C O M B I C O M

GB INSTRUCTION MANUAL **F5 EtherCAT Operator**

Mat. No.	Rev.
CTF50E0-K100	1B

KEB

GB

Table of contents

1. Introduction

1.1 Preface

We welcome you as a customer of the Karl E. Brinkmann GmbH and congratulate you to the aquisition of this product. You have chosen a product on highest technical standard.
This manual as well as the specified hardware and software are developments of the Karl E. Brinkmann GmbH. 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. Karl E. Brinkmann GmbH reserves itself the right to change/adapt specifications and technical data without previous notification. Errors and ommissions excepted!
The safety and warning directions in this manual as well as in further documentation must be observed for a safe operation. The safety and warning directions specified in this manual is not exhaustive.
The pictographs used in this manual have following meaning:

Danger
Warning
Caution

Attention
observe at all costs

Information
Help
Tip

The information contained in the technical documentation, as well as any user-specific advice in spoken and written and through tests, are made to best of our knowledge and information about the application. However, they are considered for information only without responsibility. This also applies to any violation of industrial property rights of a third-party.
Inspection of our units in view of their suitability for the intended use must be done generally by the user. Inspections are particulary necessary, if changes are executed, which serve for the further development or adaption of our products to the applications (hardware, software or download lists). Inspections must be repeated completely, even if only parts of hardware, software or download lists are modified.
Application and use of our units in the target products is outside of our control and therefore exclusively in the area of responsibility of the user.

1.2 Product description

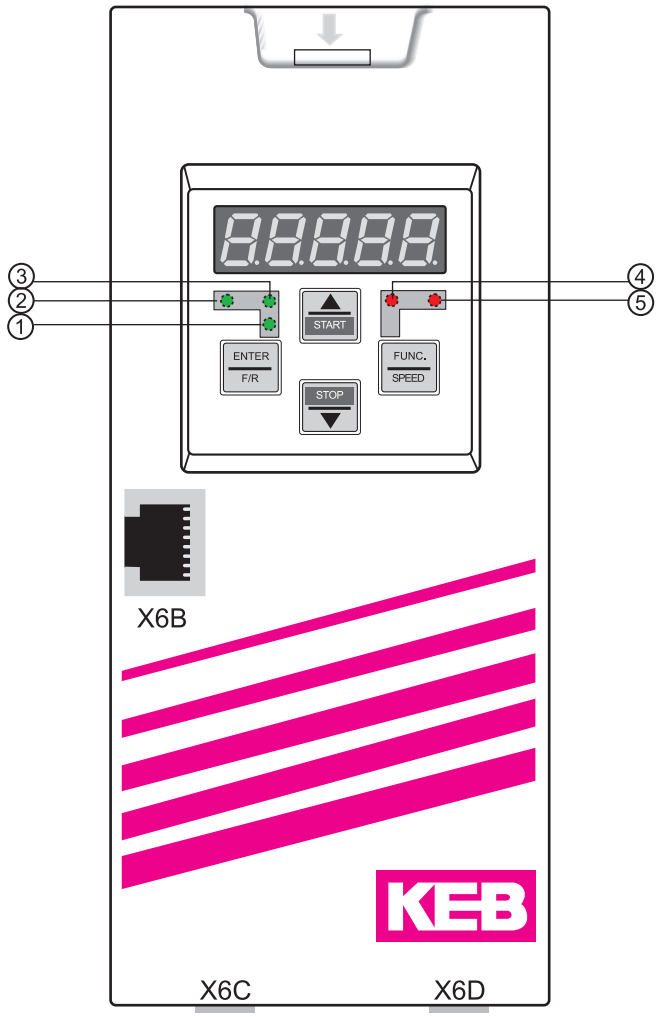
KEB develop, produce and sell static frequency inverters worldwide in the industrial power range. The inverters of the type F5 can be equipped optionally with a EhterCAT slave interface. The F5 EtherCAT operator is integrated into the FI housing by simple plug-in and fits into all F5-units. Here it concerns to an intelligent interface which controls the data transfer from EtherCAT to the FI control and reverse.

1.3 List of literature

[1]: ESC10/20 Hardware Data Sheet V1.0 v. 8.3.2005
[2]: CANopen Application Layer and Communication Profile DS301 V4.02
[3]: Application manual of the implemented inverter
[4]: CANopen Device profile drives and motion control DSP402 V2.0

2. Hardware

2.1 Overview of the control elements



① Process data active
② EtherCAT-Mailbox active
③ EtherCAT-Run
④ EtherCAT-Error
⑤ Inverter-Error
X6B Diagnostic interface
X6C EtherCAT-In
X6D EtherCAT-Out

2.2 Meaning of the LED´s

Component	Description
EtherCAT Mailbox active	Flashes as long as a mailbox command is carried out.
Process data active	Flashes as long as there is process data communication from and to the inverter.

