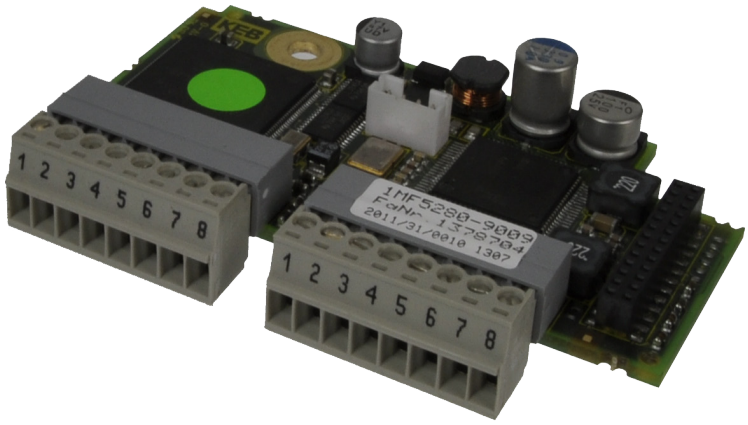
COMBIVERT



GB INSTRUCTION MANUAL — Encoder interface

Channel 1 — EnDat 2.2 and BiSS

Channel 2 — variable

Mat.No.	Rev.
DEF5ZEM-K010	1C

KEB

1. Safety Instructions

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 warning directions. The pictographs used in this instruction manual have following meaning:

	Danger	Refers to danger of life by electric current.
	Warning	Refers to possible danger of injury or life.
	Note	Refers to tips and additional information.

1.1 Validity

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 particularly 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.

	Controlling by the user	Application and use of our units in the target products is outside of our control and therefore lies exclusively in the area of responsibility of the user.
	Use under special conditions	The used semiconductors and components of KEB are developed and dimensioned for the use in industrial products. If the KEB COMBIVERT is used in machines, which work under exceptional conditions or if essential functions, life-supporting measures or an extraordinary safety step must be fulfilled, the necessary reliability and security must be ensured by the machine builder.

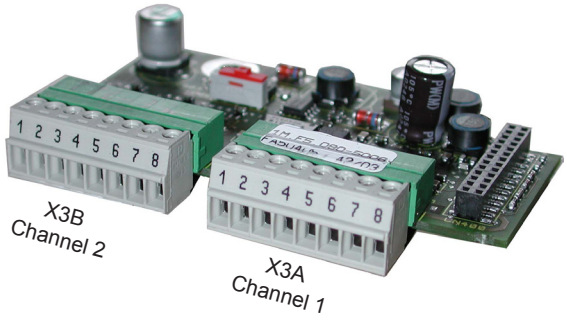
1.2 Qualification

All operations serving transport, installation and commissioning as well as maintenance are to be carried out by skilled technical personnel (observe IEC 364 or CENELEC HD 384 or DIN VDE 0100 and national accident prevention rules!). According to this manual qualified staff means those who are able to recognise and judge the possible dangers based on their technical training and experience and those with knowledge of the relevant standards and who are familiar with the field of power transmission (VDE 0100, VDE 0160 (EN 50178), VDE 0113 (EN 60204) as well as the appropriate regulations for your area.

	Danger by high voltage	KEB electronics components contain dangerous voltages which can cause death or serious injury. In operation, drive converters, depending on their degree of protection, may have live, uninsulated, and possibly also moving and hot surfaces. In case of inadmissible removal of the required covers, of improper use, wrong installation or maloperation, there is the danger of serious personal injury and damage to property.

2. Product Description

Figure 1: Encoder interface EnDat and BiSS at channel 1



X3B	X3A
Channel 2	Channel 1
see material number	Incremental encoder input EnDat and BiSS

2.1 General

Each of the interface cards delivered by KEB include two interfaces. As there are numerous different combinations available each interface will be described by means of separate instructions. 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 Material number

xM	F5	K8G	X	X	X	X

Term of delivery	0	installed	Z	Option, spare part
Interface X3B	9	TTL-output terminal 8pole		9009
	F5	Series		
applicable for housing size	1M	D, E (circuit board 1M.F5.280-xxxx see above)		
	2M	G…U (circuit board 2M.F5.280-xxxx see above)		

2.3 Scope of delivery (option or replacement delivery)

- Encoder Interface
- two instruction manuals
- fixing bolt
- packing material

2.4 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.

