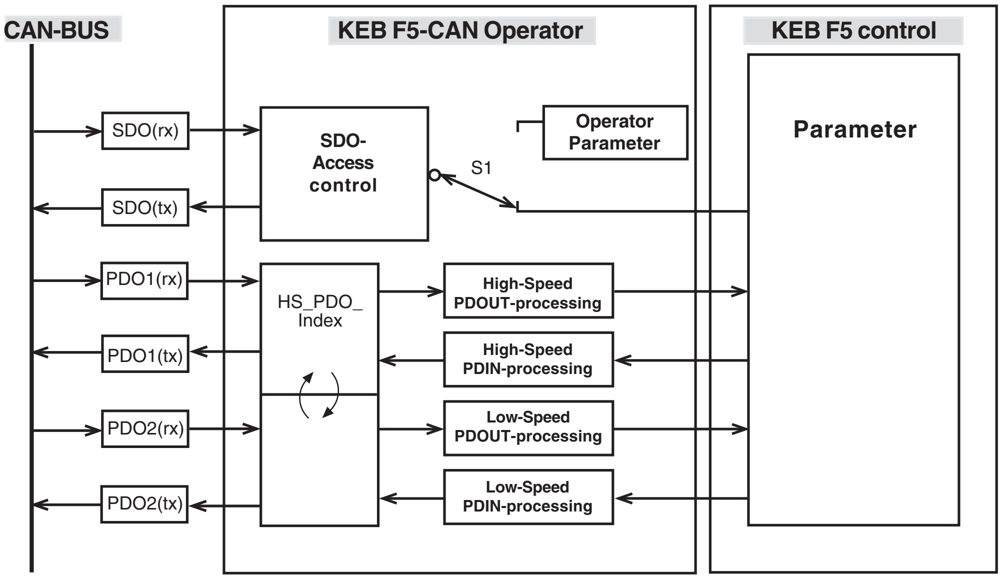
PDO2(rx) = Out-Identifier	= 768 + Node_Id
PDO2(tx) = IN-Identifier	= 640 + Node_Id

Over the 5th identifier the CAN master can give the frequency inverter unaddressed and unacknowledged data. In dependence on the data direction from the Master to the Slave, it is referred to in the following as **OUT2-Identifier**.

Over the 6th identifier the frequency inverter now passes new data unaddressed and unacknowledged to the CAN-Master **(IN2-Identifier).**

The two PDO's are with regard to the management identical but differ clearly in the form of internal processing. Only one of the two can be processed, like in the previous Software-versions as High-Speed-PDO. With regard to the processing the added PDO is on equal terms with the SDO-commands and is referred to as Low-Speed-PDO. It is adjustable, which of the two PDO's is to be the High-Speed-PDO. Just as before the first PDO 'High-Speed' and the second PDO are disabled when the goods are shipped. Therefore it is not necessary to alter existing CAN-Applications.

The CAN-interface connection controls the flow of data from CAN-BUS (SDO(rx), PDO1(rx) and PDO2(rx) up to the frequency inverter-control and also from the frequency inverter to the CAN-BUS (SDO (tx), PDO1(tx) and PDO2(tx):



The above Fig. shows the function of the CAN-interface connection. The position of the switch **S1** is exclusively defined by the parameter address (16 Bit Index plus 8 Bit Subindex) contained in the CAN-SDO(rx)-telegram. Within a certain Index-range lie the so-called configuration data of the CAN-interface connection. These parameters define the behaviour of the CAN-interface connection and therefore are realized in this. Access to parameters in the Index-range 2000(hex) to 5EFF(hex) are passed on as write/read requests to the inverter-control.

6.1 Characteristic of the High-Speed-PDO

- The Process data mapping is located in the inverter-control. The corresponding parameters are in the system-parameter group (SY). Since the coding of the PD-mapping of the inverter differs from CANopen, it is automatically converted by the CAN-operator accordingly.
- The setting of new process output data by CAN is converted by only one special process data service to the inverter-control.
- The minimum cycle time for new process output data is circa 3ms.
- The cyclic reading of process input data is executed by only one special process data-read service.
- The minimum achievable cycle time for the reading of process input data is circa 3ms.
- Not all parameters of the inverter-control can be mapped onto the High-Speed-PDO.

6.2 Characteristic of the Low-Speed-PDO

- Process data mapping is exclusively managed by the CAN-operator.
- The setting of new process output data by CAN is converted to ‘n’ single services (like SDO-commands) to the inverter-control, at that ‘n’ corresponds to the number of mapped parameters in the PDO-mapping.
- The minimum cycle time for new process output data is circa ‘n’ * 5 ms.
- The cyclic reading of process input data is executed by ‘n’ single read services, at that ‘n’ corresponds to the number of mapped parameters in the PDO-mapping.
- The minimum achievable cycle time for the reading of process input data is circa ‘n’ * 5 ms.
- All parameters of the inverter-control can be mapped onto the Low-Speed-PDO.

6.3 Process data mapping

The definition of the target for the data in the PDO(rx)-telegrams respectively the source for the data in the PDO(tx)-telegrams completely abides by the regulations of the CANopen-communication profile [12]. Here a complex structured object (parameter) defines the PDO-mapping for every data direction.

Another object per data direction defines the communication definition (PDO Communication Parameter). See parameter description of

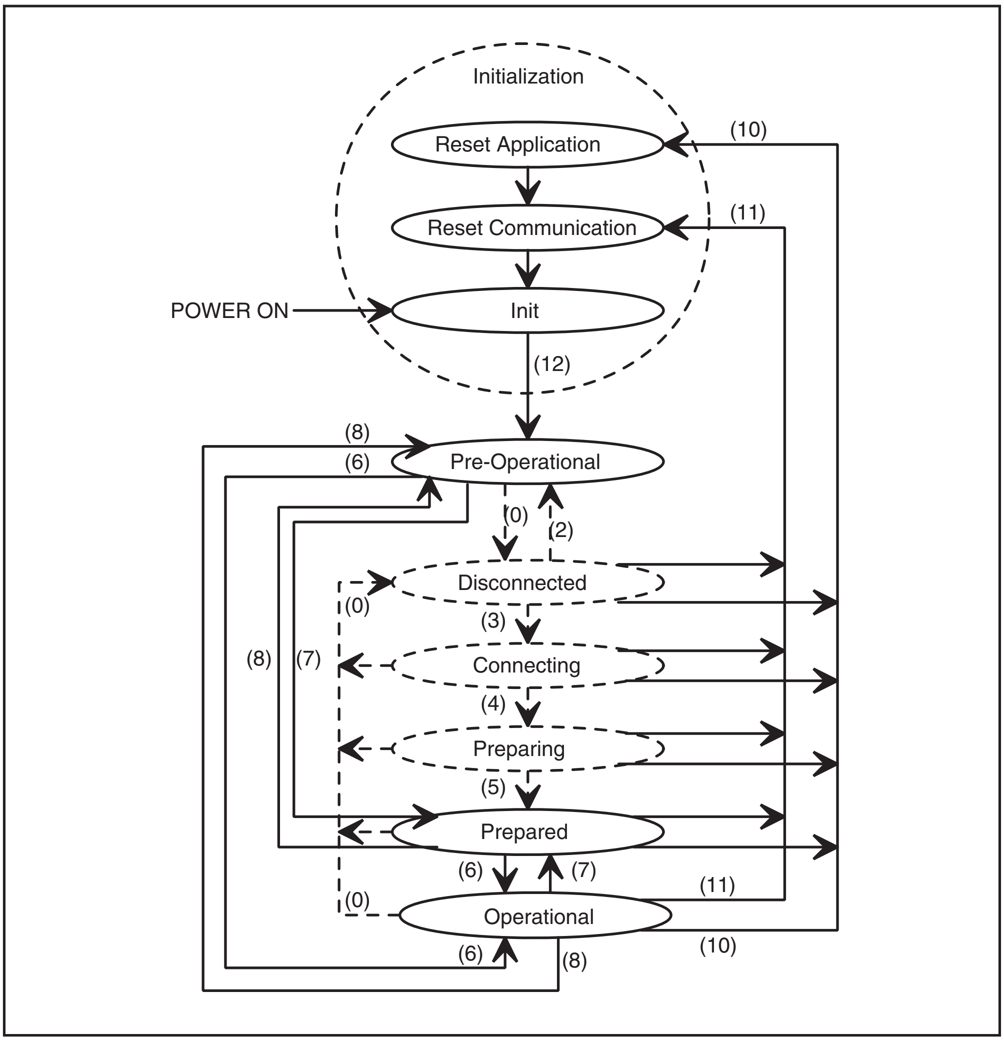
- **1st receive PDO mapping**
- **1st transmit PDO mapping**
- **1st receive PDO parameter**
- **1st transmit PDO parameter**

- **2nd receive PDO mapping**
- **2nd transmit PDO mapping**
- **2nd receive PDO parameter**
- **2nd transmit PDO parameter**

in this Instruction Manual.

6.4 CANopen Bootup-sequence

After the initialization phase the KEB-CAN-interface connection goes automatically into status **Pre-Operational.** In this status the communication over SDO(rx) and SDO(tx) with the services Domain Download (Parameter write) and Domain Upload (Parameter read) is already activated. Only the process data communcation is still inactive in this status. It is released by the NMT-command Start_Remote_Node() (Fig.). The goal of this start sequence is the operating condition **Operational.** In this status the communication is completely activated. With the NMT-protocol certain CAN-nodes are addressed by the above mentioned **Node-Id.**



The KEB-CANopen-interface connection realizes following transitions, illustrated in the above diagram by a solid line:

6: Start_Remote_Node()

CAN-telegram:

Identifier = 0	
01h	Node-Id
B0	B1

Node_Id = 0 (all NMT-Slaves are addressed) or
Node_Id = inverter-address + 1 (only 1 frequency inverter is addressed)

7: Stop_Remote_Node()

CAN-telegram:

Identifier = 0

02h	Node-Id
B0	B1

Node_Id = 0 (all NMT-Slaves are addressed) or
Node_Id = inverter-address + 1 (only 1 frequency inverter is addressed)

8: Enter_Pre-Operational_State()

CAN-telegram:

Identifier = 0

80h	Node-Id
B0	B1

Node_Id = 0 (all NMT-Slaves are addressed) or
Node_Id = inverter-address + 1 (only 1 frequency inverter is addressed)

10: Reset_Node(): During the execution of this function a Software-Reset is carried out in the KEB-CAN-interface connection.

CAN-telegram:

Identifier = 0

81h	Node-Id
B0	B1

Node_Id = 0 (all NMT-Slaves are addressed) or
Node_Id = inverter-address + 1 (only 1 frequency inverter is addressed)

11: Reset_Communication(): function like at Reset_Node().

CAN-telegram:

Identifier = 0

82h	Node-Id
B0	B1

Node_Id = 0 (all NMT-Slaves are addressed) or
Node_Id = inverter-address + 1 (only 1 frequency inverter is addressed)

12: Enter Pre-Operational automatically(): see above

6.5 Bootup-Message

The KEB-F5-CAN-operator releases a Bootup-Message, if the initialization phase is completed after POWER ON. It is a telegram to identifier = 1792 + Node_Id with the data length = 1 and the value = 0.

6.6 Node-Guarding

A protocol is provided in [12], with which a CAN-node can inquire the current status of any node. It belongs to the network management-functionality (NMT) of the CAN-node and is referred to as Node-Guarding . The KEB-CANopen-interface connection supports the Node-Guarding. The Node-Guarding request is deposited on the Node-Guarding-Identifier by a Remote-Frame. The response arrives as data telegram with 1 Byte data on the same identifier. The data byte contains the node-status plus a toggle bit (MSBit), which is inverted from message to message. Each node has its special Node-Guarding-Identifier.

At the Minimum Capability Device this identifier is a direct result from the Node-Id:

Node-Guarding-Identifier = 1792 + Node-Id

Value of the node-status	significance
1	DISCONNECTED
2	CONNECTING
3	PREPARING
4	PREPARED
5	OPERATIONAL
127d	PRE_OPERATIONAL

6.7 Life-Guarding

The F5-CANopen-operator supports the Life-Guarding. It concerns the monitoring of the cyclic guarding of the CAN-Master. For that reason the Life-Guarding should be activated only with the cyclic Node-Guarding. The Life-Guarding operates completely detached from all other monitoring functions. It is activated by the product of the two parameter values Guard Time and Life Time Factor. Shows the product = 0, then the Life-Guarding is not activated. Otherwise the product specifies the Life-Guarding-Timeout time. With activated Life-Guarding the Node-Guarding monitoring starts as soon as the first Node-Guard-Request is received. The function, that is executed upon occurrence of the Life-Guarding-Timeout case, is adjustable by two further parameters (LifeGuardTout_Addr, LifeGuardTout_Data). It concerns on one hand a write access to any parameter in the inverter-control and on the other hand a function code that defines, which action shall be executed in the operator. On delivery the CAN-operator is adjusted in such a way, that on occurrence of Life-Guarding-Timeout the value 1 is written in Set0 of the parameter SY.50 (control word). In addition the CAN-Operator switches into the state Pre_Operational.

6.8 Emergency Object

The CANopen-communication profile DS301 defines a mechanism, after which the nodes signal independently, if the event of important incidents. This Emergency-Message is also supported by the KEB-F5-CANopen-operator. The function is deactivated in the default setting. The Emergency-Message is activated by changing the parameter EmergencyCycle to a value unequal 0. Then the CAN-operator reads during this cycle time the value of the parameter Inverter Status (RU.00) from the inverter-control and converts it into the ErrorCode-Value after [13]. Has the value changed an Emergency-Message is send to Identifier 128d + Node_Id. That means, that the transition from an error state to normal operating conditions is also announced by an Emergency-Message. The contents of the telegram is only in part firmly set by the profile. All in all the contents of the Emergency-Message looks as follows at the KEB-F5-CAN :

Identifier = 128 + Node_Id

B0	B1	B2	B3	B4	B5	B6	B7
Error Code		Error-Register	Inverter status		00h	00h	00h
LB	HB		LB	HB			

All errors are stored in the ‚Pre-defined Error Field‘ defined by the profile. At the KEB-F5-CANopen-operator this field contains maximal five entries. Whereby the first entry always contains the last error that occurred. Please take the coding of the entries from the description of the parameter of the same name.