further on next side

<table>
<tr><td>Component</td><td>Description</td></tr>
<tr><td>EtherCAT Run</td><td>Green RUN-Led according to the specification of ‚RUN Indicator‘ in the EtherCAT specification ([1]):
<table>
<tr><td>Flashing</td><td>Actual condition</td></tr>
<tr><td>Off</td><td>INIT</td></tr>
<tr><td>Cyclically blinking with ON(200ms) / OFF(200ms)</td><td>PRE-OPERATIONAL</td></tr>
<tr><td>Single flash with ON(200ms) / OFF(1000ms)</td><td>SAFE-OPERATIONAL</td></tr>
<tr><td>On</td><td>OPERATIONAL</td></tr>
</table></td></tr>
<tr><td>EtherCAT ERROR</td><td>Red Led according to specification of ‚ERR Indicator‘ in the EtherCAT specification ([1]):
<table>
<tr><th>Flashing</th><th>Description</th></tr>
<tr><td>Off</td><td>No error</td></tr>
<tr><td>Cyclically blinking with ON(200ms) / OFF(200ms)</td><td>General configuration errror</td></tr>
<tr><td>Single flash with ON(200ms) / OFF(1000ms)</td><td>The application of the slave device has automatically changed the communication state</td></tr>
<tr><td>Double Flash with ON(200ms) / OFF(200ms) / ON(200ms) / OFF(1000ms)</td><td>The application watchdog has responded</td></tr>
<tr><td>On</td><td>The process data watchdog has responded. The host controller of the application does not respond any more.</td></tr>
</table></td></tr>
<tr><td>Inverter Error</td><td>Red Led as a repeater of the Error-Led of the inverter control:
<table>
<tr><th>Flashing</th><th>Description</th></tr>
<tr><td>Off</td><td>No power supply on the inverter control board</td></tr>
<tr><td>Blinking</td><td>Inverter control board in error status</td></tr>
<tr><td>On</td><td>Operating condition OK</td></tr>
</table></td></tr>
</table>

2.3 Diagnostic interface X6B

RJ45 connector of the diagnostic interface.

Attention !!! In order to avoid a destruction of the PC interface, the diagnostic interface may only be connected to the serial interface of the PC by a special HSP5 cable with voltage adaption.

2.4 EtherCAT interface X6C, X6D

Standard Ethernet-RJ45 c onnector according to IEEE 802.3 100Base-T.

<table>
<tr><td>Link</td><td>Yellow Led in Ethernet connector:
<table>
<tr><th>Flashing</th><th>Description</th></tr>
<tr><td>Off</td><td>No Ethernet link present</td></tr>
<tr><td>Blinking</td><td>Ethernet communication active</td></tr>
<tr><td>On</td><td>Ethernet link present</td></tr>
</table></td></tr>
<tr><td>Speed</td><td>Green Led in Ethernet connector: Displays, whether the Ethernet communication is running with 100Mbit/s (LED = ON) or not.</td></tr>
</table>

3. Software

3.1 Fundamentals of the EtherCAT interface connection

The KEB F5 EtherCAT operator contains a EtherCAT slave controller for time-critical operations of the EtherCat communication. By using this EtherCAT controller it is guaranteed that basic communication is compatible to the EtherCAT specification.

3.1.1 EtherCAT Configuration (EEPROM)

All values are saved in intel format (LSbyte first) into the EEPROM. The following table only lists the main features of the KEB-F5-EtherCAT-EEPROM.

Byte Offset	Description	Value
0	PDI-Control	0009h
2	PDI-Config	0400h
4	SyncImpulseLength	000Ah

3.1.2 Mailbox communication

The KEB F5 EtherCAT operator supports the mailbox communication. All parameters of the FI control and the operator can be read out or preset itself via this mailbox by using the CANoverEtherCAT.

Buffer size of the receive mailbox	**Minimum**	**Maximum**
	16 Byte	50 Byte
Buffer size of the transmit mailbox	Minimum	Maximum
	16 Byte	50 Byte
Supported mailbox protocols	CANoverEtherCAT(CoE)	
Supported CoE services	Initiate SDO download expedited in server mode, Initiate SDO upload expedited in server mode, Emergency as client	

3.1.2.1 Parameter addressing by 16 bit index plus 8 bit subindex

The following table shows parameter grouping according to [2]:

1.Index	Last index	Description
1000h	1FFFh	Communication parameter according to [2]
2000h	5E00h	Parameter of the FI control with index = KEB-Parameter-Address + 2000h(*1). The subindex is used for set-addressing
6000h	9FFFh	Device profile parameters according to [4]

(*1): The KEB parameter address can be found in the application manual of the used FI.

3.1.2.2 Set-addressing with subindex

For KEB parameters (Index = 2000h...5FFFh) the subindex is used for set-addressing. Thereby the following coding is used:

Subindex	Description
0	Indirect set-addressing: The set to be addressed depends on the value of parameter Fr.09 in the FI control.
1	Direct addressing of set0
2	Direct addressing of set1
4	Direct addressing of set2
8	Direct addressing of set3
16	Direct addressing of set4
32	Direct addressing of set5
64	Direct addressing of set6
128	Direct addressing of set7

By use of this bit-coding it is possible to address more than one parameter-set simultaneously. However this should not be used for parameter-reading, because an error message is returned if not all values in the addressed sets are the same. This mechanism can also be used to map PDO-Rx-data simultaneously to the parameters in several sets of the inverter.

3.1.3 Process data communcation

Through the process data channel it is possible to preset non-addressed setpoints to the KEB-F5 and actual values can be requested. Data communication of the process data between application and EtherCAT slave controller occurs via 3-buffer mechanism. The maximum of process data that can be transferred is 8 byte each per direction.

3.1.4 Distributed clocks

The function distributed clocks is used for the synchronous operating mode (see above) in the KEB-F5-EtherCAT operator. In this mode the interrupt cycles of the FI control is synchronized to the EtherCAT distributed clock-cycles. With this a very precise synchronization of several KEB-F5 inverters is possible. Does the EtherCAT master not support distributed clocks or are the distributed clocks not activated, then the KEB-F5-EtherCAToperator is working completely asynchronous to the EtherCAT cycle.