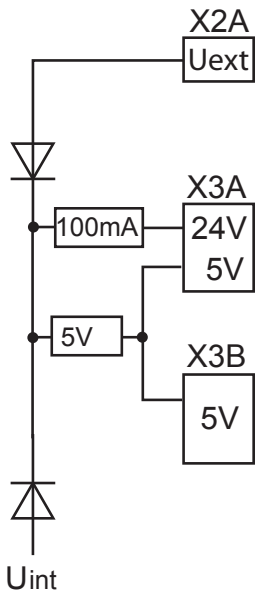
- Switch inverter de-energized and await capacitor discharge time
- Pull off operator
- Remove plastic cover
- Remove fixing bolt
- Fix interface board beginning from the socket connector straightly
- Screw in fixing bolt
- • Adjust desired supply voltage with DIP-switch (if it exists)
- Attach plastic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

3. Description of the Interface

3.1 Voltage supply

Figure 3.1 Voltage supply of control and encoder interfaces

U_{int}	24 VDC	Internal voltage supply of the 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 und X3B for encoder supply (max. 1 A at external supply). Current I_{int} reduces itself by draw current to the 5 V output in accordance with the following formula: $I_{24V} = I_{int} - \frac{5V \times I_{5V}}{U_{int}}$	
5 V	Voltage output for encoder supply (I_{max} 300 mA). 5.25 V are obtained from the 24 V voltage.	



3.2 Channel 1

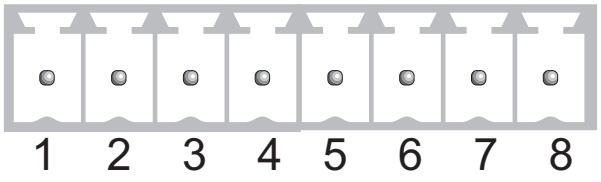
The encoder protocol is adjusted with the control card parameter ec.62. Up to now all Endat 2.2 (also EnDat 2.1 only digital) rotary encoder and BISS encoder are evaluated by Hengstler of the series Acuro.

Storing and reading of data to/from the encoder is possible with ec.38 = 1/2 at status nop of the control board. The data structure in the encoder is compatible with previous EnDat encoder interfaces. An encoder written with EnDat analog encoder interface (e.g. 2M.F5.280-2022) can be read out with this encoder interface and reverse.

3.2.1 Specifications

X3A	Terminal block 8-pole		
Interface type	EnDat 2.2/BiSS		
Input signals	5 V TTL, data and clock according to RS-422/RS-485		
Inputs / tracks	EnDat		BiSS
	data channel SSI bidirectional, half duplex		data channel SSI unidirectional
	clock frequency	EnDat 2.1 = 1 MHz	clock frequency 3.125 MHz
		EnDat 2.2 = 4.16 MHz	
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	150 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



PIN	Name	Description
1	Data+	Data channel+
2	Data-	Data channel-
3	CL+	Clock signal+
4	CL-	Clock signal-
5	–	
6	5 V	5.25 V voltage output for encoder supply
7	24 V	24 V voltage output for encoder supply
8	COM	Reference potential for voltage supply
–	GND	Function earth is not available at the terminal block and must be connected at appropriate place at the unit.

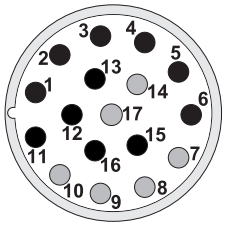
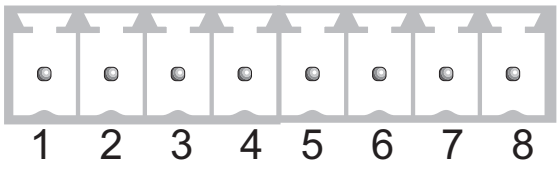
3.2.3 Input signals channel 1

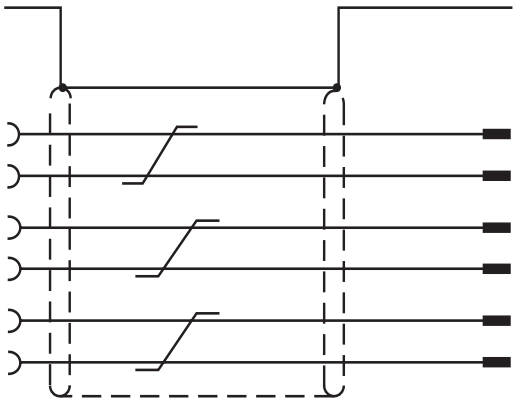
3.2.3.1 Encoder breakage recognition

An error bit is evaluated for monitoring of the encoder at channel 2. The monitoring is switched on/off with parameter Ec.42 (Ec.20 up to V2.8). The recognition of encoder breakage triggers an „error! encoder change“ (value 35).