7. Coding of the data in the four CAN-telegram-types

Over this telegram the logical CAN-Master can inquire (read) or change (write) the value of aa parameter. In the communication profile a write-service is referred to as **Domain Download** and a read-service as **Domain Upload**. The KEB-CAN-interface connection supports only the short form of these two services, thus only one telegram can be exchanged for the service request and another for the service acknowledgement between logical CAN-Master and the KEB-CAN-interface connection.

7.1 SDO(rx)-telegram

The addressing of the parameter is done over an unsigned 16-Bit-Index plus the unsigned 8-Bit-Subindex. The parameters of the frequency inverter-control lie in the index range 2000(hex) to 5EFF(hex). The CAN-Index is a result of the parameter-address (see parameter description of the employed FI-control) by adding the Offset 2000(hex):

CAN-Index = KEB-Parameter-address + 2000(hex)

The subindex serves as additional addressing for complex parameters of the operator. It can also be used for the set-addressing of parameters of the frequency inverter-control. The following applies:

Subindex = 0

For set-programmable parameters the value of the parameter FR.09 specifies the selected set.

Subindex unequal 0

For set-programmable parameters the subindex specifies the selected set. Keep in mind that the set is bit-coded. Thus it is possible to change the value of the parameters in several sets at the same time during the writing. If during the reading several sets are addressed at the same time, then the value of the parameter is returned only under the provision that it is the same in all addressed sets. In case not all values are equal an error signal is returned.

Subindex (if unequal 0):

set 7	set 6	set 5	set 4	set 3	set 2	set 1	set 0
B7	*B6*	*B5*	*B4*	*B3*	*B2*	*B1*	*B0*

7.1.1 Initiate Domain Download Request (write request of the Master)

7......3....0	7....0	15..8	7...........0	7.......0	15.....8	23....16	31...24
0010nn1s	Index LB	HB	Sub- Index	LSB	Data		
B0	B1	B2	B3	B4	B5	B6	B7

nn: Only valid with s=1: Contains the number of Bytes of the data-field, that contains no data.

s: If it is equal 1, then nn contains the number of Bytes in the data-field, that contains no data.
Otherwise no display of the data length in nn.

Index: 16-Bit (unsigned) addressing of the parameter (see above).

Subindex: 8-Bit (unsigned) subaddressing for complex parameters and the direct set-addressing.

Data: Data to be transmitted. The LSByte is transmitted first.

7.1.2 Initiate Domain Upload Request (read reqquest of the Master)

7......3....0	7....0	15..8	7...........0				
01000000	Index LB	HB	Sub- Index	reserved			
B0	B1	B2	B3	B4	B5	B6	B7

Index: 16-Bit (unsigned) addressing of the parameter (see above).

Subindex: 8-Bit (unsigned) subaddressing for complex parameters and the direct set-addressing.

7.2 SDO(tx)-telegram

7.2.1 Initiate Domain Download Response (write acknowledgement from the FI)

This response is transmitted by the KEB-CAN-interface connection, if the requested write service was performed error-free.

Index: see above
Subindex: see above

7......3....0	7....0	15..8	7...........0				
01100000	Index LB	HB	Sub-Index	reserved			
B0	B1	B2	B3	B4	B5	B6	B7

7.2.2 Initiate Domain Upload Response (read acknowledgement from the FI)

This response is transmitted by the KEB-CAN-interface connection, if the requested read service was performed error-free.

nn: see above
s: see above
Index: see above
Subindex: see above
Data: see above

7......3....0	7....0	15..8	7...........0	7......0	15......8	23...16	31....24
0100nn1s	Index LB	HB	Sub-Index	LSB	Data		
B0	B1	B2	B3	B4	B5	B6	B7

7.2.3 Abort Domain Transfer (error response from the FI)

This response is transmitted by the KEB-CAN-interface connection, if the requested write or read service could not be carried out. In this case an error description is returned.

7......3....0	7....0	15..8	7...........0	7......0	15....8	7......0	7......0
10000000	Index LB	HB	Sub-Index	Additional-Code LB	HB	Error-Code	Error-Class
B0	B1	B2	B3	B4	B5	B6	B7

Error-Class	Error-Code	Additional-Code	Significance
6	1	0000h	Invalid access to a parameter, e.g. Writing to a Read_Only-Parameter.
6	1	0010h	Invalid password.
6	1	0011h	Operation not possible.
6	4	0000h	The addressed parameter does not exist.
6	4	0041h	Invalid PD-assignment.
6	6	0000h	The internal communication between operator and FI-control is malfunctioning.
6	7	0010h	Data length invalid.
6	9	0011h	Invalid Subindex.
6	9	0012h	Language identifier invalid.
6	9	0030h	The written value lies outside the valid value range.
8	0	0022h	Inverter busy.

7.3 PDO1(rx)-telegram

With this telegram the logical CAN-Master transfers new process output data to the inverter. With the default setting the KEB-CAN-interface connection expects a telegram of ≥ 4 Byte data with following content:

7..........0	15.......8	7.........0	15.......8
Control word		Setpoint speed	
LB	HB	LB	HB
B0	B1	B2	B3

The length and assignment of the PDO1(rx)-telegram can be changed by different operator-parameters. This change can be made only by the SDO(tx)-telegram (see above).

Following operator-parameters affect the structure of the process output data:

- 1st receive PDO Mapping
- 1st receive PDO Parameter

7.4 PDO1(tx)-telegram

With this telegram the KEB-CAN-interface connection announces process input data to the (logical) CAN-Master.

The length, assignment and control of this telegram is affected by following operator-parameters:

- 1st transmit PDO Mapping
- 1st transmit PDO Parameter

The default setting produces following telegram structure:

7..........0	15........8	7........0	15........8
Status word		Actual speed	
LB	HB	LB	HB
B0	B1	B2	B3

7.5 PDO2(rx)-telegram

With this telegram the logical CAN-Master transfers new process output data to the inverter. With the default setting the KEB-CAN-interface connection expects a telegram of ≥ 4 Byte data with following content:

7..........0	15.......8	7.........0	15.......8
Control word		Setpoint speed	
LB	HB	LB	HB
B0	B1	B2	B3

The length and assignment of the PDO2(rx)-telegram can be changed by different operator-parameters . This change can be made only by the SDO(tx)-telegram (see above).

Following operator-parameters affect the structure of the process output data:

- 2nd receive PDO Mapping
- 2nd receive PDO Parameter

7.6 PDO2(tx)-telegram

With this telegram the KEB-CAN-interface connection announces process input data to the (logical) CAN-Master.

The length, assignment and control of this telegram is affected by following operator-parameters:

- 2nd transmit PDO Mapping
- 2nd transmit PDO Parameter

The default setting produces following telegram structure:

7..........0	15........8	7........0	15........8
Status word		Actual speed	
LB	HB	LB	HB
B0	B1	B2	B3

8. Operator Parameters

Legend

Parameter name	Object-type	**CAN-SDO-Index**

8.1 Parameter defined Parameter

These parameters define the configuration of the KEB F5-CAN-interface connection and therefore are realized here and not in the frequency inverter control:

PD_Stored — Single variable (Var) — 5FE2h

Subindex: 0
Data Length: 1 Byte
Access: READ_WRITE
Meaning: Determines whether the current process data assignment is read from the EEPROM or processed with the Standard-PD-assignment.
Coding:
FFh ==> works with the saved PD-assignment
sonst ==> works with the Standard-PD-assignment.
Default Setting: FFh
Notice: A changed value takes effect immediately and is stored non-volatile.

OP_NodeId — Single variable (Var) — 5FE3h

Subindex: 0
Data Length: 1 Byte
Access: READ_WRITE
Significance: Enables the setting of the CANopen-node-address in the CAN-operator, independent of the inverter-address.
Coding:
255: As hitherto the node-address is defined from the inverter-address (ud.06):
Node_Id = inverter-address + 1
1...127: The node-address is maintained in the operator and stored:
Node_Id = OP_NodeId
Default Setting: 255
Notice: A value change is effective immediately and stored non-volatile.

Watchdog Activation — Single variable (Var) — 5FDAh

SDO-Subindex: 0

Data Length: 1 Byte

Access: READ_WRITE

Meaning: Enables the delay of the activation of the Fieldbus-Watchdog after POWER On respectively a Reset-command via CAN.

Coding: 0: The Fieldbus-Watchdog is active immediately.

Values unequal zero are bit-coded and have following significance:

Bit0: Activation of the Fieldbus-Watchdog after the first SYNC-telegram
Bit1: Activation of the Fieldbus-Watchdog after the first Node-Guarding
Bit2: Activation of the Fieldbus-Watchdog after the first transition into the node-status OPERATIONAL
Bit3: Activation of the Fieldbus-Watchdog after the first PDOUT1-telegram
Bit4: Activation of the Fieldbus-Watchdog after the first PDOUT2-telegram
Bit5: Activation of the Fieldbus-Watchdog after the first SDO-telegram

Default Setting: 0

Permitted PDO-mapping: no mapping

Notice: A value change is effective immediately and stored non-volatile. Several occurrences can be defined as Fieldbus-Watchdog-activation. In that case Watchdog becomes active as soon as one of the defined occurrences takes place.

B7	B6	B5	B4	B3	B2	B1	B0
		1. SDO	1. PDOUT2	1. PDOUT1	1. OPERA-TIONAL	1. Node-Guarding	1. SYNC

Watchdog Inhibit — Single variable (Var) — 5FF9h

Subindex: 0

Data Length: 1 Byte

Access: READ_WRITE

Significance: Defines upon which events the Fieldbus-Watchdog is triggered. The Fieldbus-Watchdog is used to put the frequency inverter into the error status, if no more activities take place on CAN. The real activation and programming of Watchdog is adjusted in the FI-control. Take the parameters to be adjusted from the instruction manual of the FI-control.

Coding: bit-coded:

Bit 0 = 1

When starting a PDOUT-telegram to the FI-control the Watchdog is reset. Note, that the occurrence of this event also depends on the adjustment of the parameter 1st Receive PDO Parameter.Tx_type as well as on the value of the parameter PDOUT_Wr_Mode.

Bit 1 = 1

At the beginning of the processing a SDO-job the Watchdog is reset.

Bit 2 = 1

If the node does not detect any transmission problems onto CAN, the Watchdog is reset.

Bit 3 = 1

At every receipt of a SYNC-telegram the Watchdog is reset.

Bit 4 = 1

At every receipt of a Node-Guard-Request-telegram the Watchdog is reset.

Bit 5 = 1

At every receipt of a SYNC-telegram the Watchdog is reset, provided that at least once process output data have been transmitted to the frequency inverter control.

Default Setting: 07h

The Watchdog is always reset, if:

- process output data are written to the FI-control,
- an SDO-job is started and
- no transmission problems to CAN are detected.

Notice: A changed value takes effect immediately and is stored non-volatile.

PDOUT_WrMode — Single variable (Var) — 5FE4h

Subindex: 0
Data Length: 1 Byte
Access: READ_WRITE
Significance: Defines the conditions under which PDOUT-data is written to the FI-control. Herewith the communication between CAN-operator and FI-control can be relieved.
Coding:
0: All PDOUT-data are always written to the FI-control, regardless whether these are changed or not.
255: All PDOUT-data are always written to the inverter, if at least one of the values was changed.
Otherwise: Only the changed values are written.
Default Setting: 255
Notice: A value change is effective immediately and stored non-volatile.

HS_PDO_Index — Single variable (Var) — 5FE5h

Subindex: 0
Data Length: 1 Byte
Access: READ_WRITE
Significance: With this parameter it is defined which PDO should be the High-Speed PDO.
Coding:
0: 1.PDO is High-Speed-PDO
1: 2.PDO is High-Speed-PDO
Default Setting: 0
Notice: A changed value is stored non-volatile, but becomes active only after the next switch-on or Reset Node-command. Moreover, in case of a change of value all PDO's are deactivated (Bit 31 from PDO Parameter CobID = 1).

PDIN1_Cycle_Time — Single variable (Var) — 5FE6h

Subindex: 0
Data Length: 2 Byte
Access: READ_WRITE
Significance: Specifies the cycle time in which the process input data of the PDO1 are read in status OPERATIONAL by the FI-control.
Coding: 1 ms
Default Setting: 25 = 25ms
Notice: A changed value takes effect immediately and is stored non-volatile.

PDIN2_Cycle_Time — Single variable (Var) — 5FE7h

Subindex: 0
Data Length: 2 Byte
Access: READ_WRITE
Significance: Specifies the cycle time in which the process input data of PDO2 are read in status OPERATIONAL by the FI-control.
Coding: 1 ms
Default Setting: 100 = 100ms
Notice: A changed value takes effect immediately and is stored non-volatile.

SAVE_CAN_Baud

Single variable (Var) **5FFEh**

Subindex:	0
Data Length:	1 Byte
Access:	READ_WRITE
Significance:	Serves for the non-volatile storing of the adjusted CAN-transmission rate.
Coding write:	FFh = Non-volatile storing of CAN_Baud
	0 = no storing
Coding read:	FFh = Adjusted value corresponds with the stored value
	00h = adjusted value is not equal to stored value

CAN_Baud

Single variable (Var) **5FFFh**

Subindex:	0	
Data Length:	1 Byte	
Access:	READ_WRITE	
Significance:	Index for CAN-transmission rate	
Coding:	0 = 10 Kbit/s	5 = 250 Kbit/s
	1 = 20 Kbit/s	6 = 500 Kbit/s*
	2 = 50 Kbit/s	7 = 1000 Kbit/s*
	3 = 100 Kbit/s	8 = 800 Kbit/s*
	4 = 125 Kbit/s	9 = 25 Kbit/s
Default Setting:	1	
Notice:	A changed value takes effect immediately but is not automatically stored non-volatile. The Bit-Timing abides by the specifications of the working committee Physical-Layer der CiA [2]. See Annex regarding Bit-Timing. What kind of transmission rates are possible depends on the line length, the sum of the deceleration times and the Bit-Timing and must be cleared up for each individual case.	