3.2 Functions

3.2.1 Process data mapping

Which parameters of the inverter control concern to the process data is determined by the process data assignment. The default process data assignment for this is:

Process output data (EtherCAT-Master → KEB-Slave):

Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
SY.43: Control word (long)				SY.52: Set speed		IN.22: User Parameter 1	
LSByte			MSByte	LSByte	MSByte	LSByte	MSByte

Process input data (KEB-Slave → EtherCAT-Master):

Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
SY.44: Status word (long)				SY.53: Actual Speed		IN.22: User Parameter 1	
LSByte			MSByte	LSByte	MSByte	LSByte	MSByte

The process data assignment can be adapted by CANopen parameters with index = 1600h and index = 1A00h. The default process data assigment has the following meaning:

Index	Subindex	Value
1600h	0	3
1600h	1	202B0120h
1600h	2	20340110h
1600h	3	2E160110h
1A00h	0	3
1A00h	1	202C0120h
1A00h	2	20350110h
1A00h	3	2E160110h

IMPORTANT !!! For synchronous operating mode the process data assignment has to follow the form 1*32-Bit + 1-2times 16-Bit for both data directions.

3.2.2 Synchronous mode

In synchronous mode the SYNCO interrupt preset by the EtherCat slave controller is used as synchronisation signal for the internal communication. Synchronous operating mode is only possible for the F5-EtherCAT operator, if SYNC0 signals are activated by the EtherCAT master and the process data assignment is preset in both data directions according to the above mentioned rules (1 time 32-Bit + 1-2 time 16-Bit).

The following register presettings in the KEB-EtherCAT slave must be made by the master for this:

Bit0 and Bit1 must be set to 1 in (byte) register 0981h:

0981h:

Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
x	x	x	x	x	x	1	1

A multiple of 1 ms must be entered in the 32 bit register beginning with the address = 09A0h. Please note that this value is indicated in ns. Value = 1.000.000 is correspond to 1ms:

09A0h	09A1h	09A2h	09A3h
LS-Byte	Byte1	Byte2	MS-Byte

In synchronous mode the operator displays constantly the following output:

The value of parameter Com_Cycle gives information about the adjusted cycle time.

This synchronous operating mode includes some restrictions. As mentioned above the display is static. Furthermore inputs via keyboard are also no longer possible. The diagnostic interface continues to operate. But the processing speed of all services heavy depends on the synchronous cycle time. The cycle time is preset as multiple of 1 ms, the minimum possible value is 1 ms. During each SYNCO cycle the actual process output data are transferred to the FI control and the actual process intput data are read from it.
If the synchronous operating mode is activated, but no SYNC0 interrupts are released, the F5-EtherCAT operator switches in automatic synchronous mode at default setting which can be identified in the following display string:

Herein the operator simulates the SYNC0 interrupts time controlled according to the configured sync0 cycle time. In the following the SYNCO interrupt is meant if we speak from ‚**SYNC event**'. The SYNC timeout time is four times of the adjusted SYNC cycle time (see Com_Cycle). This can be adapted by the user via parameter **User_HS_SyncToutTime**.

A process output data monitoring is additionally running to the SYNC monitoring in the current software, when the EtherCAT operator runs in synchronous operation mode.The operator recognizes the missing of incomming new process output data. The value of parameter Real_HS_SyncToutTime is accepted as timeout time. That means the PDOUT monitoring operates with the same Timeout adjustment as the SYNC Timeout monitoring.
However this additional functionality can be switched off for downward compatibility reasons via parameter FBS Config. In contrast to the reaction of the SYNC Timeout case (HS_SyncToutMode), the reaction to the PDOUT Timeout case is not adjustable in the synchronous operation mode. If the PDOUT Timeout case occurs, the operator automatically leaves the synchronous operation mode and goes into EtherCAT status PreOperational. The

SYNC Timeout reaction is carried out if PDOUt Timeout and SYNC Timeout are at the same time.

3.2.3 Emergency

If this function is activated via parameter EmergencyCycle, the EtherCat operator reads cyclically parameter ru.00 from the inverter control. The operator starts an emergency message via CoE channel of the mailbox communication if an error status is recognized . This is also done if the error is no longer present. The message contains 8 bytes of data. The first 3 bytes of this data are defined by [2], the last 5 bytes can be assigned manufacturer-specific. The KEB-F5-EtherCAT operator fills the emergency message as follows:

Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
ErrorCode		Error register	InverterState (ru.00)		00h (KEB)	00h (KEB)	00h (KEB)
LB	HB		LB	HB			

3.2.4 EtherCAT-Watchdog

It is a monitoring function of the EtherCAT slave controller. The watchdog monitors the cyclic incoming of new process output data in operational state. This function must be activated by the EtherCAT master.

- The register Watchdog devider(WD_Devider: 0400h) must be set.
- SyncManager2-Control-Byte. Bit6 must be set to 1 (XML file).
- Register Watchdog-Time-Syncmanager (WD_Time_SM: 0420h) mut be unequal to 0.

The watchdog timeout time is calculated as follows:

WD_Time = (WD_Devider + 2) * WD_Time_SM * 40ns

When responding the Syncmanager watchdog the EtherCAT slave changes automatically into safe operational state.

By the operator parameter watchdog inhibit releasing the EtherCAT watchdog can be used also for releasing the field bus watchdog (see next chapter). Thereby the field bus watchdog releases after the EtherCAT watchdog, decelerated by the field bus watchdog time (Pn.05).

3.2.5 Field bus watchdog

The field bus watchdog is a function in the EtherCAT operator. It serves to set the inverter control into error (E.BUS) or warning (A.BUS), if certain events on the field bus do not occur cyclically within an adjustable cycle-time. Two operator parameters (**Watchdog inhibit**, **Watchdog activation**) exist for activating the field bus watch-dog. Additionally the parameters **Pn.05**, **Pn.06** have to be set in the inverter control to define the cycle time and the reaction on the timeout.

The EtherCAT operator monitors the occurance of the configured field bus events. Different events can cause the reset of the watchdog. Does the timeout-time expire without one of the configured events occur, then the operator triggers the watchdog event via the serial interface to the inverter. If and how the FI control reacts on this, is de-termined by the responded parameters in the FI control of the inverter.

