

Technical Information

Application Note | H6 AFE Master/Slave Operation

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1 Preface

The described hardware and/or software are developments of the KEB Automation KG. The enclosed documents correspond to conditions valid at printing. Misprint, mistakes and technical changes reserved.

The application notes describe solved applications or application scenarios. They serve designers and developers as an approach to be taken in the implementation of own applications. However, they are considered for information only without responsibility. The selection with regard to their suitability for the intended use can only be made by the user.

The use of our units in the target products is beyond of our control and therefore exclusively the responsibility of the machine manufacturer, system integrator or customer.

1.1 Signal words and symbols

The used signal words and symbols have the following meaning:



- Dangerous situation, which will cause death or serious injury in case of non-observance of this safety instruction.



- Dangerous situation, which may cause death or serious injury in case of non-observance of this safety instruction.



- Dangerous situation, which may cause minor injury in case of non-observance of this safety instruction.



- Situation, which can cause damage to property in case of non-observance.

RESTRICTION

Is used when certain conditions must meet the validity of statements or the result is limited to a certain validity range.



- Is used when the result will be better, more economic or trouble-free by following these procedures.

- ▶ This arrow starts an action step.
- / - Enumerations are marked with dots or indents.
- => Cross reference to another chapter or another page.

Content

1	Preface	3
1.1	Signal words and symbols.....	3
1.2	Registered trademarks	4
2	AFE Master / Slave Operation H6	5
2.1	Enhanced power by master / slave operation with EtherCAT® Master	5
2.2	Circuit diagram 400V mains.....	6
2.3	System initial setting / parameterization	7
2.4	Settings of the EtherCat master	8
2.5	Process data settings.....	8
2.6	Mains synchronization slave (speed search).....	8

Figures

Figure 1: Principle structure	5
Figure 2: Circuit diagram	6

Tables

Table 2-1: Parameterization master.....	7
Table 2-2: Parameterization slave	7

1.2 Registered trademarks

The following registered trademarks are used in this documentation:

EtherCAT®

EtherCAT® is a registered trademark and patented technology licensed by Beckhoff Automation GmbH, Germany.

2 AFE Master / Slave Operation H6

2.1 Enhanced power by master / slave operation with EtherCAT® Master

In order to be able to cover a larger power range, two AFE systems should be connected parallel or the two DC buses should be connected. The transfer of the setpoint I_{sq_ref} and the phase position to the slave must be done with an EtherCAT® master. It synchronizes both AFE units so that the requested load sharing takes place. Redundancy is only conditionally possible (EtherCAT® operation) and is the responsibility of the customer.