CAN_Baud2

Single variable (Var) **5FECh**

Subindex:	0	
Data Length:	1 Byte	
Access:	READ_WRITE	
Significance:	Index for CAN-transmission rate alternatively to CAN_Baud (s.o.)	
Coding:	0 = 10 Kbit/s	5 = 250 Kbit/s
	1 = 20 Kbit/s	6 = 500 Kbit/s*
	2 = 50 Kbit/s	7 = 1000 Kbit/s*
	3 = 100 Kbit/s	8 = 800 Kbit/s*
	4 = 125 Kbit/s	9 = 25 Kbit/s
Default Setting:	1	
Notice:	Contrary to parameter CAN_Baud a changed value is immediately stored non-volatile, but becomes active only after a Reset Node-command or after the next switch-on.	

* Please observe chapter ‘Important Warning Notice’

8.2 Parameters defined by the communication Parameter

Device type (according to CANopen (13)) Single variable (Var) 1000h

Subindex: 0
Data Length: 4 Byte
Access: READ_ONLY
Significance: Decribes the unit type according to CANopen-communication profile.
Coding: No predefinition up to now.
Default Setting: 0
Notice: This parameter is constant, therefore it can be read only.

error register (according to CANopen (13)) Single variable (Var) 1001h

Subindex: 0
Data Length: 1 Byte
Access: READ_ONLY
Significance: Indicates the Error-Status of the CANopen-user.
Coding: Bit0 : = 1 ==> Error exists
Default Setting: 0
Notice: This parameter can be read only. The Inverter-Parameter status (Ru.00) serves as source for this parameter. The conversion of the Ru.00-values into values of the Error-Register is found in the table in the annex.
Note, the value of the Error-Register is updated only with activated Emergency-Processing (--> Emergency Cycle).

Manufacturer Status Register Single variable (Var) 1002h

SDO-Subindex: 0
Data Length: 4 Byte
Access: READ_ONLY
Meaning: Direct mapping of the parameter Inverter-Status (RU.00) in DS301-parameter range.
Coding: See description of the parameter Inverter-Status (RU.00) in the Instruction Manual of the inverter control.
Default Setting: 0
Permitted PDO-mapping:

High-Speed-PDO		Low-Speed-PDO	
rx	tx	rx	tx
NO	YES	NO	YES

Notice: Is mapped internally on the parameter RU.00.

Manufacturer Device Name — Single variable (Var) — 1008h

SDO-Subindex: 0
Data Length: 4 Byte
Access: READ_ONLY
Meaning: Outputs the value of the parameter Inverter_Identification (SY.02) of the FI-control as 4-character hexadecimal-string.
Coding: The value 1234h would be transferred in the SDO-Response-telegram as follows:

B4	B5	B6	B7
31h	32h	33h	34h

Default Setting: Depending on the inverter type
PDO-mapping: no mapping

Identify Object — Structured variable (Record) — 1018h

Subindex: 0 (Number of supported entries in the record)
Data Length: 1 Byte
Access: READ_ONLY
Significance: Specifies the number of entries in this object.
Coding: 1
Default Setting: 2
Notice: The value of this parameter can be read only.

Subindex: 1 (Vendor-ID)
Data Length: 4 Byte
Significance: Manufacturer identification assigned by the CAN in Automation User Group.
Coding: Bit31 . . . Bit24: Department
Bit23 . . . Bit0: Company
Default Setting: 00000014h
Notice: The value of this parameter can be read only.

Subindex: 2 (Product code)
Data Length: 4 Byte
Significance: Product description
Coding: 00000004h = Typ F4
00000005h = Typ F5
Default Setting: 00000005h
Notice: The value of this parameter can be read only.

Manufacturer Software Version — Single variable (Var) — 100Ah

SDO-Subindex: 0
Data Length: 4 Byte
Access: READ_ONLY
Meaning: Outputs the value of the parameter Software-Version (IN.06) of the FI-control as 4-character hexadecimal string.
Coding: The value 140h/260d (= version 2.60) would be transferred in the SDO-Response-telegram as follows:

B4	B5	B6	B7
30h	31h	30h	34h

Default Setting: Depending on the Software-Version of the inverter control.
PDO-mapping: no mapping

1st receive PDO Parameter — Structured variable (Record) — 1400h

Subindex: 0 (Number of supported entries in the record)
Data Length: 1 Byte
Access: READ_WRITE
Significance: Specifies the number of entries that can be addressed under this object.
Coding: 1
Default Setting: 2
Notice: The value of this parameter can be read only.

Subindex: 1 (COB-ID)
Data Length: 4 Byte
Significance: Indicates to which identifier the PDO(rx) for the transfer of the process output data is transferred. In addition to it control information for this PDO are contained in the higher Bits.
Coding:

Bit31(MSB)	= 0	==>	The processing of the process output data is activated.
Bit31(MSB)	= 1	==>	Processing of the process output data disabled.
Bit30	= 0	==>	Remote Frame on the corresponding Identifier is answered.
Bit30	= 1	==>	Remote Frame is not answered.
Bit29	= 0	==>	11-bit Identifier (CAN V2.0A)
Bit29	= 1	==>	29-Bit Identifier (CAN V2.0B), not adjustable here. But 29-Bit-Identifier-telegrams are received and processed.

Bit28...Bit0: Identifier (Bit0 = LSB), here for Bit28 to Bit11=fixed=0.

Default Setting: 00000200h + Node_Id
Notice: A changed value takes effect immediately and is stored non-volatile. When activating the process data processing (Bit31 from “1” to “0”) the setting of the parameter 1st Receive PDO mapping (Index = 1600h) is transferred to the inverter control. If the FI-control does not accept the mapping an error response is returned here and the process output data processing remains disabled. If the PD--mapping is accepted by the FI, it is automatically stored non-volatile and the process output data processing is enabled as desired. Since the identifier assignment of the PDOs is derived directly from the Node_Id, the Bits Bit28 to Bit0 can only be read. During writing these Bits are ignored.

Subindex: 2 (transmission type)
Data Length: 1 Byte
Significance: Defines, when and how this object is transmitted on the CAN-Bus.
Coding: **0 ... 240:**
On receipt of a SYNC-command (Identifier = 128d, data length = 0) the current process output data are transferred to the FI-control.
254 (asynchronous, manufacturer-specific):
The process output data are transferred to the FI-control as soon as at least one has changed.
255 (asynchronous, profile-specific):
See asynchronous, manufacturer-specific.
Notice: A changed value takes effect immediately and is stored non-volatile.
Please also consider the effect of the parameter PDOUT_WrMode.

2nd receive PDO parameter Structured variable (Record) 1401h

Subindex: 0 (Number of supported entries in the record)
Data Length: 1 Byte
Access: READ_WRITE
Significance: Specifies the number of entries that can be addressed under this object.
Coding: 1
Default Setting: 2
Notice: The value of this parameter can be read only.

Subindex: 1 (COB-ID)
Data Length: 4 Byte
Significance: Indicates to which identifier the PDO(rx) for the transfer of the process output data is transferred. In addition to it control information for this PDO are contained in the higher Bits.
Coding:
Bit31(MSB) = 0 ==> The processing of the process output data is activated.
Bit31(MSB) = 1 ==> Processing of the process output data disabled.
Bit30 = 0 ==> Remote Frame on the corresponding Identifier is answered.
Bit30 = 1 ==> Remote Frame is not answered.
Bit29 = 0 ==> 11-bit Identifier (CAN V2.0A)
Bit29 = 1 ==> 29-Bit Identifier (CAN V2.0B), not adjustable here. But 29-Bit-Identifier-telegrams are received and processed.
Bit28...Bit0: Identifier (Bit0 = LSB), here for Bit28 to Bit11=fixed=0.
Default Setting: 80000300h + Node_Id
Notice: A changed value takes effect immediately and is stored non-volatile. On activation of the process data processing (Bit31 from “1” to “0”) the setting of the 2nd Receive PDO mapping is converted to a corresponding inverter mapping. If this could be executed successfully, the mapping is automatically stored non-volatile. Since the identifier assignment of the PDOs is derived directly from the Node_Id, the Bits Bit28 to Bit0 can only be read. During writing these Bits are ignored.

Subindex: 2 (transmission type)
Data Length: 1 Byte
Significance: Defines, when and how this object is transmitted on the CAN-Bus.
Coding: **0 ... 240:**
On receipt of a SYNC-command (Identifier = 128d, data length = 0) the current process output data are transferred to the FI-control.
254 (asynchronous, manufacturer-specific):
The process output data are transferred to the FI-control as soon as at least one has changed. .
255 (asynchronous, profile-specific):
See asynchronous, manufacturer-specific.
Notice: A changed value takes effect immediately and is stored non-volatile.
Please also consider the effect of the parameter PDOUT_WrMode.

1st receive PDO mapping — Structured variable (Record) — 1600h

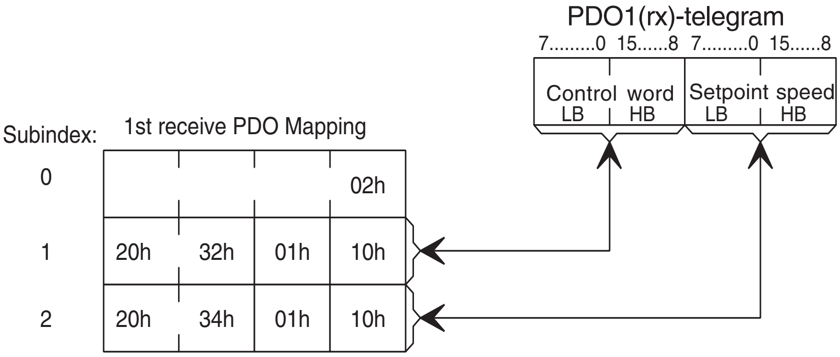
Subindex: 0 (Number of mapped objects in PDO)
Data Length: 1 Byte
Access: READ_WRITE
Significance: Specifies the number of entries that can be addressed under this object.
Coding: 1 (maximal valid value range 1......4).
Default Setting: 2
Notice: A writing of this parameter causes the automatic deactivation of the process output data processing (Bit31 of Index 1400h, Subindex = 1 is set to “1”).

Subindex: 1 to maximal 4 (nth object to be mapped)
Data Length: 4 Byte
Significance: Describes an object mapping. The Index, Subindex and the object length are specified in Bits.
Coding:

Index HB	*Index LB*	*Sub-Index*	Object-length
B3	*B2*	*B1*	*B0*

Default Setting: see below
Notice: A writing of this parameter causes the automatic deactivation of the process output data processing (Bit31 of Index 1400h, Subindex = 1 is set to “1”).

The correlation between process output data mapping and the corresponding PDO1(rx)-telegram structure is shown once more in the default-assignment:



Example for the coding the data on the CAN-BUS:

The first mapped object in the Receive-PDO shall not be the control word but Parameter with the Index 2302h and Subindex = 1. In this case the 8 Bytes of the Initiate-Domain-Download-Requests are to be filled as follows:

23h	00h	16h	01h	10h	01h	02h	23h
B0	B1	B2	B3	B4	B5	B6	B7

2nd receive PDO mapping

Structured variable (Record) **1601h**

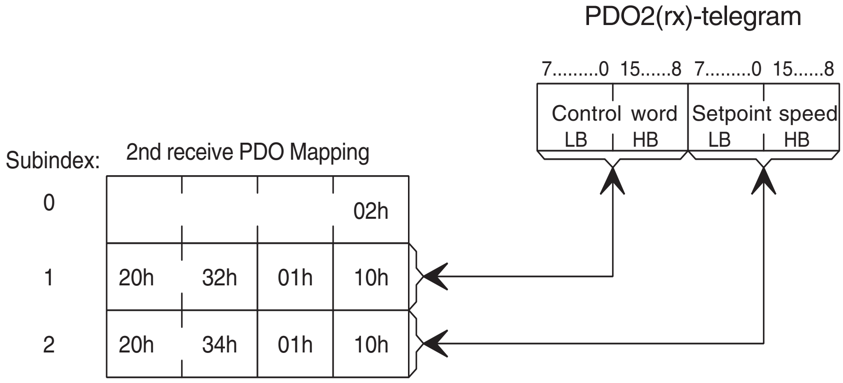
Subindex: 0 (Number of mapped objects in PDO)
Data Length: 1 Byte
Access: READ_WRITE
Significance: Specifies the number of entries that can be addressed under this object.
Coding: 1 (maximal valid value range 1......4).
Default Setting: 2
Notice: A writing of this parameter causes the automatic of the process output data processing (Bit31 of Index 1401h, Subindex = 1 is set to „1“).

Subindex: 1 to maximal 4 (nth object to be mapped)
Data Length: 4 Byte
Significance: Describes an object mapping. The Index, Subindex and the object length are specified in Bits.
Coding:

Index		*Sub-Index*	Object-length
HB	*LB*		
B3	*B2*	*B1*	*B0*

Default Setting: see below
Notice: A writing of this parameter causes the automatic deactivation of the process output data processing (Bit31 of Index 1401h, Subindex = 1 is set to “1”).

The correlation between the process output data mapping and the corresponding PDO2(rx)-telegram structure is shown once more in the default-assignment:



1st transmit PDO Parameter Structured variable (Record) 1800h

Subindex: 0 (Number of supported entries in the record)
Data Length: 1 Byte
Access: READ_WRITE
Significance: Specifies the number of entries in this object.
Coding: 1
Default Setting: 3
Notice: The value of this parameter can be read only.

Subindex: 1 (COB-ID)
Data Length: 4 Byte
Significance: Indicates to which identifier the PDO(tx) for the transfer of the process input data is transferred. In addition some additional information are contained in the higher Bits.
Coding:

```
Bit31(MSB) = 0  ==>  The processing of the process input data is active.
Bit31(MSB) = 1  ==>  Processing of the process input data disabled.
Bit30      = 0  ==>  Remote Frame on the corresponding Identifier is answered.
Bit30      = 1  ==>  Remote Frame is not answered.
Bit29      = 0  ==>  11-Bit-Identifier (CAN V2.0A)
Bit29      = 1  ==>  29-Bit Identifier (CAN V2.0B), not adjustable here.
Bit28...Bit0: Identifier (Bit0 = LSB), here Bit28 to Bit11=fixed=0.
```

Default Setting: 00000180h + Node_Id
Notice: A changed value takes effect immediately and is stored non-volatile. On activation of the process data processing (Bit31 from “1” to “0”) the setting of the parameter 1st transmit PDO mapping (Index 1A00h) is transferred to the inverter control. If the FI-control does not accept the mapping an error response is returned and the process input data processing remains switched off. If the FI accepts the PD-mapping it is automatically stored non-volatile and the process input data processing is activated as desired. Since the identifier assignment of the PDOs is derived directly from the Node_Id, the Bits Bit28 to Bit0 can only be read. During writing these Bits are ignored.