3.2.4 Connection of the encoder

3.2.4.1 Encoder cable at terminal strip X3A

Motor encoder plug	Interface terminal block
	

Name	PIN		PIN	Core color
GND	–		–	exterior shielding
Data+	14		1	pink
Data-	17		2	blue
Clock+	8		3	green
Clock-	9		4	yellow
COM	10		8	black
+5,25 V	7		6	red

3.2.5 Encoder cable

KEB encoder cables are corresponding to the following specification:

Signal lines	2 x (2 x 0.15 mm²)
Supply lines	2 x 0.38 mm²
Particularities	trailing capable, oil-resistant
Temperature range	constant up to 80 °C
Color	green RAL 6018

Use original KEB-cable for Endat-digital/BiSS-communication due to the high clock frequencies.

3.2.6 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
KEB encoder cable resistance R:	0.048 Ω/m bei 0.38 mm²

3.2.7 Tested encoders

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

EnDat: Heidenhain ROQ 437, ECI 1317, EQN 1125
BiSS: Hengstler Acuro AD58, AD36, AD34

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

3.3 Channel 2

The description of input X3B is depending on the used encoder interface. It is described in a separate manual.

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.2 to F5-S
- Select parameter Ec.0 and control whether „EnDat“ is entered. The displayed value has to be confirmed by „ENTER“ in any case.
- Select parameter Ec.10 and carry out the same for the 2nd encoder interface.
- Select Ec.62 and adjust the required protocol (EnDat or BiSS)
- Select parameter Ec.38; if automatic read in is not adjusted in Bit 2, read out encoder data with Bit 0.
- Select parameter Ec.37 and control encoder status.

4.1 EnDat-Parameter

The following parameters are stored in the EnDat-encoder and automatically read in e.g.manually read/write by Ec.38:
Synchronous motors: dr.23…dr.28, dr.30…32
Asynchronous motors: dr.0…dr.7
Encoder parameter: Ec.1…3, In.31…32
Controller parameter: cS.19

4.1.1 Encoder 1 status (Ec.37)

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

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.0. Exception! An error due to wrong increments per revolution (value 70) is reset immediately, if the correct increments per revolution are adjusted (from software 2.7). Attention, the modulation is released, when the control release is still set!	
64	Encoder is unknown and will not be supported
65	Error on access to the encoder memory.
68	Communication abort after faultless operation.
66	During the initialization phase there is no communication to the encoder.
98	Interface is busy
The following status messages triggers „Error Encoder 1“ (E.Enc1), if encoder data is read:	
97	KEB-reference is undefined. Memory structure of the encoder does not correspond to the KEB-definition and therefore data cannot be read. The encoder is defined by writing data. At F5-S the error is reset as follow: • writing a system position to Ec.2. • perform a system position trimming
Following status messages trigger error „Error Hybrid“ (E.HYb):	
0,255	No communication between interface and control card.
The following error messages are directly displayed by the encoder.	
>128	Evaluation of the errors in accordance with chapter 4.1.2.

An error bit is implemented in the fast position communication in both protocols which is set by the encoder if the position value can not be build reliably. If this bit is set by the encoder, the interface transmits error message 80h as status to the control card. Then the control card triggers the error ru.0 = E.EncC. During this time the encoder interface reads the appropriate error bit from the encoder and then transmits it to the control card.

4.1.2 Error message from EnDat encoder

Error messages, which are released by the EnDat encoder (Ec.37 > 128), can be defined indirectly.

EnDat error message = Ec.37 - 128

The bit-coded error messages (address 0 in the memory range „operating condition") are defined in the EnDat protocol description.

Example: Ec.37 = 132; EnDat error message = 132 - 128 = 4

This value means (according to the protocol description) bit 2 = 1 „position value error“.

The following error messages are defined:

Bit	Meaning if set
0	Failure of the lighting
1	Signal amplitude error
2	Position value error
3	Overvoltage
4	Undervoltage of the supply
5	Overcurrent
6	Battery change necessary
7	is always protected and means that error message is directly from the encoder
8-15	reserved

4.1.3 Error message from BiSS encoder

Error messages, which are released by the BISS encoder (Ec.37 > 128) can be defined indirectly.

BiSS error message = Ec.37 - 128

The bit-coded error messages (address 0x68) are defined in the BiSS protocol description.

Example: Ec.37 = 132; BiSS error message = 132 - 128 = 4

This value means (according to the protocol description) bit 2 = 1 „position value error“.
The following error messages are defined:

Bit	Meaning if set
0	LED dirty, defective, too hot
1	Multiturn error
2	Position error
3	not defined
4	not defined
5	not defined
6	Temperature within undefined range

4.1.4 Read/write Encoder 1 (Ec.38)

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.0 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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