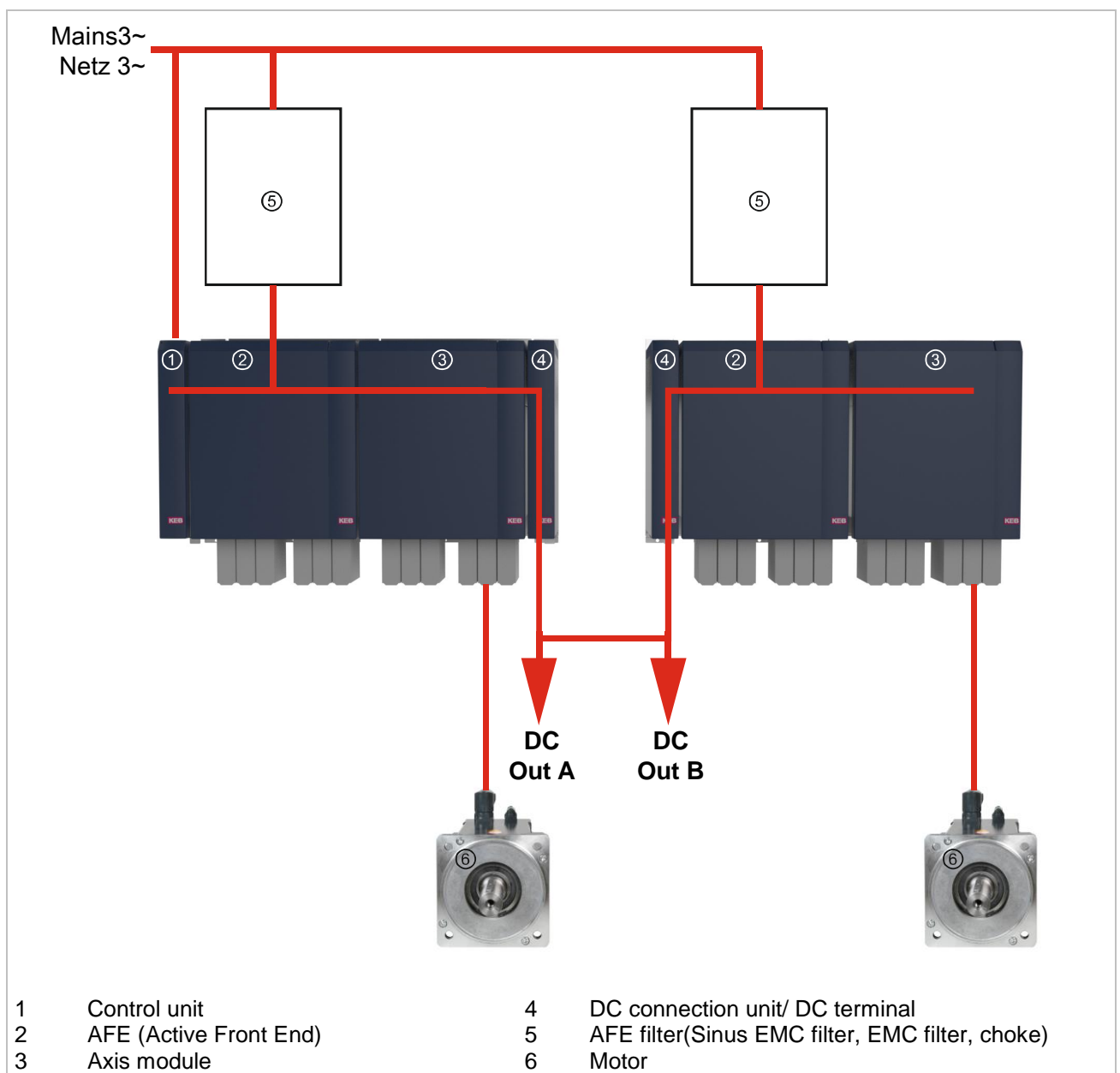


Figure 1: Principle structure

2.2 Circuit diagram 400V mains

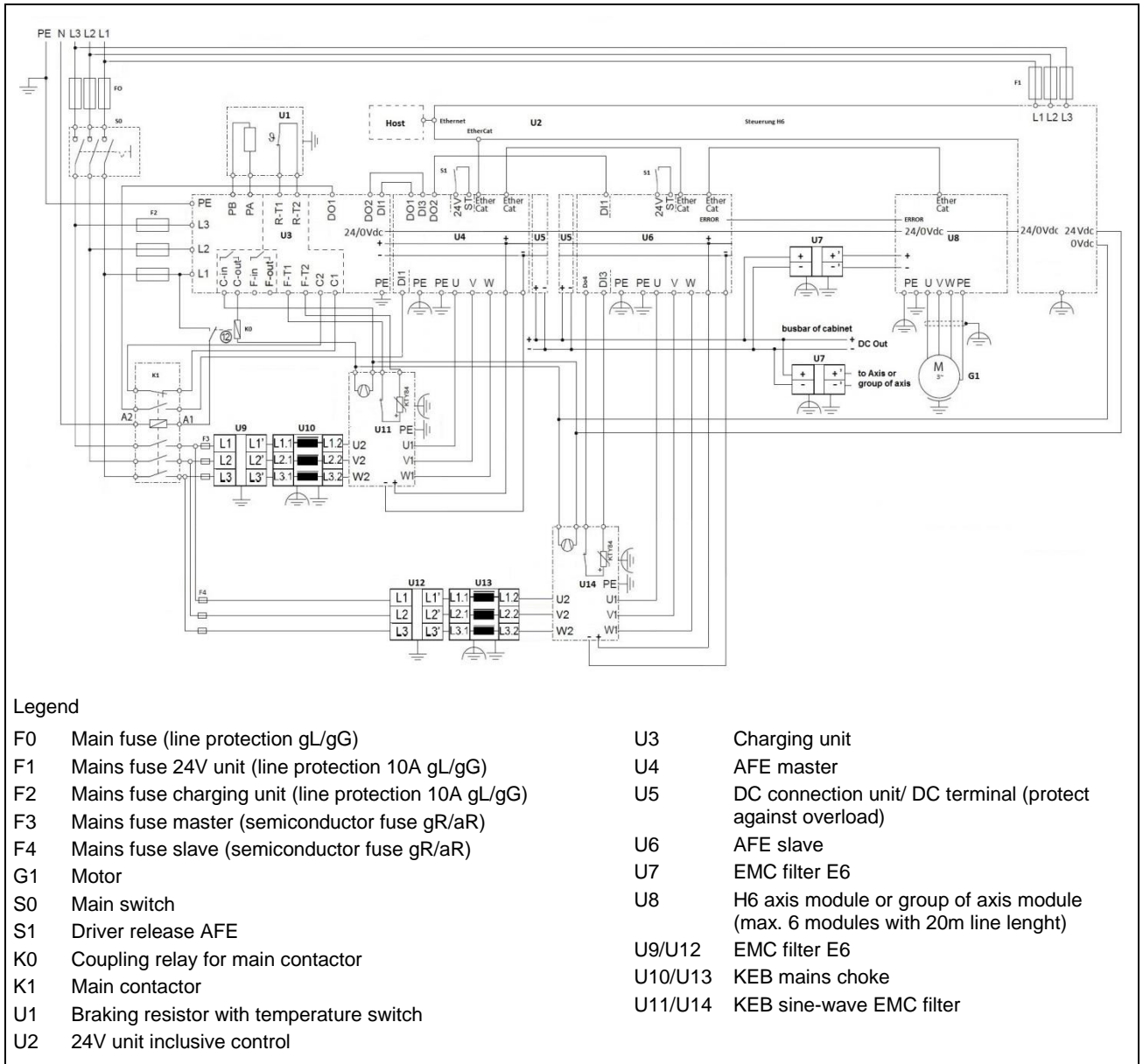


Figure 2: Circuit diagram

ATTENTION

Load reduction in error case

- The currents of the AFE master and slave must be monitored with a control.
- If an AFE unit fails, it must be ensured that load reduction takes place and the max. current of the DC connection unit is not exceeded!

ATTENTION**Observe special features in operation!**

- An autotransformer must be connected upstream at a 480V mains.
- The cable lengths of the DC feedback from the sine-wave EMC filter should neither be shortened nor lengthened.
- The respective release has to be done via the control word. In particular, the synchronization of the slave has to be carried out with a control.
- The network synchronization (speed search) of the slave shall only be done when the master is ready for operation (see circuit diagram).
- The synchronization (congruence) of the master and slave currents, especially during load step are depending on the cycle of the control (EtherCAT® master). We recommend a cycle time less than 2 ms.

2.3 System initial setting / parameterization**Master**

Parameter	Value	Note
Cu01	= Cu01_single / 2	Gain voltage controller kp
Cu17		Total capacity of the system [μ F]
Cu21	$\geq 720V$	Due to modulation without 3rd harmonic
Ds05	40 ms	Smoothing time for EMF precontrol
Is00	18	Without 3rd harmonic
Is12	0	Smoothing of ru parameters for slave transmission for operation