Subindex: 2 (transmission type)
Data Length: 1 Byte
Significance: Defines, when and how this object is transmitted on the CAN-Bus.
Coding: **0 (synchronous acyclic):**
At every receipt of a SYNC a PDO(tx)-telegram is transmitted on CAN.
1 - 240 (synchronous, cyclic):
In this setting range it is adjusted by means of the value, how many SYNC-telegrams must be received, before a PDO(tx)-telegram is transmitted on CAN.
252 (synchronous-RTROnly):
A PDO(tx)-telegram is only transmitted after a Remote-Request on the PDO(tx)-Identifier.
253 (asynchronous-RTROnly):
A PDO(tx)-telegram is only transmitted after a Remote-Request on the PDO(tx)-Identifier.
254 (asynchronous, manufacturer-specific):
A PDO(tx)-telegram is transmitted as soon as at least one Byte has changed.
255 (asynchronous, profile-specific):
A PDO(tx)-telegram is transmitted as soon as at least one Byte has changed.
Notice: A changed value takes effect immediately and is stored non-volatile.

Subindex: 3 (inhibit time)
Data Length: 2 Byte
Significance: Describes the minimal temporal distance between two CAN-telegrams on this Identifier.
Coding: 100 µs
Default Setting: 150 (= 15 ms)
Notice: A changed value takes effect immediately and is stored non-volatile. The internal resolution for the Inhibit-Time is 1ms. Thus the adjusted value has an inaccuracy of +/- 1 ms.

2nd transmit PDO Parameter Structured variable (Record) 1801h

Subindex: 0 (Number of supported entries in the record)
Data Length: 1 Byte
Access: READ_WRITE
Significance: Specifies the number of entries in this object.
Coding: 1
Default Setting: 3
Notice: The value of this parameter can be read only.

Subindex: 1 (COB-ID)
Data Length: 4 Byte
Significance: Indicates to which identifier the PDO(tx) for the transfer of the process input data is transferred. In addition some additional information are contained in the higher Bits.
Coding:
Bit31(MSB) = 0 ==> The processing of the process input data is active.
Bit31(MSB) = 1 ==> Processing of the process input data disabled.
Bit30 = 0 ==> Remote Frame on the corresponding Identifier is answered.
Bit30 = 1 ==> Remote Frame is not answered.
Bit29 = 0 ==> 11-Bit-Identifier (CAN V2.0A)
Bit29 = 1 ==> 29-Bit Identifier (CAN V2.0B), not adjustable here.
Bit28...Bit0: Identifier (Bit0 = LSB), here Bit28 to Bit11=fixed=0.
Default Setting: 80000280h + Node_Id
Notice: A changed value takes effect immediately and is stored non-volatile. On activation of the process data processing (Bit31 from “1” to “0”) the setting of the parameter 2nd transmit PDO mapping is converted into a corresponding inverter mapping. If this could be executed successfully, the mapping is automatically stored non-volatile. Since the identifier assignment of the PDOs is derived directly from the Node_Id, the Bits Bit28 to Bit0 can only be read. During writing these Bits are ignored.

Subindex: 2 (transmission type)
Data Length: 1 Byte
Significance: Defines, when and how this object is transmitted on the CAN-Bus.
Coding:
0 (synchronous acyclic):
At every receipt of a SYNC a PDO(tx)-telegram is transmitted on CAN.
1 - 240 (synchronous, cyclic):
In this setting range it is adjusted by means of the value, how many SYNC-telegrams must be received, before a PDO(tx)-telegram is transmitted on CAN.
252 (synchronous-RTROnly):
A PDO(tx)-telegram is only transmitted after a Remote-Request on the PDO(tx)-Identifier.
253 (asynchronous-RTROnly):
A PDO(tx)-telegram is only transmitted after a Remote-Request on the PDO(tx)-Identifier.
254 (asynchronous, manufacturer-specific):
A PDO(tx)-telegram is transmitted as soon as at least one Byte has changed.
255 (asynchronous, profile-specific):
A PDO(tx)-telegram is transmitted as soon as at least one Byte has changed.
Notice: A changed value takes effect immediately and is stored non-volatile.

Subindex: 3 (inhibit time)
Data Length: 2 Byte
Significance: Describes the minimal temporal distance between two CAN-telegrams on this Identifier.
Coding: 100 µs
Default Setting: 1000 (= 100 ms)
Notice: A changed value takes effect immediately and is stored non-volatile. The internal resolution for the Inhibit-Time is 1ms. Thus the adjusted value has an inaccuracy of +/- 1 ms.

1st transmit PDO mapping   Structured variable (Record)   1A00h

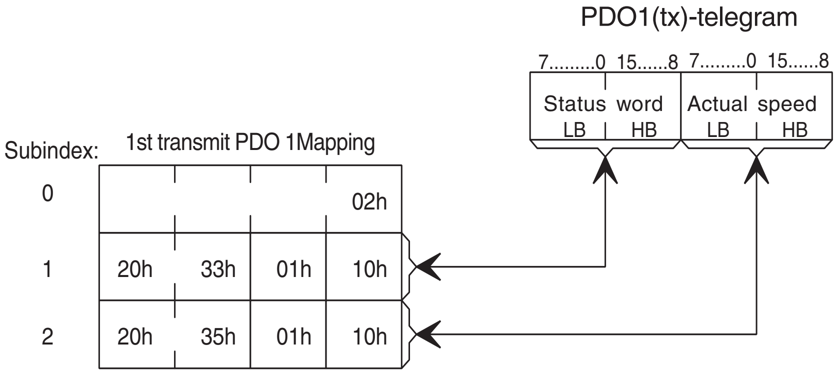
Subindex: 0 (Number of mapped objects in PDO)
Data Length: 1 Byte
Access: READ_WRITE
Significance: Specifies the number of entries that can be addressed under this object.
Coding: 1 (maximal valid value range 1......4)
Default Setting: 2
Notice: A writing of this parameter causes the automatic switch-off of the process input data processing (Bit31 of Index 1800h, Subindex=1 is set to “1”).

Subindex: 1 to maximal 4 (nth object to be mapped)
Data Length: 4 Byte
Significance: Describes an object mapping. The Index, Subindex and the object length are specified in Bits.
Coding:

Index		Sub-Index	Object-length
HB	LB		
B3	B2	B1	B0

Default Setting: see below
Notice: A writing of this parameter causes the automatic switch-off of the process input data processing (Bit31 of Index 1800h, Subindex=1 is set to “1”).

The correlation between the process input data mapping and the corresponding PDO1(tx)-telegram structure is shown once more in the default-assignment:



2nd transmit PDO mapping   Structured variable (Record)   1A01h

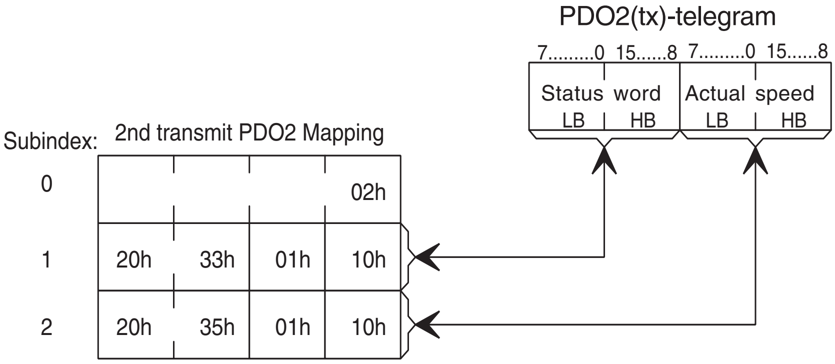
Subindex: <u>0 (Number of mapped objects in PDO)</u>
Data Length: 1 Byte
Access: READ_WRITE
Significance: Specifies the number of entries that can be addressed under this object.
Coding: 1 (maximal valid value range 1......4)
Default Setting: 2
Notice: A writing of this parameter causes the automatic switch-off of the process input data processing (Bit31 of Index 1801h, Subindex=1 is set to “1”).

Subindex: <u>1 to maximal 4 (nth object to be mapped)</u>
Data Length: 4 Byte
Significance: Describes an object mapping. The Index, Subindex and the object length are specified in Bits.
Coding:

Index		Sub-Index	Object-length
HB	LB		
B3	B2	B1	B0

Default Setting: see below
Notice: A writing of this parameter causes the automatic switch-off of the process input data processing (Bit31 of Index 1801h, Subindex=1 is set to “1”).

The correlation between the process input data mapping and the corresponding PDO2(tx)-telegram structure is shown once more in the default-assignment:



8.3 Parameter for the Life-Guarding

Guard Time

Single variable (Var) **100Ch**

Significance: Defines together with the Life Time Factor the monitoring time for the Life-Guarding.
SDO-Subindex: 0
Data Length: 2 Byte
Access: READ_WRITE
Coding: 0 = Life-Guarding switched off, otherwise: 1 ms
Permitted PDO-mapping: not mappable
Notice: A changed value takes effect immediately and is stored non-volatile.

Life Time Factor

Single variable (Var) **100Dh**

Significance: Defines together with the Guard Time the monitoring time for the Life-Guarding.
SDO-Subindex: 0
Data Length: 1 Byte
Access: READ_WRITE
Coding: 0 = Life-Guarding switched off, otherwise: 1
Permitted PDO-mapping: not mappable
Notice: A changed value takes effect immediately and is stored non-volatile.

LifeGuardTout.Addr

Single variable (Var) **5FDFh**

Significance: Defines together with the LifeGuardTout_Data the function, that is executed once after the Life-Guarding Timeout occurred.
SDO-Subindex: 0
Data Length: 4 Byte
Access: READ_WRITE
Coding: The value consists of the parameter-address to be written and the parameter-set as well as the function code for the operator. The mapping below shows the structure of the value, as it appears in the CAN-SDO-telegram:

B0	B1	B2	B3
opfunc	Set	Parameter address	
		LB	HB

opfunc = 0 --> no activity in the operator
1 --> Transition into Pre_Operational
Parameter-address: Address of the parameter to be written
Set: Set selection byte of the parameter to be written.

Permitted PDO-mapping: not mappable
Default Setting: Parameter-address = 0032h(SY.50)
Parameter-set = 1(Satz0)
Opfunc = 1: Transition into Pre_Operational
Notice: A changed value takes effect immediately and is stored non-volatile.

LifeGuardTout.data Single variable (Var) 5FDEh

Significance:	Defines the value of the inverter-parameter to be written in case Life-Guarding-Timeout occurs.
SDO-Subindex:	0
Data Length:	4 Byte
Access:	READ_WRITE
Coding:	Depending on the selected inverter-parameter.
Permitted PDO-mapping:	Not mappable
Default Setting:	1
Notice:	A changed value takes effect immediately and is stored non-volatile.

8.4 Parameter of the Emergency-processing

EmergencyCyle — Single variable (Var) — 5FDDh

Significance: Serves for the activation/deactivation of the Emergency-processing. The value also shows the cycle time, during which the value of the parameter Inverter Status is read, to indicate a possible error.

SDO-Subindex: 0

Data Length: 2 Byte

Access: READ_WRITE

Coding: 0 = switched off, otherwise: 1 ms

Permitted PDO-mapping: not mappable

Default Setting: 0 (switched off)

Notice: A changed value takes effect immediately and is stored non-volatile.

Pre-defined ErrorField — Field variable (Array) — 1003h

Significance: This field contains the last five error messages. The first error field (Subindex=1) always contains the error that occurred last. According to this, entries with higher subindex have occurred earlier.

SDO-Subindex: 0,1,2,3,4,5

Data Length: 4 Byte

Access: Subindex = 0 : Read_Write, otherwise: READ_ONLY

Coding: Subindex = 0 : Number of filled entries
Subindex ! = 0 :

B0	B1	B2	B3
ErrorCode		Inverter status	
LB	HB	LB	HB

Permitted PDO-mapping: not mappable

Default Setting: 0 (switched off)

Notice: Only the Subindex = 0 is writable. When writing with the value = 0 the entire field is reset.

8.5 Parameter for the Synchronous-Mode

ComCyle — Single variable (Var) — 1006h

Significance: Serves for the activation/deactivation of the synchronous-mode. The value is coded in µs, but has an internal resolution of 1ms.
SDO-Subindex: 0
Data Length: 4 Byte
Access: READ_WRITE
Coding: 0 = OFF (normal mode), otherwise: 1µs
Value range: 0, 1000, 2000, 3000 . . . 65000
Notice: The parameter is available only over CAN-SDO. The parameter is stored non-volatile and shows the value zero after every new start. The CAN-operator switches back automatically into the normal mode, if after four-times ComCycle-time no SYNC-telegram is received (also see HS_SyncToutDelay).

HS_SyncToutDelay — Single variable (Var) — 5FE0h

Significance: With this parameter the SYNC-Timeout monitoring can be delayed by the desired number of SYNCs.
SDO-Subindex: 0
Data Length: 2 Byte
Access: READ_WRITE
Coding: 0: The SYNC-Timeout monitoring is active immediately after change-over into the Synchronous-Mode.
Otherwise: Number of SYNC-telegrams until the Timeout monitoring becomes active.
Value range: 0. . . 65535
Notice: The parameter is stored non-volatile.

9. Access to Operator-Parameters over the Diagnostic Interface

The Operator-Parameters are managed in the operator itself. Access to these parameters is possible by the CAN-interface as well as by the Diagnostic Interface (per Combivis). Keep in mind, that a CAN-parameter is partly distributed onto several Operator-parameters and thus the outer appearance of a parameter on CAN and in Combivis can vary slightly. This chapter lists the Operator-parameters that are of relevance to the user with the reference to the corresponding CAN-parameter. The complete description is found in the chapter Operator-Parameter.

