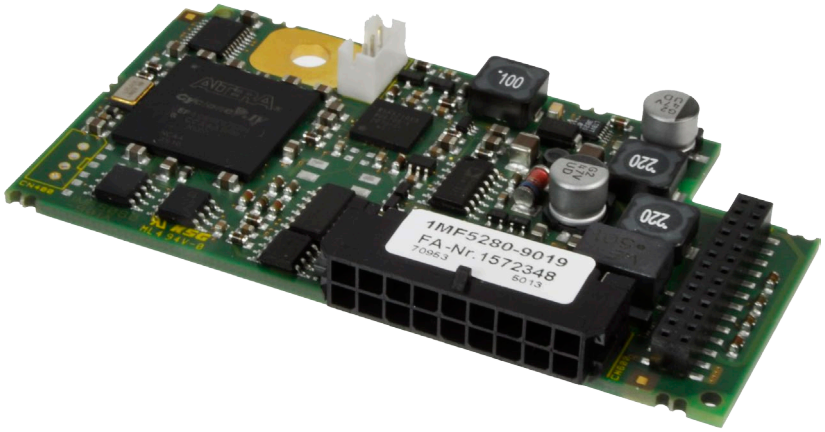
COMBIVERT



INSTRUCTION MANUAL **Encoder Interface**

Channel 1 BiSS + 1Vpp

Translation of original manual			
Document	Part	Version	Date
20097260	GBR	00	0115

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1. Preface

The described hard- and software are developments of the Karl E. Brinkmann GmbH. The enclosed documents correspond to conditions valid at printing. Misprint, mistakes and technical changes reserved.

1.1 Information on special measures

The used pictograms have following significance:

Danger	Is used, when death or serious bodily injury may be the consequence of non-observance of the measure.
Warning	Is used, when bodily injury and/or substantial property damage may be the consequence of non-observance of the measure.
Caution	Is used, when property damage may be the consequence of non-observance of the measure.
Attention	Is used, when noise sensitive or unrequested operation may be the consequence of non-observance of the measure.
Info	Is used, when a better or simpler result can be the consequence of the measure.

For a special case the instructions can be supplemented by additional pictograms and text.

1.2 Documentation

Prior to performing any work on the unit the user must familiarize himself with the unit. This includes especially the knowledge and observance of the safety and operating instructions.

Attention	**Observe safety and operating instructions**
	Precondition for all further steps is the knowledge and observance of the safety and operating instructions. This is provided accompanied by the device or by the download site of www.keb.de.

Non-observance of the safety and operating instructions leads to the loss of any liability claims. The warnings and safety instructions in this manual work only supplementary. This list is not exhaustive.

1.3 Validity and liability

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.

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.

Selection of our units in view of their suitability for the intended use must be done generally by the user.

Tests can only be done within the application by the machine manufacturer. They must be repeated, even if only parts of hardware, software or the unit adjustment are modified.

Danger  **by tamper from unauthorized personnel**	
	Unauthorised opening and tampering may lead to death, bodily injury, property damage and malfunctions. Modification or repair is permitted only by authorized personnel by KEB. Infringement will annul the liability for resulting consequences.

The suspension of liability is especially valid also for operation interruption loss, loss of profit, data loss or other damages. Disclaimer of warranty will cause void the guarantee. This is also valid, if we referred first to the possibility of such damages.

If single regulations should be or become void, invalid or impracticable, the effectivity of all other regulations or agreements is not affected.

Through multitude applications not each possible case of installation, operation or maintenance can be considered. If you require further information or if special problems occur which are not treated detailed in the documentation, you can request the necessary information via the local Karl E.Brinkmann GmbH agency.

1.4 Copyright

The customer may use the instruction manual as well as further documents or parts from it for internal purposes. Copyrights are with KEB and remain valid in its entirety.

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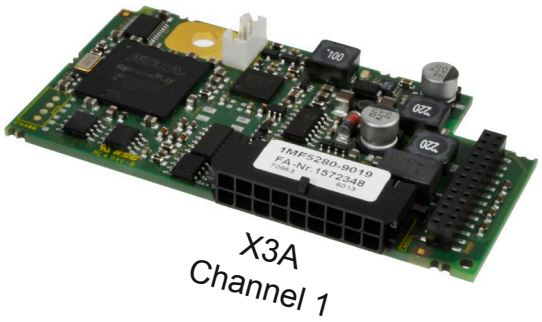
Other wordmarks or/and logos are trademarks (™) or registered trademarks (®) of their respective owners and are listed in the footnote on the first occurrence.

When creating our documents we pay attention with the utmost care to the rights of third parties. Should we have not marked a trademark or breach a copyright, please inform us in order to have the possibility of remedy.