IS13	0	Smoothing of ru parameters for slave transmission for operation

Table 2-1: Parameterization master

Slave

Parameter	Value	Note
Cu01	0	Voltage controller switched off
Cu03	0	Voltage controller switched off
Cu20	0	Smoothing of ru parameters for slave transmission for operation
Cu21	Cu21(Master) – 20V	Safety factor; is only required for the start
Cu99	off	Voltage controller switched off
Dd16	4	Start with preset frequency at an angle of 0°; must be synchronized via control! (from software version 1.7)
Ds05	40 ms	Smoothing time for EMF precontrol
Is00	18	Without 3rd harmonic
Is12	0	Just like master
IS13	0	Just like master

Table 2-2: Parameterization slave

2.4 Settings of the EtherCat master

The master/slave control concept provides that the Iq setpoint of the master is transmitted to the slave via process data. The control represents an additional delay in the controlled system. This is to be kept as low as possible, for example, by choosing a small cycle time. The delay clocks between reading and writing the control can be reduced by one clock by setting parameter "FrameAtTaskStart = FALSE".

EtherCat master

Parameter	Value	Note
FrameAtTaskStart	FALSE	Lower latency at read/write operation



➤ FAQ CVStudio6 0005 EthercatTiming.pdf

Process data are also required for the network synchronization (Speed search) of the slave. A bus-synchronous operation is absolutely necessary for this (bit 8 of the status-word ST00 at master and slave is set. If necessary, write cycle time with parameter fb10)!