Following information to the addressing of Operator-parameters and parameters of the Inverter-control: All parameters of a KEB-inverter (FI-parameter + Operator-parameter) are addressed over the Diagnostic Interface with a 16-Bit parameter address plus 8-Bit set selection byte. For the parameter-address applies, that it is divided into the Parameter-group address (High Byte) and a consecutive number (Low Byte):
KEB-Parameter-address:

B15 B8	B7 B0
Group	Number

Every parameter-group can be occupied with operator-parameters as well as with parameters of the inverter-control. For the distinction of the localization of the parameters the consecutive „Number“ is divided into two ranges:

Number = 0 . . . 127 --> Parameter of the inverter-control
Number = 128 . . . 255 --> Operator-parameter

Moreover, it must be noted, that exactly as with the inverter-parameters some operator-parameters exist several times. These use the set selection byte in KEB in the familiar manner. Here applies, that over Set 0 the first mapping of the parameter is addressed and in Set 1 the second one. Presently the set-programmable operator-parameters are limited to the process-data parameters. Since at present the CAN-operator supports two PDOs, these parameters exist in Set 0 for the first PDO and in Set 1 for the second one.

All set-programmable parameters are provided with a corresponding reference under *Notice*. All other parameters exist only in Set 0.

Example:
The parameter PD_In_Para_CobId of the first PDO is addressed over the Diagnostic Interface with set selection byte = 01 (hex). The same parameter of the second PDO is in Set 1 (set selection byte = 02 (hex)).
Keep in mind that the simultaneous addressing of a operator-parameter in several sets is generally prohibited.

Legend	**Parameter name**	Brief account	**Parameter-address**

Operator type — OS.00 — 0180h

Significance: Describes the Operator-type.
Data Length: 2 Byte
Set-programming: Not set-programmable
Coding: The two most significant decimal places specify the customer, the next two decimal places name the type and the next two decimal places indicate the version resolved into 0.1.

Example:

Value 10421 (dec) means:	customer	=	1 (KEB)
	Type	=	4 (CAN)
	Version	=	21 (V 2.1)

Notice: Only for information.

Software date — OS.02 — 0182h

Significance: Configures the software date.
Data Length: 2 Byte
Coding: The lowest decimal digit shows the year 2000.
The next two decimal digits show the month.
The next two decimal digits show the day.
Notice: The representation is as follows: day, month, year

Diag Error Count — OS.03 — 0183h

Significance: Specifies the number of occurred errors on the Diagnostic Interface.
Data Length: 2 Byte
Coding: 1
Notice: Only for information.

Diag Response delay time — OS.04 — 0184h

Significance: Minimal response delay time for inquiries over the Diagnostic Interface.
Data Length: 1 Byte
Coding: 1 ms
Notice: This parameter is not available over CAN.

Diag Baudrate — OS.05 — 0185h

Significance: Specifies the transmission rate on the Diagnostic Interface.
Data Length: 1 Byte
Coding:

0:	1200 Bit/s
1:	2400 Bit/s
2:	4800 Bit/s
3:	9600 Bit/s
4:	19200 Bit/s
5:	38400 Bit/s

Notice: The value of the parameter is a mapping of the parameter SY.07 and therefore it is only readable over the Diagnostic Interface.

HSP5 Max InvBusy retries OS.06 0186h

Significance: Indicates how often a HSP5-service to the inverter-control is repeated, it the inverter rejects the service with the error 'Inverter busy' .
Data Length: 1 Byte
Coding: 1

HSP5 Tout Count OS.07 0187h

Significance: Counts the time exceedance at the internal communication between Operator and FI-control.
Data Length: 2 Byte
Coding: 1
Notice: This parameter is not available over CAN and exists only in Set 0.

OP_Node_Id FB.00 0280h

Data Length: 1 Byte
Notice: This parameter is identical with the CAN-parameterOP_Node_Id and exists only in Set 0.

CAN_Baud2 FB.01 0281h

Data Length: 1 Byte
Notice: This parameter corresponds to the CAN-parameter CAN_Baud2 (s.o.) and exists only in Set 0.

Act_CAN_Baud FB.02 0282h

Significance: Shows the currently adjusted CAN-Bitrate.
Data Length: 1 Byte
Coding: See CAN_Baud.
Notice: This parameter ist Read_Only and not available on CAN and exists only in Set 0.

Watchdog Activation FB.03 0283h

Data Length: 1 Byte
Notice: This parameter is identical with the CAN-parameter Watchdog_Activation and exists only in Set 0.

Watchdog inhibit FB.04 0284h

Data Length: 1 Byte
Notice: This parameter is identical with the CAN-parameter Watchdog_Inhibit (s. o.) and exists only in Set 0.

HS_PDO_Index FB.05 0285h

Notice: This parameter corresponds to the operator-parameter HS_PDO_Index and exists only in Set 0.

DSP402_OpMode FB.06 0286h

Data Length: 4 Byte
Notice: This parameter corresponds to the operator-parameter DSP402_ModesOfOperation and exists only in Set 0.

PD_In_Para_CobID FB.07 0287h

Data Length: 4 Byte
Notice: This parameter corresponds to the CAN-parameter „nth transmit PDO Parameter, Cob ID“ * and exists in Set 0 and Set 1.

PD_In_Para_TxType FB.08 0288h

Data Length: 1 Byte
Notice: This parameter corresponds to the CAN-parameter „nth transmit PDO Parameter, TxType“ and exists in Set 0 and Set 1.

PD_In_Para_Inhibit FB.09 0289h

Data Length: 2 Byte
Notice: This parameter corresponds to the CAN-parameter „nth transmit PDO Parameter, Inhibit Time“ and exists in Set 0 and Set 1.

PD_In_Cycle FB.10 028Ah

Notice: This parameter corresponds to the CAN-parameter PDIN_Cycle_and exists in Set 0 (PDIN1_Cycle_Time) and Set 1 (PDIN2_Cycle_Time).

Nr_PDIn_Objs FB.11 028Bh

Data Length: 1 Byte
Notice: This parameter corresponds to the least significant Byte (LSB) of the CAN-parameter nth transmit PDO mapping, Nr Mapped Objects and exists in Set 0 and Set 1.

PD_Inx Index (with x = 1 . . . 4) FB.12,15,18,21 028Ch,028Fh,0292h,0295h

Data Length: 2 Byte
Notice: These parameters correspond to the most significant word of the parameter nth transmit PDO mapping, PDO mapping for the nth application object to be mapped and exist in Set 0 and Set 1.

PD_Inx Set (mit x = 1 . . . 4) FB.13,16,19,22 028Dh,0290h,0293h,0296h

Data Length: 1 Byte
Notice: This parameter corresponds to the third-ranked Byte of the parameter nth transmit PDO mapping, PDO mapping for the nth application object to be mapped and exists in Set 0 and Set 1.

PD_Inx _BitDlen (with x = 1 . . . 4) FB.14,17,20,23 028Eh,0291h,0294h,0297h

Notice: This parameter corresponds to the least significant Byte of the parameter nth transmit PDO mapping, PDO mapping for the nth application object to be mapped and exists in Set 0 and Set 1.

PDOUT_WrMode FB.25 **0299h**

Notice: This parameter corresponds to the CAN-parameter „PDOUT_WrMode“ and exists only in Set 0.

PD_Out_Para_CobID FB.26 **029Ah**

Data Length: 4 Byte
Notice: This parameter corresponds to the CAN-parameter „nth Receive PDO Parameter, Cob ID“ and exits in Set 0 and Set 1.

PD_Out_Para_TxType FB.27 **029Bh**

Data Length: 1 Byte
Notice: This parameter corresponds to the CAN-parameter „nth Receive PDO Parameter, TxType“ and exists in Set 0 and Set 1.

Nr_PDOut_Objs FB.28 **029Ch**

Data Length: 1 Byte
Notice: This parameter corresponds to the least significant Byte (LSB) of the parameter nth Receive PDO mapping, PDO mapping for the nth application object to be mapped and exists in Set 0 and Set 1.

PD_Outx Index (with x = 1 . . . 4) FB.29,32,35,38 **029Dh,02A0h,02A3h,02A6h**

Data Length: 2 Byte
Notice: This parameter corresponds to the most significant word of the parameter nth Receive PDO mapping, PDO mapping for the nth application object to be mapped and exists in Set 0 and Set 1.

PD_Outx Set (with x = 1 . . . 4) FB.30,33,36,39 **029Eh,02A1h,02A4h,02A7h**

Data Length: 1 Byte
Notice: This parameter corresponds to the third ranked Byte of the parameter nth Receive PDO mapping, PDO mapping for the nth application object to be mapped and exists in Set 0 and Set 1.

PD_Outx_BitDlen (with x = 1 . . . 4) FB.31,34,37,40 **029Fh,02A2h,02A5h,02A8h**

Notice: This parameter corresponds to the least sifnificant Byte of the parameter nth Receive PDO mapping, PDO mapping for the nth application object to be mapped and exists in Set 0 and Set 1.

ProcessData Inx (with x = 1 . . . 4) FB.42...45 **02AAh - 02ADh**

Significance: x. Process input data word
Data Length: 2 Byte
Coding: Depending on the mapped parameter
Notice: This parameter is Read_Only and corresponds to the x. Wort of the PDO (tx) - telegram on CAN and exists in Set 0 and Set 1.

ProcessData Outx (with x = 1 . . . 4) FB.46...49 02AEh - 02B1h

Significance: x. Process output data word
Data Length: 2 Byte
Coding: Depending on the mapped parameter
Notice: This parameter is Read_Only and corresponds to the x. Wort of the PDO (rx) - telegram on CAN and exists in Set 0 and Set 1.

Take Stored PD-Map FB.50 02B2h

Notice: This parameter corresponds to the CAN- parameter PD_Stored (Index = 5FE2h), (see above) and exists only in Set 0.

Check PD Setting FB.51 02B3h

Significance: Indicates whether the last adjusted PD-assignment change was executed error-free.
Data Length: 1 Byte
Coding: 0: Error occurred in the last PD-assignment change.
255d: Last PD-assignment change was executed error-free.
Notice: This parameter is not available on CAN and exists only in Set 0.

ComCycle FB.52 02B4h

Notice: This parameter corresponds to the CAN-parameter ComCycle and exists only in Set 0.

HS_SyncToutDelay FB.53 02B5h

Notice: This parameter corresponds to the CAN-parameter HS_SyncToutDelay and exists only in Set 0.

LifeGuardTout.Addr FB.54 02B6h

Notice: This parameter corresponds to the CAN-parameter LifeGuardTout.Addr and exists only in Set 0.

LifeGuardTout.Data FB.55 02B7h

Notice: This parameter corresponds to the CAN-parameter LifeGuardTout.Data and exists only in Set 0.

EmergencyCycle FB.56 02B8h

Notice: This parameter corresponds to the CAN-parameter EmergencyCycle and exists only in Set 0.

Save_VLRamps FB.57 02B9h

Notice: This parameter corresponds to the CAN-parameter Save_VLRamps and exists only in Set 0.

VL_Ramp_CalcMode FB.58 02BAh

Notice: This parameter corresponds to the CAN-parameter VL_Ramp_CalcMode and exists only in Set 0.

10. Change-over of the transmission-type of the PDOs

The transmission-type of the parameter **1st/2nd receive PDO Parameter** as well as of the **1st/2nd transmit PDO Parameter** is changeable. The valid values are:

-	Asynchronous manufacturer-specific	(Value = 254 = Default) as well as
-	Asynchronous profile-specific	(Value = 255)
-	Synchronous acyclic	(Value = 0)
-	Synchronous cyclic	(Value = 1)
-	Synchronous cyclic	(Values= 1, 2, . . . 240)
-	Synchonous RTROnly	(Value = 252)
-	Asynchronous RTROnly	(Value = 253)

According to CANopen the values 0 to 240 possess identical behaviour at the PDO(rx). That means, that at the PDO(rx) the PDOUT-data are updated at every SYNC, regardless of the value the tx-type has. Please also keep in mind the influence of the parameter PDOUT_WrMode on the PDO1, PDO2(rx)-processing.

10.1 Asynchronous manufacturer-specific (Value = 254d/FEh) or asynchronous profile-specific (Value = 255d/ FFh)

If in parameter **1st/2nd receive PDO Parameter** the transmission-type is adjusted to one of these values, it means, that the process output data in status OPERATIONAL are transferred to the inverter-control on receipt of a valid PDO(rx)-telegram, if at least 1 Byte has changed. A valid PDO(rx)-telegram is a telegram on the corresponding identifier with a data length of ≥ the data length that results from the PDO(rx)-mapping. In the standard case it means, that all telegrams on the OUT-identifier with a data length of ≥ 4 Byte are accepted.

In status OPERATIONAL the process input data are also read cyclical by the FI-control. If the value 254d or 255d is adjusted in parameter **1st/2nd transmit PDO Parameter**, it means that a PDO(tx)-telegram is transmitted to CAN, if the process input data have changed.

10.2 Synchronous acyclic (Value = 0) or synchronous cyclic (Values = 1 to 240)

If in parameter **1st/2nd receive PDO Parameter** the transmission-type is adjusted to once of these values, it means, that the process output data in status OPERATIONAL are transferred to the inverter-control on receipt of a SYNC-telegram. Provided, that a valid PDO(rx)-telegram was received before.

For the parameter **1st/2nd transmit PDO Parameter the value** transmission-type = 0/ 1 means, that in status OPERATIONAL a PDO(tx)-telegram is immediately transmitted on CAN after receiving a SYNC-telegram.

For all synchronous values of the tx_type applies, that the SYNC-telegram triggers the transmission of the appropriate PDO(tx) respectively the transmission of the PDO(rx). With the exact value it is determined how many SYNC-telegrams are necessary for it. With the values 0 and 1 every SYNC activates the corresponding event. The values 2 to 240 itself specify the number of required SYNC-telegrams. However, it must be observed that in this value range the behaviour of all PDO(rxx)-telegrams is identical with the value = 1.

Example:	PDO1(tx).tx_type = 10:	After 10 SYNC-telegrams the Slave transmits a PDO1(tx) on CAN with the current PDIN1-data.
	PDO1(rx).tx_type = 10:	After everySYNC-telegram the current PDOUT1-data are forwarded.