1.5 Pay attention to markings

Info	Pay attention to markings
Functional Safety FS	Pay special attention to units with one of these markings on the nameplate..See documentation for special installation or operation requirements!

2. Product Description



X3A
Channel 1
TTL, BiSS + 1Vpp, EnDat + 1Vpp

Figure 1: Encoder Interface

2.1 General

The instruction covers the installation of the interface card, the connection as well as the start-up of a suitable encoder.

Further information and the parameter adjustments are described in the application manual for the inverter/servo.

2.2 Operation

The encoder card supports TTL, BiSS-C[1] (with or without 1Vpp signals). and EnDat[2] (2.1, 2.2, with or without 1Vpp signals). During initialization the CPU determines the connected encoder by checking the encoder signals:TTL, BiSS-C or EnDat. The encoder status is displayed in Ec.36.

Possible values for Ec.36:

21:	TTL with zero signal	
48	Endat without 1Vpp signals	
49:	EnDat 2.1 Singleturn	with 1 Vpp signals
52:	Endat 2.1 multiturn	
53:	Endat 2.2 singleturn	
54.	Endat 2.2 multiturn	

further on next page

1 *BiSS is a registered trademark of iC-Haus GmbH*
2 *EnDat is a registered trademark of Dr Johannes Heidenhain GmbH.*

57:	BiSS-C Hengstler singleturn	with 1 Vpp-signal
58:	BiSS-C Hengstler multiturn	
59:	BiSS-C without electronic type plate	
67:	BiSS-C Kübler singleturn	
68:	BiSS-C Kübler multiturn	
72:	BiSS-C without electronic type plate with 1 Vpp signals	

Detection of the encoder manufacturer is only possible, if the encoder has an electronic type plate, such as all Hengstler encoder. Kübler does not support actually an electronic type plate. Consequently, only values 72 and 59 for Kübler encoder are currently possible.

2.2.1 Operation TTL with zero singal

The correct inc/r must be entered in Ec.01 for the operation of a TTL encoder (possible values from 1...16384)

All three signals are checked for encoder breakage during operation.

Info If no zero signal is recognized, error Ec.37 = 68 is triggered after initialization.

2.2.2 Operation BiSS and Endat

The inc/r must be set to 2048 in Ec.01 for the operation with BiSS and Endat, independent on the real increments of the encoder.

If a BiSS-C encoder without electronic type plate is used, the following parameters must be adjusted additionally:

Ec.44	Singleturn resolution
Ec.53	Multiturn resolution
Ec.43	data code binary or gray

Furthermore the data word must be constructed as follows:

Structure data word:	| MT | ST | ERR | WARN | CRC |
MT	Multiturn resolution
ST	Singleturn resolution
ERR	Error bit 0-active
WARN	Warning bit 0-active
CRC	x^6 + x^1 + 1 (0x43)

The encoder must also transmit an error and warning bit.

If the encoder has an electronic type plate (the manufacturer is then also displayed in Ec.36), only the inc/r must be set to 2048.

If the encoder has 1Vpp signals, the encoder must support 2048 increments per revolution . The numbers of increments must be set on 2048 in Parameter Ec.01.

If 1Vpp signals are detected during initialization, they are also tested for encoder breakage. If none signals are detected, non signals are checked.

If no position value can be read from the encoder for the actual control cycle (e.g. due to errors) a position value is interpolated from the two previous position values. If no position value can be read for three times successively, the encoder interface sends the error message Ec.37 = 68, which causes error ru.00 = E.EnCC = 35.

If the encoder supports this, data storage/-reading in/from the encoder is possible at nOP of the control card with Ec.38 = 1/2. The data structure in the encoder is compatible with all other F5-encoder cards.

If an error is sent directly by the encoder, the highest bit of the error value is set and sent to the control card as status. Values > 128 are error messages directly from the encoder.

2.3 Material number

xM	F5	K8G	X	X	X	X

Term of delivery	0	installed	Z	Option, spare part
Interface X3B	9	none	9019	
	F5	Series		
suitable for	1M	D, E (circuit board 1MF5280-xxxx see above)		

2.4 Scope of delivery (option or replacement delivery)

- Encoder Interface
- INSTRUCTION MANUAL
- fixing bolt
- packing material

2.5 Mechanical installation

All kind of works on the inverter may be carried out by authorized personnel in accordance with the EMC and safety rules only.