4 Operator Parameters

Name:	**Com_Cycle**
Index:	**1006h**
Subindex:	0
Description:	Serves for control, whether the synchronous operating mode is active. The value is coded in *s, but it has an internal resolution of 1 ms.
Data length:	4 Byte
Coding:	0 = OFF (normal operating mode), otherwise 1 µs.
Value range:	0, 1000, 2000, 3000, ..., 65000
Remarks:	The content of the 32-Bit-Register 09A0h in the EtherCAT slave controller serves as source for this value.

Name:	**Device type**
Index:	**1000h**
Description:	Displays the type of device according to [2]:
Subindex:	0
Data length:	4 Byte
Coding:	Byte4 | Byte5 | Byte6 | Byte7 Device profile no. | Additional informations LB | HB | LB | HB
Default value:	0

Name:	**Error register**
Index:	**1001h**
Description:	Displays the actual error status according to [2]:
Subindex:	0
Data length:	1 Byte
Coding:	Bit7: Manufacturer spec. | Bit6: Reserv. | Bit5: Device profile spec. | Bit4: Communication | Bit3: Temperature | Bit2: Voltage | Bit1: Current | Bit0: Error generally
Default value:	0
Remarks:	This parameter is read-only.

Name:	**Manufactuer Status Register**
Index:	**1002h**
Description:	Returns the value of parameter RU.00 as 4 byte value.
Subindex:	0
Data length:	4 Byte
Coding:	s. [3]
Remarks:	This parameter is read-only.

Name:	**Pre-defined error field**
Index:	**1003h**
Description:	This parameter contains a field of maximum 6 entries where the error-history can be read out. Subindex = 0 contains the number of errors that have been saved whereby the entries with subindex = 1-5 contain the real error entries
Subindex:	**0: number of errors**
Data length:	4 Byte
Coding:	1
Remarks:	Writing on subindex = 0 deletes the error-history completely.
Subindex:	**1-5: standard error field**
Data length:	4 Byte
Coding:	according to [2], as follows:

Byte4	Byte5	Byte6	Byte7
ErrorCode		InverterState(ru.00)	
LB	HB	LB	HB

Remarks:	The entries are read-only.

Name:	**Manufactuer Device Name**
Index:	**1008h**
Description:	Displays the value of parameter inverter identification SY.02 as 4-character hexadecimal coded string.
Subindex:	0
Data length:	4 Byte
Coding:	Value 0864Ah/2148 would appear in the CAN telegram as follows:

Byte4	Byte5	Byte6	Byte7
30h:‘0‘	38h:‘8‘	36h:‘6‘	34h:‘4‘

Remarks:	This parameter is read-only.

Name:	**Manufacturer Hardware Version**
Index:	**1009h**
Description:	Displays the value of parameter hardware version (IN.00) as 4-character hexadecimal coded string.
Subindex:	0
Data length:	4 Byte
Coding:	Value 014Ah/330 would appear in the CAN telegram as follows:

Byte4	Byte5	Byte6	Byte7
30h:‘0‘	31h:‘1‘	34h:‘4‘	41h:‘A‘

Remarks:	This parameter is read-only.

Name:	**Manufactuer Software Version**
Index:	**100Ah**
Description:	Displays the value of parameter software version (IN.06) as 4-character hexadecimal coded string.
Subindex:	0
Data length:	4 Byte

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Coding:	Value 014Ah/330 would appear in the CAN telegram as follows: Byte4: 30h:‘0‘ | Byte5: 31h:‘1‘ | Byte6: 34h:‘4‘ | Byte7: 41h:‘A‘
Remarks:	This parameter is read-only.

Name:	**Identity Object**
Index:	**1018h**
Description:	Indicates the identification of the node in form of a structure.
Subindex:	**0 : Nr of entries**
Description:	Indicates the number of objects in this PDO.
Data length:	1 Byte
Coding:	1
Default value:	2
Subindex:	**1 : Vendor ID**
Description:	Indicates the code that has been distributed by the CAN in automation user group.
Data length:	4 Byte
Coding:	
Default value:	00000014h (KEB)
Subindex:	**2 : Product Code**
Description:	Indicates the product code of the node. This parameter is coded manufacturer-specific.
Data length:	4 Byte
Coding:	Combivis Config_Id of the connected inverter control.
Default value:	Depending on the connected inverter control.
Subindex:	**3: Revision Number**
Description:	Indicates the revision number of the node. This parameter is coded manufacturer-specific.
Data length:	4 Byte
Coding:	1
Default value:	
Remarks:	All members of this parameter are read-only.

Name:	**ECATAddr**
Index:	**1100h**
Description:	Indicates the EtherCAT address.
Subindex:	0
Data length:	2 Byte
Coding:	1
Remarks:	This parameter is read-only.

Name:	**Syncman CommType**
Index:	**1C00h**
Description:	This parameter indicates the communication type of the used SyncManager.
Subindex:	**0 : NumbersOfUsedSyncManagerChannels**
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Description:	Indicates the number of objects in this PDO.
Data length:	1 Byte
Coding:	1
Default value:	4
Remarks:	The value of the parameter is ReadOnly.
Subindex:	**1 : CommType SM0**
Description:	Indicated the communication type of SyncManager 0.
Data length:	1 Byte
Coding:	0: Not used
	1: Mailbox receive (master to slave)
	2: Mailbox send (slave to master)
	3: Processdata output (master to slave)
	4: Processdata input (slave to master)
Default value:	1
Remarks:	The value of the parameter is ReadOnly.
Subindex:	**2 : CommType SM1**
Description:	Indicated the communication type of SyncManager 1.
Data length:	1 Byte
Coding:	s.a.
Default value:	2
Remarks:	The value of the parameter is ReadOnly.
Subindex:	**3 : CommType SM2**
Description:	Indicated the communication type of SyncManager 2.
Data length:	1 Byte
Coding:	s.a.
Default value:	3
Remarks:	The value of the parameter is ReadOnly.
Subindex:	**4 : CommType SM3**
Description:	Indicated the communication type of SyncManager 3.
Data length:	1 Byte
Coding:	s.a.
Default value:	4
Remarks:	The value of the parameter is ReadOnly.