10.3 Synchronous/ asynchronous RTROnly (Values = 252, 253)

These values are only valid for Tx-PDOs. The transmission of the current PDIN-data over the corresponding PDO(tx)-telegram on CAN is only started upon receipt of a Remote-Frame-Request on the corresponding identifier.

11. Synchronous-Mode

In the synchronous-mode the internal processing cycle of the CAN-operator and the connected frequency inverter control is adjusted over the SYNC-telegram on CAN. Shortest deceleration times and above all extremely little deviation in the deceleration times are the ultimate goal of this operating mode. It is achieved with simultaneous compatibility on CAN. But clear functional restrictions are connected with the synchronous-mode. Though the general operation is maintained.
In the synchronous-mode the highest priority lies on the fastest possible transfer of process data. The mapping of the process data is adjustable over the process data mapping and is only subject to the restrictions of the already known High-Speed-PDOs in the CAN-operator.

Following conditions apply to the synchronous-mode:

The synchronous-mode operates only in OPERATIONAL-status of the node.
Only the High-Speed-PDO may be active.
The PDO works in both directions synchronous.
The PDO-mapping in both directions fulfills following conditions:

- Number of mapped parameters in both direction = 2 or 3:
- The first mapping occupies 32-Bit
- Every further mapping occupies 16-Bit

The synchronous-mode is activated by writing on the new parameter ComCycle with a value unequal zero.
In the synchronous-mode the SYNC-telegrams on CAN must be transmitted within the adjusted time (ComCycle). 'The maximal temporal deviation of two successive SYNC-telegrams must not exceed ca. 80µs. If this maximal deviation is exceeded, it must be clarified in each individual case, whether the application functions in the desired manner. The CAN-operator monitors the receipt of the SYNC-telegrams. If no SYNC is received within the Timeout time, the operator automatically switches back into the normal mode. The Timeout time corresponds to four-times of the expected SYNC-cycle time (ComCycle).

The necessary presettings are comprised in the following table:

Index	Subindex	Dlen	Value
5FE5h	0	1	0
1801h	1	4	8000XXXXh
1401h	1	4	8000XXXXh
1800h	2	1	0 or 1
1400h	2	1	0 or 1
1A00h	0	1	≤ 3
1A00h	1	4	XXXXXX20h
1A00h	2	4	XXXXXX10h
1A00h	3	4	XXXXXX10h
1600h	0	1	≤ 3
1600h	1	4	XXXXXX20h
1600h	2	4	XXXXXX10h
1600h	3	4	XXXXXX10h
1006h	0	4	A multiple of 1000(dec)

11.1 Functionalrestriction in the Synchronous-Mode

In the synchronous-mode all CAN-SDO-jobs and jobs from the diagnostic interface are interlaced in the process data transfer. On this account only CAN-SDO-accesses to parameters in the inverter-control with Subindex = 0 are possible. That means, parameters in the inverter can only be addressed in the set defined by the set indicator (Fr.09) (indirect set-addressing). Note, that every CAN-telegram can shift the SYNC in time, even if the SYNC-telegram has a very high priority due to its low identifier. Therefore, if at all possible, it should be abstained from any other CAN-communication in the synchronous-mode (Node-Guarding, SDO-commands, NMT-commands). Only PDO(rx)-telegrams, PDO(tx)-relegrams and the SYNC should be transmitted.

The keyboard is not processed in the synchronous-mode. The display is static and shows ‚Synch‘. The diagnostic-interface continues to operate with similar restrictions that apply to the CAN-SDO-communication: Parameters in the inverter can only be read or written over the HSP5-service = 1 with the set-selection Byte = 1 (indirect set-addressing over Fr.09).

12. DSP402-Support

Please refer to the description of the parameter DSP402_ModesOfOPeration to find out which DSP402-Modes are supported.
The CAN in Automation User Group has published the version 2.0 of the DSP402-unit profile for drives on 26.07.2002. The KEB-F5-CANopen-interface connection supports a subset of the functions and parameters, that are defined in the DSP402. The CAN-operator takes over the conversion of the DSP402-parameter into parameters of the inverter-control. This conversion is, in part, complex and consequently intensive in running time . For that reason a mapping of such parameter, that must be transliterated on the High-Speed-PDO is not permitted in most cases. But the DSP402-parameters can be addressed over the SDO-commands. Likewise, nearly all DSP402-parameters are mappable on the Low-Speed-PDO .
Some of the parameters in the KEB-F5-frequency inverter, that serve as basis for realized DSP402-parameters, are set-programmable. Since the DSP402-profile does not support any set-programming, the following provision was made for the DSP402-realization: All DSP402-profile parameters, that are converted to parameters in the frequency control, are stored in Set0. They have no influence on the parameters in other sets:

The DSP402-profile works exlusively in parameter-set 0

12.1 Presettings for DSP402-operation

The DSP402-profile supports the differentiation of the ramps for clockwise and counter-clockwise rotation. Therefore, the ramp times for clockwise and counter-clockwise rotation must have the same values. That conditions the following presettings for the inverter-control:

Parameter	Parameter-Address	Parameter-Set	Parameter-Value
OP.29	031Dh	Set 0	-1
OP.31	031Fh	Set 0	-1

For the operation over the DSP402-control and status word the following presettings are to be made in the inverter-control:

Parameter	Parameter-Address	Parameter-Set	Parameter-Value
UD.01	0801h	Set	440
OP.00	0300h	Set0	5
OP.01	0301h	Set 0	6
OP.02	0302h	Set 0	0
OP.60	033Ch	Set 0	0
OP.61	033Dh	Set 0	0
DI.01	0B01h	Set 0	Bit0 = 1
DI.02	0B02h	Set 0	Bit0 = 1
DI.09	0B09h	Set 0	2

12.2 Details to the DSP402-Velocity ramps

The DSP402-profile defines a Velocity-ramp (VL-ramp) as a structure developed from two parts:

- VL-ramp.Dspeed: Delta-speed-value of the ramp in rpm.
- VL-ramp.Dtime: Delta-time-value of the ramp in seconds.

Internally in the inverter-control a ramp is defined by a fixed part the so-called ramp-reference value and an adjustable part the ramp time. The DSP402-ramp values are stored in the CAN-operator. During a read access these buffer values are accessed. If one of the values is written an additional write access to the corresponding ramp time in the inverter-control becomes necessary. The ramp values according to DSP402-coding are not automatically stored non-volatile in the operator. The user can explicitly request it over parameter Save_VL_Ramps.

The conversion of a VL-ramp into a FI-ramp time is clear. However, the likewise necessary conversion of a FI-ramp time into a VL-ramp is not clear. For that reason a method for the reversion of the conversion must be found. The KEB-F5-CANopen-operator supports different reversion modes, which are selectable by the parameter VL_ramp_CalcMode (see below).

Moreover, it must be noted that with each change of one of the two VL-ramp parts a write access to the relevant FI-ramp times is always effected. That means, that with the change of both VL-ramp parts initially only one part is converted into a FI-ramp time. At this point the FI-ramp time does not correspond to the desired ramp. Only after the second VL-ramp part has also been written, the desired ramp is preset as FI-ramp time. This problem also applies to the Low-Speed-PDO. The DSP402-profile does not provide any regulations for the consistent setting of VL-ramps. The just illustrated problem must be solved by the user:

- For example, one of the two VL-ramp times always remains unchanged and the ramp is varied only with the other part of the VL-ramp.
- Another approach would be to never change the ramps while the FI drives ramps.

12.3 DSP402-Profile and Synchronous-Mode

It is generally possible to operate in the synchronous-mode over DSP402-profile parameters, but it must be noted, that the synchronous-mode does not support any conversion/reversion of parameter values. Therefore DSP402-parameters to be converted are not mappable on process data in the synchronous-mode. The following parameters do not require a conversion:

- VL_TargetVelocity(Index=6042h)
- VL_ControlEffort(Index=6043h)

The direct set-addressed SDO-access is also not permitted in the synchronous-mode. Consequently the most SDO-accesses on DSP402-parameters would be rejected with error.

For these reasons it is practically unrealistic to operate with DSP402-parameters in the synchronous-mode.

12.4 General Parameters of the DSP402-profile

Legend

Parameter name	Object-type	CAN-SDO-Index

DSP402_ErrorCode — Single variable (Var) — 603Fh

Significance: Indicates the current error status of the unit.
SDO-Subindex: 0
Data Length: 2 Byte
Access: READ_ONLY
Coding: According to DSP402-setting, see table in the Annex
PDO-mapping:

High-Speed-PDO		Low-Speed-PDO	
rx	tx	rx	tx
NO	YES	NO	YES

Notice: Is mapped internally on the parameter RU.00. If the FI signals no error status, but the CAN-operator has detected an error, it is returned.

DSP402_Control word — Single variable (Var) — 6040h

Significance: Serves for the setting of control commands. The parameter is bit-coded and is mapped in the inverter-control on the parameter SY.50 (control word).
SDO-Subindex: 0
Data Length: 2 Byte
Access: READ_WRITE
Coding: Only the supported Bits are listed in the following Fig.:

B15	B7	B6	B5	B4	B3	B2	B1	B0
	Fault Reset	Operation Mode Specific			Enable Operation	Quick Stop	Enable Voltage	Switch On

B6	B5	B4	
RFG Use REF	RFG Unlock	RFG Enable	VELOCITY MODE
Reserved	Reserved	Homing Operation Start	HOMING MODE
Abs / Rel	Change Set Immed.	New Setpoint	PROFILE POSITION MODE

The Bits B6 to B4 are defined mode-dependent. Grey highlighted Bits are currently not realized in the KEB-CANopen-interface connection.

Permitted PDO-mapping:

High-Speed-PDO		Low-Speed-PDO	
rx	tx	rx	tx
YES	YES	YES	YES

Notice: Is mapped internally on the parameter SY.50 .

DSP402_Status word — Single variable (Var) — 6041h

Significance: Serves for the publication of the current condition. The parameter is bit-coded and is mapped on the parameter SY.51 (status word) in the inverter-control.

SDO-Subindex: 0

Data Length: 2 Byte

Access: READ_ONLY

Coding: Only the supported Bits are listed in the following Fig.:

B15	B13	B12	B11	B10	B9	B6	B5	B4	B3	B2	B1	B0
	Operation Mode Specific		Internal Limit Active	Target Reached	Remote	switch on Disabled	Quick Stop	Voltage Enabled	Fault	Operation Enabled	Switched on	Ready to switch on

B13	B12	
Reserved	Reserved	VELOCITY MODE
Homing ERROR	Homing Attained	HOMING MODE
Following ERROR	Setpoint Ackn.	PROFILE POSITION MODE

The Bits B13, B12 are defined mode-dependent. Grey highlighted Bits are currently not realized in the KEB-CANopen-interface connection.

Permitted PDO-mapping:

High-Speed-PDO		Low-Speed-PDO	
rx	tx	rx	tx
NO	YES	NO	YES

Notice: Is mapped internally on the parameter SY.51.

DSP402_ModesOfOperation — Single variable (Var) — 6060h

Significance: Serves for the setting of the desired DSP402-operations mode.

SDO-Subindex: 0

Data Length: 1 Byte

Access: READ_WRITE

Coding:
(-1): Manufacturer-specific
0: reserved
1: Profile Position Mode[*1]
2: Velocity Mode
3: Profile Velocity Mode(not possible here)
4: Torque Profile Mode(not possible here)
5: reserved
6: Homing Mode[*1]
7: Interpolated Position Mode(not possible here)

Default Setting: (-1): Manufacturer-specific

Permitted PDO-mapping: not mappable

Notice: At present no real difference exists between the Modes (-1) and 2.

[*1:] These modes are permitted for the control types ud.02 = 4, 5, 6, 8, 9, 10 only.

DSP402_ModesOfOperationDisp — Single variable (Var) — 6061h

Significance: Indicates the current DSP402-operations mode.

SDO-Subindex: 0

Data Length: 1 Byte

Access: READ_ONLY

Coding: s. DSP402_ModesOfOperation

Default Setting: (-1): Manufacturer-specific

Permitted PDO-mapping: not mappable

DSP402_SuppDriveModes Single variable (Var) 6502h

Significance: Indicates bit-coded the supported modes of the CANopen-interface connection.

SDO-Subindex: 0

Data Length: 4 Byte

Access: READ_ONLY

Coding:

B31 B16	B15 B7	B6	B5	B4	B3	B2	B1	B0
Manufacturerspecific	reserved	Inter polated Position	Homing	reserved	Torque	Profile Velocity	Velocity	Profile Position

The manufacturer-specific Bits are not used here.

Permitted PDO-mapping: not mappable

DSP402_AbortConnOptionCode Singl variable (Var) 6007h

Significance: Determines the behaviour after the connection to CAN was aborted. Abort of the connection to CAN is here synonymous with the following events:

- Response of the Life Guarding Timeout monitoring
- BusOff-condition of the CAN-controller

SDO-Subindex: 0

Data Length: 2 Byte

Access: READ_WRITE

Coding: (**-1**): The behaviour of the connection abort to CAN is determined by the two parameters LifeGuardTout_Addr and LifeGuardTout_Data, see above

0: No activity

1: Transition into PRE_OPERATIONAL, if the current condition is OPERATIONAL and explicit triggering of the Fieldbus-Watchdog (E.Bus) at the inverter-control (provided these are activated in the FI).

2: Transition into PRE_OPERATIONAL, if the current condition is OPERATIONAL and command, Disable Voltage‘ via the DSP402_Control word.

3: Transition into PRE_OPERATIONAL, if the current condition is OPERATIONAL and command, Quick Stop‘ via the DSP402_Control word.

Default Setting: (-1)

Permitted PDO-mapping: not mappable

Notice: A value change is effective immediately and stored non-volatile.

DSP402_MotionProfileType Single variable (Var) 6086h

Significance: Indicates the way of motion realization.

SDO-Subindex: 0

Data Length: 2 Byte

Access: READ_WRITE

Coding: (-1): Linear ramps with s-curves that can be activated

0: Linear ramps (not adjustable here)

1: sin^2-ramps (not adjustable here)

2: Jerk-free ramps (not adjustable here)

3: Jerk-limited ramps (not adjustable here)

Default Setting: (-1)

Permitted PDO-mapping: not mappable

Notice: At present only one value can be selected.