- Switch inverter de-energized and await capacitor discharge time
- Pull off operator
- Remove plastic cover
- Remove fixing bolt
- Fix interface board beginning from the socket connector straightly
- Screw in fixing bolt
- Adjust desired supply voltage with DIP-switch (if it exists)
- Attach plastic cover

3. Description of the Interface

3.1 Voltage supply

U_{int}	24 VDC	Internal voltage supply of COMBIVERT
U_{ext}	Control terminal strip (X2A) of the COMBIVERT with external voltage supply 24…30 Vdc.	
24 V	Voltage output of encoder interfaces X3A for encoder supply. At 100 mA load the voltage can be reduced upto 4 V (compared to no-load operation).	
5 V	Voltage output for encoder supply (I_{max} 500 mA). 5.25 V are obtained from the 24 V voltage.	

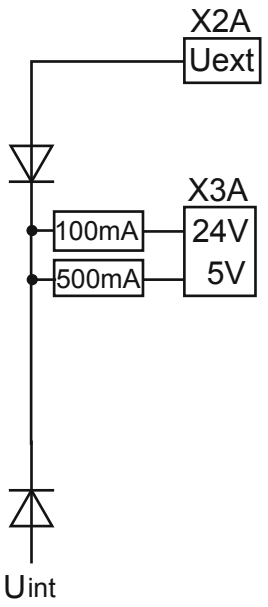


Figure 2: Voltage supply of control and encoder interfaces

3.2 Channel 1

Info Storing and reading of data to/from the encoder is possible with Ec.38 = 1/2 at status nOP of the control board.

3.2.1 Specifications

X3A	18-pole socket
Interface type	BiSS, TTL, Endat
Input signals	Signals A, B, N (max. 300 kHz), data und clock according to RS-422/ RS-485. Signals Sin and Cos: 1Vpp diferential signal (max. 200 kHz)
Resolution Singleturn	depending on the encoder, max. 24 Bit. If the resolution of the encoder is higher, the least significant, additional bits are deleted.
Resolution Multiturn	max. 15 Bit
Input resistance	120 Ω
Max. line length	50 m, the value is additionally limited by the signal frequency, cable capacity and supply voltage.

3.2.2 Description of X3A

Line length dependent on baud rate

2	4	6	8	10	12	14	16	18
1	3	5	7	9	11	13	15	17

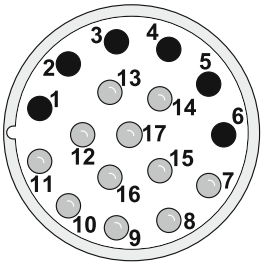
PIN \ Encoder	Inc-TTL	BiSS and Endat
1	A+	COS+
2	A-	COS-
3	B+	SIN+
4	B-	SIN -
5	N+	Data+
6	N-	Data-
7		Clock-
8		
9		Clock+
10		
11		
12		
13	GND	GND
14	GND	GND
15		
16	5V	5V
17	24V	24V
18	GND	GND
shielding	The shield have to be mounted on the grounding bar with a shielding clamp (see "figure 4: encoder cable shield with shielding clamp on grounding bar“).	

3.3 Connenction of the encoder Biss + 1 Vpp / EnDat + 1 Vpp

Encoder cable at terminal X3A

- Encoder cable double-shielded and twisted in pairs
- connect both sides of the external shield to PE
- connect the internal shield one-sided to Pin 14 (X3A)
- Do not connect internal and external shield!

Motor encoder plug



Socket X3A

2	4	6	8	10	12	14	16	18
1	3	5	7	9	11	13	15	17

Name	PIN		PIN	Core color
GND	–		–	external shielding (see„Figure 4“
A+	15		1	green
A-	16		2	yellow
B+	12		3	blue
B-	13		4	red
Data+	14		5	gray
Data-	17		6	pink
Clock+	8		9	black
Clock-	9		7	purple
COM	10		13	white
+5,25 V	7		16	brown
			14	internal shielding

Figure 3: Connection of the encoder

3.3.1 Encoder cable for evaluation without 1 Vpp-signals

KEB encoder cables are corresponding to the following specification:

Signal lines	(2 x 2 x 0,15 mm² twisted pair and single shielded
Supply line	2 x 0,38 mm²)
Particularities	trailing capable, oil resistand, suitable for high clock frequeny
Temperature range	to 80 °C durable
Color	green RAL 6018
Material number	00H6L51-2xxx

Attention Due to high clock frequencies use only original KEB cables for BiSS and Endat evaluation, without 1Vpp signals.

3.3.2 Encoder cable for evaluation with 1 Vpp-signals

KEB encoder cables are corresponding to the following specification:

Signal lines	(4 x (2 x 0,14 mm²) twisted in pairs and double-shielded
Supply line	2 x (0,5mm²))
Particularities	trailing capable, oil-resistant
Temperature range	to 80 °C durable
Color	green RAL 6018
Material number	00H6L53-2xxx

3.3.3 Encoder line length

The maximum line length is 50 m. It is limited by the signal frequency, cable capacity and the line resistance.