Name:	**Syncman0 PDOAssign**
Index:	**1C10h**
Description:	This parameter indicates the PDO assignment for Syncmanager 0.
Subindex:	**0 : NumbersOfAssignedPDOs**
Description:	Indicated the number of assigned PDOs.
Data length:	1 Byte
Coding:	1
Default value:	0
Remarks	The value of the parameter is ReadOnly.

Name:	**Syncman1 PDOAssign**
Index:	**1C11h**
Description:	This parameter indicates the PDO assignment for Syncmanager 1.
Subindex:	**0 : NumbersOfAssignedPDOs**
Description:	Indicated the number of assigned PDOs.
Data length:	1 Byte
Coding:	1
Default value:	0
Remarks	The value of the parameter is ReadOnly.

Name:	**Syncman2 PDOAssign**
Index:	**1C12h**
Description:	This parameter indicates the PDO assignment for Syncmanager 2.
Subindex:	**0 : NumbersOfAssignedPDOs**
Description:	Indicated the number of assigned PDOs.
Data length:	1 Byte
Coding:	1
Default value:	1
Remarks	The value of the parameter is ReadOnly.
Subindex:	**1 : 1st PDOMappingObjekt**
Description:	Indicates the first PDO mapping object.
Data length:	2 Byte
Coding:	1
Default value:	1600h
Remarks:	The value of the parameter is ReadOnly.

Name:	**Syncman3 PDOAssign**
Index:	**1C13h**
Description:	This parameter indicates the PDO assignment for Syncmanager 3.
Subindex:	**0 : NumbersOfAssignedPDOs**
Description:	Indicated the number of assigned PDOs.
Data length:	1 Byte
Coding:	1
Default value:	1
Remarks	The value of the parameter is ReadOnly.
Subindex:	**1 : 1st PDOMappingObjekt**
Description:	Indicates the first PDO mapping object.
Data length:	2 Byte
Coding:	1
Default value:	1A00h
Remarks:	The value of the parameter is ReadOnly.

<table>
<tr><td>Name:</td><td>1st receive PDO Mapping</td></tr>
<tr><td>Index:</td><td>1600h</td></tr>
<tr><td>Description:</td><td>This parameter defines the process data assignment of the first master to slave.</td></tr>
<tr><td>Subindex:</td><td>0 : Nr of Mapped objects</td></tr>
<tr><td>Description:</td><td>Indicates the number of mapped objects in this PDO.</td></tr>
<tr><td>Data length:</td><td>1 Byte</td></tr>
<tr><td>Coding:</td><td>1</td></tr>
<tr><td>Default value:</td><td>3</td></tr>
<tr><td>Remarks:</td><td>Value = 0 deactivates the operation of this PDO. When activating the PDO by writing a value unequal to zero the operator first checks the process data mapping for general validity. Then this mapping is converted into the inverter process data assignment and written to the inverter control. If everything could be done without error, the process data assignment is activated and stored non-volatile.</td></tr>
<tr><td>Subindex:</td><td>1-4 : Nth mapped object</td></tr>
<tr><td>Description:</td><td>Indicates an object mapping.</td></tr>
<tr><td>Data length:</td><td>4 Byte</td></tr>
<tr><td>Coding:</td><td>According to [2] as follows:

<table>
<tr><td>Byte7</td><td>Byte6</td><td>Byte5</td><td>Byte4</td></tr>
<tr><td colspan="2">Index</td><td rowspan="2">Subindex</td><td rowspan="2">Bitlength</td></tr>
<tr><td>HB</td><td>LB</td></tr>
</table>

Please note that the sequence in the CAN telegram follows the Intel format. That means that the first byte (byte4) in the CAN telegram contains the bit length of this mapping and the last byte (byte7) contains the high-byte of the index.</td></tr>
<tr><td>Default value:</td><td>s.a.</td></tr>
<tr><td>Remarks:</td><td>Writing on the mapping automatically deactivates the PDO operation by resetting the value of subindex „0“ to zero. Please note that not all parameters of the inverter control can be mapped to process data. Operator parameters can not be mapped to process data.</td></tr>
</table>

Name:	**1st transmit PDO Mapping**
Index:	**1A00h**
Description:	This parameter defines the process data assignment of the first PDO that carries data from slave to master. All further informations can be taken from the description of parameter 1st receive PDO mapping.

Name:	**HS_SyncToutMode**
Index:	**2281h**
Subindex:	0
Description:	Determines the reaction to the SYNC Timeout case, see chapter synchronous operation mode.
Data length:	1 Byte
Coding:	0: Automatic return into normal mode.
	1: Change into automatic synchronous mode.
Default value:	1
Remarks:	A new value will be immediately active and stored non-volatile.

Name:	**HS_SyncToutDelay**
Index:	**2282h**
Subindex:	0
Description:	Here it can be configured how many SYNC events have to be received until the SYNC timeout-supervising is activated after switching on. This parameter can be used if the cyclic SYNC events cannot be guaranteed immediately after switching into the synchronous operating mode.
Data length:	2 Byte
Coding:	Number of SYNC events
Default value:	0
Remarks:	A new value will be immediately active and stored non-volatile.