12.5 Parameter of the Velocity Mode

VL_TargetVelocity

Single variable (Var) **6042h**

Significance: Specifies the setpoint speed.
SDO-Subindex: 0
Data Length: 2 Byte
Access: READ_WRITE
Coding: 1 rpm
Permitted PDO-mapping:

High-Speed-PDO		Low-Speed-PDO	
rx	tx	rx	tx
YES	YES	YES	YES

Notice: Is mapped internally on the parameter SY.52.

VL_VelocityDemand

Single variable (Var) **6043h**

Significance: Specifies the speed value at the output of the ramp generator.
SDO-Subindex: 0
Data Length: 2 Byte
Access: READ_ONLY
Coding: 1 rpm
Permitted PDO-mapping:

High-Speed-PDO		Low-Speed-PDO	
rx	tx	rx	tx
NO	YES	NO	YES

Notice: Is mapped internally on the parameter RU.02.

VL_ControlEffort

Single variable (Var) **6044h**

Significance: Indicates the actual speed value.
SDO-Subindex: 0
Data Length: 2 Byte
Access: READ_ONLY
Coding: 1 rpm
Permitted PDO-mapping:

High-Speed-PDO		Low-Speed-PDO	
rx	tx	rx	tx
NO	YES	NO	YES

Notice: Is mapped internally on the parameter SY.53.

VL_VelocityMinAmount

Single variable (Var) **6046h**

Significance: Indicates the amount of the lower limit value of the setpoint value.
SDO-Subindex: 1
Data Length: 4 Byte
Access: READ_WRITE
Coding: 1 rpm
Permitted PDO-mapping:

High-Speed-PDO		Low-Speed-PDO	
rx	tx	rx	tx
NO	NO	YES	YES

Notice: Is mapped internally on the parameter OP.06.

VL_VelocityMaxAmount Single variable (Var) 6046h

Significance: Indicates the amount of the upper limit value of the setpoint value.
SDO-Subindex: 2
Data Length: 4 Byte
Access: READ_WRITE
Coding: 1 rpm
Permitted PDO-mapping:

High-Speed-PDO		Low-Speed-PDO	
rx	tx	rx	tx
NO	NO	YES	YES

Notice: Is mapped internally on the parameter OP.10.

VL_VelocityAcceleration.Dspeed Single variable (Var) 6048h

Significance: Specifies together with the VL_VelocityAcceleration.Dtime the acceleration ramp.
SDO-Subindex: 1
Data Length: 4 Byte
Access: READ_WRITE
Coding: 1 rpm
Permitted PDO-mapping:

High-Speed-PDO		Low-Speed-PDO	
rx	tx	rx	tx
NO	NO	YES	YES

Notice: Is mapped internally on the parameter OP.28.

VL_VelocityAcceleration.Dtime Single variable (Var) 6048h

Significance: Specifies together with the VL_VelocityAcceleration.Dspeed the acceleration ramp.
SDO-Subindex: 2
Data Length: 2 Byte
Access: READ_WRITE
Coding: 1s
Permitted PDO-mapping:

High-Speed-PDO		Low-Speed-PDO	
rx	tx	rx	tx
NO	NO	YES	YES

Notice: Is mapped internally on the parameter OP.28.

VL_VelocityDeceleration.Dspeed Single variable (Var) 6049h

Significance: Specifies together with the VL_VelocityDeceleration.Dtime the deceleration ramp.
SDO-Subindex: 1
Data Length: 4 Byte
Access: READ_WRITE
Coding: 1 rpm
Permitted PDO-mapping:

High-Speed-PDO		Low-Speed-PDO	
rx	tx	rx	tx
NO	NO	YES	YES

Notice: Is mapped internally on the parameter OP.30.

VL_VelocityDeceleration.Dtime Single variable (Var) 6049h

Significance: Specifies together with the VL_VelocityDeceleration.Dspeed the deceleration ramp.
SDO-Subindex: 2
Data Length: 2 Byte
Access: READ_WRITE
Coding: 1s
Permitted PDO-mapping:

High-Speed-PDO		Low-Speed-PDO	
rx	tx	rx	tx
NO	NO	YES	YES

Notice: Is mapped internally on the parameter OP.30.

VL_VelocityQuickStop.Dspeed Single variable (Var) 604Ah

Significance: Specifies together with the VL_VelocityQuickStop.Dtime the quick-stop ramp.
SDO-Subindex: 1
Data Length: 4 Byte
Access: READ_WRITE
Coding: 1 rpm
Permitted PDO-mapping:

High-Speed-PDO		Low-Speed-PDO	
rx	tx	rx	tx
NO	NO	YES	YES

Notice: Is mapped internally on the parameter PN.60.

VL_VelocityQuickStop.Dtime Single variable (Var) 604Ah

Significance: Specifies together with the VL_VelocityQuickStop.Dspeed the quick-stop ramp.
SDO-Subindex: 2
Data Length: 2 Byte
Access: READ_WRITE
Coding: 1s
Permitted PDO-mapping:

High-Speed-PDO		Low-Speed-PDO	
rx	tx	rx	tx
NO	NO	YES	YES

Notice: Is mapped internally on the parameter PN.60.

VL_QuickStopOptionCode Single variable (Var) 605Ah

Significance: Specifies the behaviour of the quick stop.
SDO-Subindex: 0
Data Length: 2 Byte
Access: READ_WRITE
Coding: The DSP402-profile determines the value range for the manufacturer-specific mode within the range –32768....-1. For this reason the value is converted in the operator into the coding of the parameter PN.58 as follows:
Value(PN.58) = Amount(VL_QuickStopOptionCode) - 1
The significance of the individual modes is to be taken from the application instruction of the used inverter-control.
-1 --> PN.58 = 0
-2 --> PN.58 = 1
-3 --> PN.58 = 2 etc.
Permitted PDO-mapping: not mappable
Notice: Is mapped internally on the parameter PN.58.

VL_PoleNr — Single variable (Var) — 604Dh

Significance: Specifies the number of poles of the motor. This value is calculated from the parameters DR.01 and DR.05 and needed for all conversions of speed (rpm) into frequency (Hz).

SDO-Subindex: 0

Data Length: 1 Byte

Access: READ_ONLY

Coding: 1

Permitted PDO-mapping: not mappable

Notice: Is calculated internally from the parameters DR.01 andDR.05.

VL_Ramp_CalcMode — Single variable (Var) — 5FDBh

Significance: Determines the mode of calculation for the conversion of a KEB-ramp time into a DSP402-Velocity-ramp.

SDO-Subindex: 0

Data Length: 1 Byte

Access: READ_WRITE

Coding:

0: Both parts of the VL-Ramp (Dspeed, Dtime) are determined in such a way, that the values becomes as small as possilbe, but the accuracy of the ramp time to be converted remains.

1: Only the VL-Rampe.Dtime is calculated, VL-Rampe.Dspeed remains unchanged.

2: The value of the KEB-ramp time is accepted as value for the VL-ramp.Dtime. VL-ramp.Dspeed is set accordingly.

Permitted PDO-mapping: not mappable

Notice: A value change is effective immediately and stored non-volatile.

Save_VL_Ramps — Single variable (Var) — 5FDCh

Significance: Serves for the non-volatile storing of the Velocity-Mode Ramps in the CAN-Operator.

SDO-Subindex: 0

Data Length: 1 Byte

Access: READ_WRITE

Coding:

B7	B6	B5	B4	B3	B2	B1	B0
		Save VL-QST. Dtime	Save VL-DEC. Dtime	Save VL-ACC. Dtime	Save VL-QST. Dspeed	Save VL-DEC. Dspeed	Save VL-ACC. Dspeed

with VL-ACC.Dspeed:	Index=6048h,Subindex=1
with VL-DEC.Dspeed:	Index=6049h,Subindex=1
with VL-QST.Dspeed:	Index=604Ah,Subindex=1
with VL-ACC.Dtime:	Index=6048h,Subindex=2
with VL-DEC.Dtime:	Index=6049h,Subindex=2
with VL-QST.Dtime:	Index=604Ah,Subindex=2

Permitted PDO-mapping: not mappable.

Notice: During reading the value 0 is always returned.

13. Factors

The DSP402-profile defines many parameters with so-called user-units. In order to realize these parameters conversion factors must be available, that perform the conversion into internal quantities. For this purpose the profile specifies an own group of parameters the so-called Factor-Group. The KEB-DSP402-realization supports no parameter of this group. But the following factors for the conversion of units are supported, that are used at different DSP402-parameters.

Every factor consists of an unsigned 32-Bit nominator and an unsigned 32-Bit denominator. Every factor is defined as structure with three members (as described below). The exact calculation formula is listed in the description to the concerned parameters:

- **Factor0**: Conversion of user-specific path-units into path-units used by the frequency inverter.
- **Factor1**: Conversion of user-specific speed-units into speed-units used by the frequency inverter.
- **Factor2**: Conversion of user-specific acceleration-units into acceleration-units used by the frequency inverter.

FactorX.NrEntries	Single variable (Var)	**5FC0h + X**
Significance:	Number of members in the Structure Factorx	
SDO-Subindex:	0	
Data Length:	1 Byte	
Access:	READ_ONLY	
Coding:	1	
Permitted PDO-mapping:	not mappable	
Notice:	A value change is effective immediately and stored non-volatile.	

FactorX.Numerator	Single variable (Var)	**5FC0h + X**
Significance:	Nominator value of Factorx	
SDO-Subindex:	1	
Data Length:	4 Byte	
Access:	READ_WRITE	
Coding:	1	
Default Setting:	1	
Permitted PDO-mapping:	not mappable	
Notice:	A value change is effective immediately and stored non-volatile.	

FactorX.Divisor	Single variable (Var)	**5FC0h + X**
Significance:	Denominator value of Factorx	
SDO-Subindex:	2	
Data Length:	4 Byte	
Access:	READ_WRITE	
Coding:	1	
Default Setting:	1	
Permitted PDO-mapping:	not mappable	
Notice:	A value change is effective immediately and stored non-volatile.	

13.1 Advanced Conversions

For some parameters the conversion by a factor consisting of numerator and denominator is not sufficient. These conversions include reference values of the FI-control for the speed. This is necessary, for example, at the conversion of an acceleration(Delta speed/ Delta time) into a ramp time. In addition to that the reference values are dependent on the F5-control type (refer to description of the parameter UD.02 in the application manual of the inverter). The following list of reference values is stored in the CAN-Operator:

Ud.02-Value	Speed-Reference Value(VRef)	Standardization
0	100	Hz
1	200	Hz
2	400	Hz
3	reserved	reserved
4	1000	rpm
5	2000	rpm
6	4000	rpm
7	reserved	reserved
8	1000	rpm
9	2000	rpm
10	4000	rpm

13.2 Example for the definition of the factors

For the optimal definition of the factor-values applies the following:

- Limit the nominator and denominator of the factors, if possible, to 16-Bit-width.
- The part of the calculation, that is the most intensive regarding the running time, is the division by FactorX.Divisor. Therefore, if possible, this value is to be = 1.

13.2.1 Factor0:User-path-unit in increments

For this conversion the values of the parameters EC.01 (encoder line number EncoderGeber1) respectively EC.11 (encoder line number Encoder2) and EC.07 (multiple evaluation Encoder1) respectively EC.17 (multiple evaluation Encoder2) must be known. Here it is based on Encoder1.

If the Factorr0 is to be defined for a setting in µm (linear motion), the following applies:

$$F0 = \frac{EC.01 * 2^{EC.07}}{U_{\text{driving pulley}}} \quad \text{with } U_{\text{driving pulley}} = \text{circumference of the driving pulley in } \mu m$$

--> Factor0.Numerator = EC.01 * $2^{EC.07}$
--> Factor0.Divisor = $U_{\text{driving pulley}}$, with $U_{\text{drivng pulley}}$ = circum. of the driving pulley in µm

If the Factor0 is to be defined for the setting of 0.01 angular degree (rotary motion), the following applies:

$$F0 = \frac{EC.01 * 2^{EC.07}}{36000}$$

--> Factor0.Numerator = EC.01 * $2^{EC.07}$
--> Factor0.Divisor = 36000

13.2.2 Factor1: User-speed-units in 0.125 rpm

If the Factor1 is to be defined for the setting-resolution 0.1 rpm, the following applies:
--> Factor1.Numerator = 8
--> Factor1.Divisor = 10

If the Factor1 is to be defined for the setting 1 µm/s, the following applies:
--> Factor1.Numerator = 480
--> Factor1.Divisor = $U_{\text{driving pulley}}$, mit $U_{\text{driving pulley}}$ = circumference of the driving pulley in µm

If the Factor1 is to be defined for setting 0.01 angular degree/s, the following applies:
--> Factor1.Numerator = 8
--> Factor1.Divisor = 600

13.2.3 Factor2: User-acceleration-units in a KEB-ramp time

The definition of Factor2 is a little more complicated. Please note, that at KEB the acceleration-/deceleration-parameters are defined as ramp time. Thus the conversion is more extensive in this case. The factor is to be demonstrated here on the example of the parameter HM_Homing_Acc, that is mapped on the parameter PS.20 in the F5-control:

To simplify the matter Factor2 can at first be written as element. Then the calculation formula is as follows:

$$\text{PS.20} = \frac{\text{Vref}}{\text{HM\_Homing\_Acc}} * \text{Factor 2}$$

Converted according to Factor2:

$$\text{Factor2} = \frac{\text{PS.20 * HM\_Homing\_Acc}}{\text{Vref}}$$

Assumption:

- UD.02 = 4: F5-M, maximumg speed = 4000 min^{-1} , Vref = 1000 rpm
- The parameter HM_Homing_Acc is to be resolved in min^{-2}

The value PS.20 = 100 represents an acceleration of 1000 min^{-1} per second. This corresponds to a value of 60000 min^{-2}. If one enters the value 100 for PS.20 and the value 60000 for HM_Homing_Acc in the above equation, the result for Factor2 is:

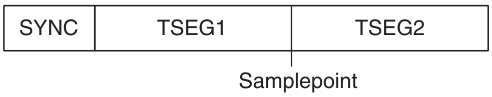
$$\text{Factor2} = \frac{100 * 60000}{1000} = 6000$$

--> Factor2.Numerator = 6000
--> Factor2.Divisor = 1

14. Annex

14.1 CAN-Bit-Timing

Regarding the adjusted Bit-Timing the KEB-CAN-interface connection(s) adhere to the specifications of the CiA-Standard [2]:
The nominal Bit-Timing is as follows:



For all adjustable Baud rates applies:

- t_q : Base time unit. All segments of the Bit-Timing result in a multiple of this time unit.
- SYNC: = 0 ==> Only the edges from recessive to dominant are used for the synchronization.
- SJW: = 0 ==> Synchronization-jump width = 1 * t_q
- TSEG2: = 1 ==> t_{SEG2} = 2 * t_q

Baud rate	Time-Quantum (t_q)	Sample-Point	TSEG1
10 Kbit/s	6.25 µs	14 * t_q = 87.5 µs	t_{SEG1} = 13 * t_q
20 Kbit/s	3.125 µs	14 * t_q = 43.75 µs	t_{SEG1} = 13 * t_q
25 Kbit/s	2,5 µs	14 * t_q = 35,0 µs	t_{SEG1} = 13 * t_q
50 Kbit/s	1.25 µs	14 * t_q = 17.5 µs	t_{SEG1} = 13 * t_q
100 Kbit/s	625 ns	14 * t_q = 8.75 µs	t_{SEG1} = 13 * t_q
125 Kbit/s	500 ns	14 * t_q = 7.0 µs	t_{SEG1} = 13 * t_q
250 Kbit/s	250 ns	14 * t_q = 3.5 µs	t_{SEG1} = 13 * t_q
500 Kbit/s	125 ns	13 * t_q = 1.625 µs	t_{SEG1} = 12 * t_q
800 Kbit/s	125 ns	7 * t_q = 1,25 µs	t_{SEG1} = 6 * t_q
1000 Kbit/s	125 ns	5 * t_q = 625 ns	t_{SEG1} = 4 * t_q

The grey highlighted transmission rates in the table are to be considered as particularly critical with regard to the line length. Moreover, the Bit-Timing for these Bit rates deviates slightly from the ones recommended by [2].

14.1.1 Important warning notice

The KEB-CAN-interface connection has a potential-isolated CAN -interface. The possible line length or the possible transmission rates are reduced by the additional delay elements (opto coupler) in the signal line. The possible line length or transmission rate depend on the delay times of all users in the CAN-network. It is the responsibility of the customer to make an assessment concerning bit rate and possible line length. The necessary information for the KEB-CAN-interface connection are listed below:

Transmit-deceleration time of the CAN-driver .... :	≤80 ns.
Receive-deceleration time of the CAN-driver .... :	≤70 ns.
Transmit-deceleration time of used opto coupler .... :	≤40 ns.
Receive-deceleration time of used opto coupler .... :	≤40 ns.

Always select the smallest CAN-transmission rate, that is needed for the processing of the process.

14.2 List of Literature

[1]: Operating Instructions frequency inverter control KEB Combivert F5 with Application Manual.

[2]: Document to the agreement of the working committee Physical-Layer of **C**AN **i**n **A**utomation (CiA) user group: CiA/DS 102-1. publisher: CiA International Users and Manufacturers Group e.V., Am Weichselgarten 26, D-91058 Erlangen. Documents to the agreement of the working committee Higher-Layer-Protocols of CiA (publisher see above):

[3]: CiA/WG2/DS201 : CAN in the OSI Reference Model

[4]: CiA/WG2/DS202-1 : CMS Service Specification

[5]: CiA/WG2/DS202-2 : CMS Protocol Specification

[6]: CiA/WG2/DS202-3 : CMS Encoding Rules

[7]: CiA/WG2/DS203-1 : NMT Service Specification

[8]: CiA/WG2/DS203-2 : NMT Protocol Specification

[9]: CiA/WG2/DS204-1 : DBT Service Specification

[10]: CiA/WG2/DS204-2 : DBT Protocol Specification

[11]: CiA/WG2/DS207 : Application Layer Naming Conventions

[12]: CiA/DS301 V.4.01 : Application Layer and Communication Profile of 01.06.2000

[13]: CiA/DSP402 V.2.0 : Device Profile Drives and Motion Control

14.3 Summary of the Operator-Parameters according to CANopen

Index	Name	Object-Typs	Subindex	Data Length in Byte	Access
1000h	device type	VAR	0	4	ro
1001h	error register	VAR	0	1	ro
1002h	Manufacturer Status Register	VAR	0	4	ro
1003h	Pre-defined ErrorField	ARRAY	1 - max. 5	4	rw
1006h	ComCycle	VAR	0	4	rw
1008h	Manufacturer Device Name	VAR	0	4	ro
1018h	Identify Object	RECORD			
1400h	1st receive PDO Parameter	RECORD			
1400h	Number of supported entries	VAR	0	1	ro
1400h	COB-ID	VAR	1	4	rw
1400h	transmission type	VAR	2	1	rw
1401h	2nd receive PDO Parameter	RECORD			
1401h	Number of supported entries	VAR	0	1	ro
1401h	COB-ID	VAR	1	4	rw
1401h	transmission type	VAR	2	1	rw
1600h	1st receive PDO Mapping	RECORD			
1600h	Number of mapped objects	VAR	0	1	rw
1600h	nth object to be mapped	VAR	1 - max. 4	4	rw
1601h	2nd receive PDO Mapping	RECORD			
1601h	Number of mapped objects	VAR	0	1	rw
1601h	nth object to be mapped	VAR	1 - max. 4	4	rw
1800h	1st transmit PDO Parameter	RECORD			
1800h	Number of supported entries	VAR	0	1	ro
1800h	COB-ID	VAR	1	4	rw
1800h	transmission type	VAR	2	1	rw
1800h	Inhibit time	VAR	3	2	rw
1801h	2nd transmit PDO Parameter	RECORD			
1801h	Number of supported entries	VAR	0	1	ro
1801h	COB-ID	VAR	1	4	rw
1801h	transmission type	VAR	2	1	rw
1801h	Inhibit time	VAR	3	2	rw

Index	Name	Object-Typs	Subindex	Data Length in Byte	Access
100Ah	Manufacturer Software Version	VAR	0	4	ro
100Ch	Guard Time	VAR	0	2	rw
100Dh	Life Time Factor	VAR	0	1	rw
1A00h	1st transmit PDO Mapping	RECORD			
1A00h	Number of mapped objects	VAR	0	1	rw
1A00h	nth object to be mapped	VAR	1 - max. 4	4	rw
1A01h	2nd transmit PDO Mapping	RECORD			
1A01h	Number of mapped objects	VAR	0	1	rw
1A01h	nth object to be mapped	VAR	1 - max. 4	4	rw
5FDAh	Watchdog_Activation	VAR	0	1	rw
5FDBh	VL_Ramp_CalcMode	VAR	0	1	rw
5FDCh	Save_VL_Ramps	VAR	0	1	rw
5FDDh	EmergencyCycle	VAR	0	2	rw
5FDEh	LifeGuardTout.Data	VAR	0	4	rw
5FDFh	LifeGuardTout.Addr	VAR	0	4	rw
5FE0h	HS_SyncToutDelay	VAR	0	2	rw
5FE2h	PD_Stored	VAR	0	1	rw
5FE3h	OP_NodeId	VAR	0	1	rw
5FE4h	PDOUT_WrMode	VAR	0	1	rw
5FE5h	HS_PDO_Index	VAR	0	1	rw
5FE6h	PDIN1_Cycle_Time	VAR	0	2	rw
5FE7h	PDIN2_Cycle_Time	VAR	0	2	rw
5FF9h	Watchdog_Inhibit	VAR	0	1	rw
5FECh	CAN_Baud2	VAR	0	1	rw
5FFEh	SAVE_CAN_Baud	VAR	0	1	rw
5FFFh	CAN_Baud	VAR	0	1	rw

14.4 Compact-summary of CAN-communication

Fixed identifier allocation:

SDO(rx)-Identifier	=	1536 + Node_Id	:	SDO-request to KEB-FI
SDO(tx)-Identifier	=	1408 + Node_Id	:	SDO-acknowledgement from KEB-FI
PDO1(rx)-Identifier	=	512 + Node_Id	:	process data to KEB-FI
PDO1(tx)-Identifier	=	384 + Node_Id	:	process data from KEB-FI
PDO2(rx)-Identifier	=	768 + Node_Id	:	process data to KEB-FI
PDO2(tx)-Identifier	=	640 + Node_Id	:	process data from KEB-FI
Node-Guarding-Identifier	=	1792 + Node_Id		
Emergency-Identifier	=	128 + Node_Id	:	Emergency Message from KEB-FI

The most important NMT-commands (telegram) on identifier = 0:

Start_Remote_Node

01h	*Node-Id*
B0	*B1*

Enter_Pre_Operational_State

80h	*Node-Id*
B0	*B1*

Reset_Node

81h	*Node-Id*
B0	*B1*

The most important values of the Node-State:

PRE_ OPERATIONAL = 7Fh : communication active except for the PDO's
OPERATIONAL = 05h : complete communication active

Example for SDO-communication:

Reading of parameter *Digital setpoint frequency setting* (op.03)
in set 4 ==> Index = 2303h, Subindex = 10h

SDO(rx)-Telegramm (zum KEB-FU)

40h	*03h*	*23h*	*10h*	*XXh*	*XXh*	*XXh*	*XXh*
B0	*B1*	*B2*	*B3*	*B4*	*B5*	*B6*	*B7*

SDO(tx)-Telegramm (vom KEB-FU)

43h	*03h*	*23h*	*10h*	*E8h*	*03h*	*00h*	*00h*
B0	*B1*	*B2*	*B3*	*B4*	*B5*	*B6*	*B7*

In this example the read value is = 1000 (03E8h)

Writing value = 5 on parameter *Setpoint value source* (op.00)
in set 0 ==> Index = 2300h, Subindex = 01h

SDO(rx)-Telegramm (zum KEB-FU)

22h	*00h*	*23h*	*01h*	*05h*	*00h*	*00h*	*00h*
B0	*B1*	*B2*	*B3*	*B4*	*B5*	*B6*	*B7*

SDO(tx)-Telegramm (vom KEB-FU)

60h	*00h*	*23h*	*01h*	*05h*	*00h*	*00h*	*00h*
B0	*B1*	*B2*	*B3*	*B4*	*B5*	*B6*	*B7*

Example for the setting of new process data with the PDO1(rx)-telegram:

The standard-process data assignment is assumed here.

The parameter *Control word* (SY.50) shall receive the value = 1,
the parameter *Setpoint speed* (SY.52) shall receive the value = 1500 (05DCh)

PDO1(rx)-Telegramm (zum KEB-FU)

01h	*00h*	*DCh*	*05h*

Karl E. Brinkmann GmbH
Försterweg 36-38 • **D**-32683 Barntrup
fon: +49 5263 401-0 • fax: +49 5263 401-116
net: www.keb.de • mail: info@keb.de

KEB Antriebstechnik GmbH & Co. KG
Wildbacher Str. 5 • **D**–08289 Schneeberg
fon: +49 3772 67-0 • fax: +49 3772 67-281
mail: info@keb-combidrive.de

KEB Antriebstechnik Austria GmbH
Ritzstraße 8 • **A**-4614 Marchtrenk
fon: +43 7243 53586-0 • fax: +43 7243 53586-21
Kostelni 32/1226 • **CZ**-370 04 Ceské Budejovice
fon: +420 38 7319223 • fax: +420 38 7330697
mail: info@keb.at

KEB Antriebstechnik
Herenveld 2 • **B**-9500 Geraadsbergen
fon: +32 5443 7860 • fax: +32 5443 7898
mail: koen.detaeye@keb.de

KEB China
Xianxia Road 299 • **CHN**-200051 Shanghai
fon: +86 21 62350922 • fax: +86 21 62350015
net: www.keb-cn.com • mail: info@keb-cn.com

Société Française KEB
Z.I. de la Croix St. Nicolas • 14, rue Gustave Eiffel
F-94510 LA QUEUE EN BRIE
fon: +33 1 49620101 • fax: +33 1 45767495
mail: sfkeb.4@wanadoo.fr

KEB (UK) Ltd.
6 Chieftain Buisiness Park, Morris Close
Park Farm, Wellingborough **GB**-Northants, NN8 6 XF
fon: +44 1933 402220 • fax: +44 1933 400724
net: www.keb-uk.co.uk • mail: info@keb-uk.co.uk

KEB Italia S.r.l.
Via Newton, 2 • **I**-20019 Settimo Milanese (Milano)
fon: +39 02 33500782 • fax: +39 02 33500790
net: www.keb.it • mail: kebitalia@keb.it

KEB - YAMAKYU Ltd.
15–16, 2–Chome, Takanawa Minato-ku
J–Tokyo 108-0074
fon: +81 33 445-8515 • fax: +81 33 445-8215
mail: kebjt001@d4.dion.ne.jp

KEB Antriebstechnik
Leidsevaart 126 • **NL**–2013 HD Haarlem
fon: +31 23 5320049 • fax: +31 23 5322260
mobil: +31 653964667
mail: vb.nederland@keb.de

KEB Portugal
Lugar de Salgueiros – Pavilhao A, Mouquim
P-4760 V. N. de Famalicao
fon: +351 252 371318 • fax: +351 252 371320
mail: keb.portugal@netc.pt

KEB Taiwan Ltd.
1F, No.19-5, Shi Chou Rd., Tounan Town
R.O.C.-Yin-Lin Hsian / Taiwan
fon: +886 5 5964242 • fax: +886 5 5964240
mail: keb_taiwan@mail.apol.com.tw

KEB Sverige
Box 265, Bergavägen 19
S-430 93 Hälsö
fon: +46 31 961520 • fax: +46 31 961935
mail: thomas.crona@keb.de

KEBCO Inc.
1335 Mendota Heights Road
USA-Mendota Heights, MN 55120
fon: +1 651 4546162 • fax: +1 651 4546198
net: www.kebco.com • mail: info@kebco.com

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