Encoder cable length =	$\frac{U - U_{min}}{I_{max} \cdot 2 \cdot R}$
max. encoder current I_{max}:	see encoder description
Supply voltage U:	5.2 V
min. supply voltage U_{min}:	see encoder description
e. g. KEB encoder cable resistance R:	0,048 Ω/m at 0,38 mm²

3.3.4 Tested encoders

The following encoders have been tested by KEB on it application:

BiSS-C: Hengstler Acuro AD58, AD36, AD34, Kübler Sendix 5853,
EnDat: Heidenhain ROQ 437, ECI 1317, EQN 1125

Info However, this does not restrict the use of rotary encoder with same specifications of other manufacturers.

3.3.5 Connection of the encoder cable shield

Attention The encoder cable shield must be mounted to the grounding bar with a shield clamp .

Figure 4: encoder cable shield with shielding clamp on grounding bar“).

4. Start-up

After the installation or exchange of an encoder interface some adjustments of the inverter/ servo software have to be done before operation:

- Switch on inverter
- Select application mode
- When using synchronous motors set Ud.02 to F5-S
- Select parameter Ec.38; if automatic read in is not adjusted in Bit 2, read out encoder data with Bit 0.
- At BiSS-C without electronic type plate, select and adjust parameter Ec.44 and Ec.53.
- Select parameter Ec.37 and control encoder status. Acknowledge possibly error messages.

4.1 Encoder 1 status (Ec.37)

This parameter displays, by means of different status messages, the status of encoder and interface. All errors are only triggered at control release in inverter state ru.00, although they are already displayed in Ec.37.

With Ec.42 can be adjusted if an error message of the encoder card triggers an error in the inverter or not (ru.00).

Value	Description
The following value is displayed at correct operation:	
16	Position values are transferred, encoder and interface are working
The following status messages triggers „Error Encoder Change“ (E.EnCC) because the correct evaluation of the position is no longer guaranteed. Error E.EnCC can only be reset via parameter Ec.00. Exception! An error due to wrong increments per revolution (value 70) is reset immediately, if the correct increments per revolution are adjusted. Attention, the modulation is released, when the control release is still set!	
64	Encoder is unknown and will not be supported
66	No communication to the encoder. Initialization is not possible
67	Incremental signals invalid
68	Absolute signals are faulty. All signals are checked at TTL-encoders, at BiSS-C and Endat the digital communication. Difference to error 66: The communication was o.k. before. Can also occur at BISS -C without el. type plate: the connection to the encoder is o.k., but the setting of the data length (Ec.44 and Ec.53) is still wrong. Error must be reset then.
further on next page	

Value	Description
69	For encoder with incremental signals, the incremental counted position is compared with the absolute position (e. g. zero signal or position via BiSS/Endat). If there is a difference, which cannot be corrected the following error is triggered.
The following status messages triggers „Error Encoder 1“ (E.EnC1), if encoder data is read:	
96	New encoder type detected. An encoder type can also be detected if an error reset is carried out at defective encoder signal.
97	This value generates the control card software after the encoder data are readout and the data content was checked for plausibility. If the encoder is not written, Ec.37 = 97 is set.  This value can also appear if the encoder interface is switched on first with the control card and no encoder is connected! Then error value 66 should be displayed, however which has a lower priority. After reset of error value 97 (e.g. by writing on Ec.02) the correct value Ec.37 = 66 is output.
The following error messages are directly displayed by the encoder.	
>128	Error message directly derived from the encoder, depending on the encoder/-protocol

4.1.1 Error Messages

Error messages ≥ 128 are directly coming from the encoder. The encoder card sets the highest bit and displays them in Ec.37.

If the encoder supports a detailed error state (see data sheet of the encoder), this state is displayed in Ec.37 and can be determined by:

Error message from the encoder: Ec.37 - 128

If Ec.37 displays value 128, the encoder has set only one error bit in the BiSS communication and supports no further information.

4.1.2 Encoder 1 read/write (Ec.38, if supported by the encoder)

With Ec.38 the parameter are read/write from/to the encoder.

Bit	Value	Function
0	1	Reading out of the parameters. Then the parameter is reset.
1	2	Storing of the parameters in the encoder (only with supervisor-password and in nOP status)
2	4	Automatic reading out of the parameters when connecting a new encoder (loading after acknowledgement with Ec.00 and default values)

At F5-S bit 2 is default-moderately set, not at F5-M and F5-G. Thus at F5-S encoder data are reading out after default loading.

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