Name:	**EmergencyCycle**
Index:	**2283h**
Subindex:	0
Description:	Serves for activation of the emergency function. Values unequal to zero define the cycle time in ms, in which the value of the inverter parameter ru.00 is read. On occurance and leaving of an error-state an emergency message is output via the emergency mechanism.
Data length:	4 Byte
Coding:	1ms, 0 = OFF (no Emergency)
Default value:	0
Remarks:	A changed value will be immediately active and stored non-volatile.

Name:	**FBS Command**
Index:	**2284h**
Subindex:	0
Description:	Serves for carry out of special commands in the EtherCAT operator.
Data length:	2 Byte
Coding:	0: command
	1: Storing of the default values in the nonvolatile memory.
Default value:	0
Remarks:	After execution of the command the operator sets bit15 of the value as confirmation that the execution is completed.

Name:	**Watchdog activation**
Index:	**2287h**
Subindex:	0
Description:	Defines, when the field bus-watchdog is activated after power on.
Data length:	1 Byte
	further on next side

Coding:	Mixture of value-coding and bit-coding. 0: The field bus-watchdog ist active immediately after power on. Bit7 | Bit6 | Bit5 | Bit4 | Bit3 | Bit2 | Bit1 | Bit0 – | – | SDO | – | PDOUT | STATE_OP | STATE_PREOP | SYNC **SYNC**: If this bit is set, the field bus-watchdog is activated after occurence of the first SYNC event. **STATE_PREOP**:**If this bit is set, the field bus-watchdog is activated after first switch to pre-operational-state.** **STATE_OP**: **If this bit is set, the field bus-watchdog is activated after first switch to operational-state.** **PDOUT**: If this bit is set, the field bus-watchdog is activated after the first receiption of process output data. **SDO**: if this bit is set, the fild bus-watchdog is activated after the first receiption of a SDO-request.
Default value:	04h
Remarks:	A changed value will be immediately active and stored non-volatile.

Name:	**Watchdog inhibit**
Index:	**2288h**
Subindex:	0
Description:	Indicates the events that reset the field bus-watchdog from running into timeout.
Data length:	1 Byte
Coding:	Bit7 | Bit6 | Bit5 | Bit4 | Bit3 | Bit2 | Bit1 | Bit0 reserved | BUSOK | SDO-Req | PDOUT
	PDOUT: If this bit is set, the field bus watchdog is reset on every transfer of process output data to the inverter control.
	SDO-Req: If this bit is set, the field bus-watchdog is reset on every receiption of a SDO-request through the mailbox channel.
	BUSOK: If this bit is set, the field bus-watchdog is reset if bit 4 of the AL status register in the EtherCAT slave controller is 0. This means, that the slave did accept the EtherCAT state-transitions requsted by the master..
Default value:	07h
Remarks:	A changed value will be immediately active and stored non-volatile.

Name:	**Save_VL_Ramps**
Index:	**228Bh**
Subindex:	0
Description:	Serves for non-volatile storing of the Velocity mode ramps in the EtherCAT operator.
Data length:	1 Byte
Access:	READ_WRITE
Coding:	Bit7 | Bit6 | Bit5 | Bit4 | Bit3 | Bit2 | Bit1 | Bit0 – | – | Save VL-QST. Dtime | Save VL-DEC. Dtime | Save VL_ACC. Dtime | Save VL-QST. Dspeed | Save VL-DEC. Dspeed | Save VL-ACC. Dspeed
	further on next side

	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
Remarks:	Value 0 is always returned on reading.	

Name:	**VL_Ramp_CalcMode**
Index:	**228Ch**
Subindex:	0
Description:	Determines the mode of calculation for the conversion of a KEB ramp time into a DSP402 velocity ramp.
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 become as small as possible, but the accuracy of the ramp time to be converted still remains.
	1: Only VL ramp. Dtime is calculated, VL ramp. Dspeed remains unchanged.
	2: As value for VL ramp. Dtime the value of the KEB ramp time is accepted. VL ramp. Dspeed is set accordingly.
Default value:	0

Name:	**User_HS_SyncToutTime**
Index:	**228Dh**
Subindex:	0
Description:	Serves for the adaption of the SYNC Timeout time in the synchronous operation mode to the application by the user.
Data length:	2 Byte
Access:	READ_WRITE
Coding:	Number of missing SYNC events until a SYNC Timeout is determined.
Default value:	0
Remarks:	A changed value will be immediately active and stored non-volatile.

Name:	**Real_HS_SyncToutTime**
Index:	**228Eh**
Subindex:	0
Description:	Indicates the real active SYNC Timeout time.
Data length:	2 Byte
Access:	READ_ONLY
Coding:	Number of missing SYNC events until a SYNC Timeout is determined.
Default value:	4
Remarks:	A changed value will be immediately active and stored non-volatile.

Name:	**FBS Config**	
Index:	**228Fh**	
Subindex:	0	
Description:	Determines the configuration of the EtherCAT connection regarding to certain behaviors.	
Data length:	2 Byte	
Access:	READ_WRITE	
Coding:	Bit-coding as follows:	
	Bit0 = 1:	No PDOUT monitoring in the synchronous operation mode. In the actual software version not only the receive of the SYNC event, but also the cyclic incromming of process output data is monitored in synchronous operation mode. By setting of this bit, the downward compatibility can be made with the previous software, where this function was not available.
Default value:	0	
Remarks:	A changed value will be immediately active and stored non-volatile.	

Name:	**PD_In_Cycle**
Index:	**2290h**
Subindex:	0
Description:	Determines the cycle time where the process input data are read by the frequency inverter in non-synchronous operation mode, in order to update them on EtherCAT.
Data length:	2 Byte
Access:	READ_WRITE
Coding:	1 ms
Default value:	25 (ms)
Remarks:	A changed value will be immediately active and stored non-volatile.

5. DSP402-Parameter

In the following parameters are listed that are defined by the CANopen device-profile DSP402 [4]. Some of this parameters are rescaled by the EtherCat operator and then they are mapped to a KEB internal parameter of the inverter control. Partly some of these parameters are completely realized in the operator.