2.5 Process data settings

This is the minimum configuration of process data required for speed search and M/S operation:

Master

Parameter	Read/write	Note
Ru23	Read	IqRef[%] (standard: *100/1024)
St48	Read	RhoAct (standard: 65536 = 360°)
Co00	Write(optional)	control word
Cu21	Write(optional)	UicRef[V]

Slave

Parameter	Read/write	Note
Co18	Write	IqOffset[%] (standard: *10)
Co00	Write	Controlword, required for speed search
Cu21	Write(optional)	UicRef[V], = Cu21(master) – 20V (required for start)

2.6 Mains synchronization slave (speed search)

The slave is parameterized by way that it starts with an angle of 0° after setting the controlword. Therefore, the starting time must be adjusted by way that also the mains angle at this moment passes the 0° mark.

The read St48 (RhoAct) provides the information via the mains angle. The read/write delay must be taken into account.



- $RhoDelay = -3.5 * cycle\ time * mains\ frequency * 360^\circ$
- Supported from software version 1.7

Belgium | KEB Automation KG
Herenveld 2 9500 Geraardsbergen Belgium
Tel: +32 544 37860 Fax: +32 544 37898
E-Mail: vb.belgien@keb.de Internet: www.keb.de

Brazil | KEB SOUTH AMERICA - Regional Manager
Rua Dr. Omar Pacheco Souza Riberio, 70
CEP 13569-430 Portal do Sol, São Carlos Brazil Tel: +55 16
31161294 E-Mail: roberto.arias@keb.de

P.R. China | KEB Power Transmission Technology (Shanghai) Co.
Ltd. No. 435 QianPu Road Chedun Town Songjiang District
201611 Shanghai P.R. China
Tel: +86 21 37746688 Fax: +86 21 37746600
E-Mail: info@keb.cn Internet: www.keb.cn

Germany | Headquarter
KEB Automation KG
Südstraße 38 32683 Barntrup Germany
Telefon +49 5263 401-0 Telefax +49 5263 401-116
Internet: www.keb.de E-Mail: info@keb.de

Germany | Geared Motors
KEB Antriebstechnik GmbH
Wildbacher Straße 5 08289 Schneeberg Germany
Telefon +49 3772 67-0 Telefax +49 3772 67-281
Internet: www.keb-drive.de E-Mail: info@keb-drive.de

France | Société Française KEB SASU
Z.I. de la Croix St. Nicolas 14, rue Gustave Eiffel
94510 La Queue en Brie France
Tel: +33 149620101 Fax: +33 145767495
E-Mail: info@keb.fr Internet: www.keb.fr

United Kingdom | KEB (UK) Ltd.
5 Morris Close Park Farm Industrial Estate
Wellingborough, Northants, NN8 6 XF United Kingdom
Tel: +44 1933 402220 Fax: +44 1933 400724
E-Mail: info@keb.co.uk Internet: www.keb.co.uk

Italia | KEB Italia S.r.l. Unipersonale
Via Newton, 2 20019 Settimo Milanese (Milano) Italia
Tel: +39 02 3353531 Fax: +39 02 33500790
E-Mail: info@keb.it Internet: www.keb.it

Japan | KEB Japan Ltd.
15 - 16, 2 - Chome, Takanawa Minato-ku
Tokyo 108 - 0074 Japan
Tel: +81 33 445-8515 Fax: +81 33 445-8215
E-Mail: info@keb.jp Internet: www.keb.jp

Austria | KEB Automation GmbH
Ritzstraße 8 4614 Marchtrenk Austria
Tel: +43 7243 53586-0 Fax: +43 7243 53586-21
E-Mail: info@keb.at Internet: www.keb.at

Russian Federation | KEB RUS Ltd.
Lesnaya str, house 30 Dzerzhinsky MO
140091 Moscow region Russian Federation
Tel: +7 495 6320217 Fax: +7 495 6320217
E-Mail: info@keb.ru Internet: www.keb.ru

Republic of Korea | KEB Automation KG
Room 1709, 415 Missy 2000 725 Su Seo Dong
Gangnam Gu 135- 757 Seoul Republic of Korea
Tel: +82 2 6253 6771 Fax: +82 2 6253 6770
E-Mail: vb.korea@keb.de

Spain | KEB Automation KG
c / Mitjer, Nave 8 - Pol. Ind. LA MASIA
08798 Sant Cugat Sesgarrigues (Barcelona) Spain
Tel: +34 93 8970268 Fax: +34 93 8992035
E-Mail: vb.espana@keb.de

United States | KEB America, Inc
5100 Valley Industrial Blvd. South Shakopee, MN 55379 United States
Tel: +1 952 2241400 Fax: +1 952 2241499
E-Mail: info@kebameric.com Internet: www.kebameric.com



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Automation mit Drive

www.keb.de

KEB Automation KG Südstraße 38 32683 Bartrup Tel. +49 5263 401-0 E-Mail: info@keb.de