Name:	**DSP402_SuppDriveModes**
Index:	**6502h**
Subindex:	0
Description:	Indicates the supported DSP402 operation modes.
Data length:	4 Byte
Coding:	according to [4]
Default value:	00000002h
PDO-mapping:	unrepresentable
Remarks:	This parameter is read-only.

Name:	**DSP402_ModesOfOperation**
Index:	**6060h**
Subindex:	0
Description:	Determines the DSP402 operation mode.
Data length:	1 Byte
Coding:	according to [4]
	-1: manufacturer-specific
	0: reserved
	1: Profile Position Mode (not possible here)
	2: Velocity Mode
Default value:	-1: manufacturer-specific
PDO-mapping:	unrepresentable

Name:	**DSP402_ErrorCode**
Index:	**603Fh**
Subindex:	0
Description:	Output of an error code.
Data length:	2 Byte
Coding:	according to [4]
Default value:	0
PDO-mapping:	receive PDO: No / transmit PDO: Yes
Remarks:	This parameter is read-only and is internally mapped to parameter **ru.00**.

Name:	**DSP402_Control word**
Index:	**6040h**
Subindex:	0
Description:	Control word according to [4]. The parameter is bit-coded.
Data length:	2 Byte
Coding:	Bit-coded according [4] The following table only lists the bits that are realised in this software. Note that some bits are different assigned by the settings of the DSP402-mode (see table below):

Modes of operation	b7	b6	b5	b4	b3	b2	b1	b0
	Fault Reset	Mode-dependent			Enable Operation	Quick Stop	Ennable Voltage	Switch ON
255	„	Res.	Res.	Res.	„	„	„	„
2	„	RFG Use Ref	RFG Unlock	RFG Enable	„	„	„	„

Default value:	
PDO-mapping:	

receive PDO	transmit PDO
Yes	Yes

Remarks:	This parameter is internally mapped to parameter **SY.50**.

Name:	**DSP402_Statusword**
Index:	**6041h**
Subindex:	0
Description:	Status word with coding according to [4]. The parameter is bit-coded.
Data length:	2 Byte
Coding:	

Mode	b15... b14	b13	b12	b11	b10	b9	b8... b7	b6	b5	b4	b3	b2	b1	b0
		Mode-dependent		Int. Limit Active	Target Reached	Remote		Switch ON Disabl.	Quick Stop	Volt. Enabl.	Fault	Operation Enabl.	Switched ON	Ready To Switch ON
255		Res.	Res.	„	„	„	„	„	„	„	„	„	„	„
2		Res.	Res.	„	„	„	„	„	„	„	„	„	„	„

Default value:	
PDO-mapping:	

receive PDO	Transmit PDO
No	Yes

Remarks:	This parameter is internally mapped to parameter **SY.51**.

6. Annex

6.1 Overview of the operator parameters

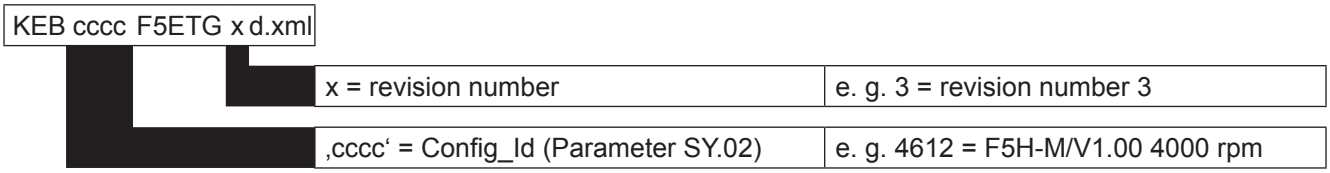
Index	Subin-dex	Diagno-sis Param. address	Diagnosis Parameter name	CANopen Parameter name	Data length in Byte	Access
1000h	0	-----	-----	Device type	4	RD
1001h (KEB)	0	-----	-----	Error register	1	RD
1002h (KEB)	0	-----	-----	Manufactuer Status Register	4	RD
1003h	0-5	-----	-----	Predefine Error Field	4	RD_RW
1006h	0	0280h	-----	ComCycle	4	RD_RW
1008h (KEB)	0	-----	-----	Manufactuer Device Name	4	RD
100Ah	0	-----	-----	Manufacturer Software Ver-sion	4	RD
1018h (KEB)	-----	-----	-----	Identity Object	-----	
1018h (KEB)	1	-----	-----	Vendor Id	4	RD
1018h (KEB)	2	-----	-----	Product Code	4	RD
1100h	0	039Dh	ECATAddr	EtherCAT address	2	RD
1600h	-----	-----	-----	1st receive PDO Mapping	-----	
1600h	0	029Bh	Nr_PDOut_Objs	Number of mapped objects	1	RD_RW
1600h	1	0297h (KEB)	PDOut1_Map	1st mapped Object	4	RD_WR
1600h	2	0298h (KEB)	PDOut2_Map	2nd mapped Object	4	RD_WR
1600h	3	0299h (KEB)	PDOut3_Map	3rd mapped Object	4	RD_WR
1600h	4	029Ah	PDOut4_Map	4th mapped Object	4	RD_WR
1A00h	-----	-----	-----	1st Transmit PDO Mapping	-----	
1A00h	0	0295h	Nr_PDIn_Objs	Number of mapped objects	1	RD_RW
1A00h	1	0291h	PDIn1_Map	1st mapped Object	4	RD_WR
1A00h	2	0292h	PDIn2_Map	2nd mapped Object	4	RD_WR
1A00h	3	0293h	PDIn3_Map	3rd mapped Object	4	RD_WR
1A00h	4	0294h	PDIn4_Map	4th mapped Object	4	RD_WR
1C00h	-----	-----		Syncman CommType	-----	RD
1C00h	0	-----		NumberOfUsedSyncManager-Channels	1	RD
1C00h	1	-----		CommType SM0	1	RD
1C00h	2	-----		CommType SM1	1	RD
1C00h	3	-----		CommType SM2	1	RD
1C00h	4	-----		CommType SM3	1	RD
1C10h	-----	-----		Syncman0 PDOAssign	1	RD
1C10h	0	-----		NumberOfAssignedPDOs	1	RD
1C11h	-----	-----		Syncman1 PDOAssign	1	RD
1C11h	0	-----		NumberOfAssignedPDOs	1	RD
1C12h	-----	-----		Syncman2 PDOAssign	1	RD

1C12h	0	-----		NumberOfAssignedPDOs	1	RD
1C12h	1	-----		1st PDOMappingObject	2	RD
1C13h	-----	-----		Syncman3 PDOAssign	1	RD
1C13h	0	-----		NumberOfAssignedPDOs	1	RD
1C13h	1	-----		1st PDOMappingObject	2	RD
2281h	0	0281h	HS_SyncToutMode	HS_SyncToutMode	1	RD_WR
2282h	0	0282h	HS_SyncToutDelay	HS_SyncToutDelay	2	RD_WR
2283h	0	0283h	EmergencyCycle	EmergencyCycle	2	RD_WR
2284h	0	0284h	FBS Command	FBS Command	2	RD_WR
2287h	0	0287h	Watchdog Activation	Watchdog Activation	1	RD_WR
2288h	0	0288h	Watchdog Inhibit	Watchdog Inhibit	1	RD_WR
228Bh	0	028Bh	Save_VLRamps	Save_VLRamps	1	RD_WR
228Ch	0	028Ch	VL_Ramp_CalcMode	VL_Ramp_CalcMode	1	RD_WR
228Dh	0	028Dh	User_HS_SyncToutTime	User_HS_SyncToutTime	2	RD_WR
228Eh	0	028Eh	Real_HS_SyncToutTime	Real_HS_SyncToutTime	2	RD
228Fh	0	028Fh	FBS Config.	FBS Config.	2	RD_WR
2290h	0	0290h	PD_In_Cycle	PD_In_Cycle	2	RD_WR
6502h	0	-----	DSP402_SuppDriveModes	DSP402_SuppDriveModes	4	RD
6060h	0	-----	DSP402_ModesOfOperation	DSP402_ModesOfOperation	1	RD_WR
603Fh	0	-----	-----	DSP402_ErrorCode	2	RD
6040h	0	-----	DSP402_Controlword	DSP402_Controlword	2	RD_WR
6041h	0	-----	DSP402_Statusword	DSP402_Statusword	2	RD

6.2 Unit desciption by XML files

KEB power transmission provides so-called XML files as unit description files, which are compatible to the actual EtherCAT standard. Since KEB drives covers a wide spectrum of applications, these differ partly significant in their object index. A XML file is generated for each KEB inverter type in order to receive a proper allocation from unit to object index.
The file name of the XML files contains the Config_Id for classification of the inverter type and the version of the EtherCat software.

The file name of a KEB F5 XML file is structured completely as follows.



Observe that not each new software version in the EtherCat operator gets also a new revision.

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 worldwide…

KEB Antriebstechnik Austria GmbH
Ritzstraße 8 • **A**-4614 Marchtrenk
fon: +43 7243 53586-0 • fax: +43 7243 53586-21
net: www.keb.at • mail: info@keb.at

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

KEB Power Transmission Technology (Shanghai) Co.,Ltd.
No. 435 QianPu Road, Songjiang East Industrial Zone,
CHN-201611 Shanghai, P.R. China
fon: +86 21 37746688 • fax: +86 21 37746600
net: www.keb.cn • mail: info@keb.cn

KEB Antriebstechnik Austria GmbH
Organizační složka
K. Weise 1675/5 • **CZ**-370 04 České Budějovice
fon: +420 387 699 111 • fax: +420 387 699 119
net: www.keb.cz • mail: info.keb@seznam.cz

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

KEB España
C/ Mitjer, Nave 8 - Pol. Ind. LA MASIA
E-08798 Sant Cugat Sesgarrigues (Barcelona)
fon: +34 93 897 0268 • fax: +34 93 899 2035
mail: vb.espana@keb.de

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
net: www.keb.fr • mail: info@keb.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 33535311 • fax: +39 02 33500790
net: www.keb.it • mail: kebitalia@keb.it

KEB Japan Ltd.
15–16, 2–Chome, Takanawa Minato-ku
J–Tokyo 108-0074
fon: +81 33 445-8515 • fax: +81 33 445-8215
mail: info@keb.jp

KEB Korea Seoul
Room 1709, 415 Missy 2000
725 Su Seo Dong, Gang Nam Gu
ROK-135-757 Seoul/South Korea
fon: +82 2 6253 6771 • fax: +82 2 6253 6770
mail: vb.korea@keb.de

KEB RUS Ltd.
Lesnaya Str. House 30, Dzerzhinsky (MO)
RUS-140091 Moscow region
fon: +7 495 632 0217 • fax: +7 495 632 0217
net: www.keb.ru • mail: info@keb.ru

KEB Sverige
Box 265 (Bergavägen 19)
S-43093 Hälsö
fon: +46 31 961520 • fax: +46 31 961124
mail: vb.schweden@keb.de

KEB America, Inc.
5100 Valley Industrial Blvd. South
USA-Shakopee, MN 55379
fon: +1 952 224-1400 • fax: +1 952 224-1499
net: www.kebamerica.com • mail: info@kebamerica.com

More and newest addresses at http://www.keb.de

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