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BA-EKE 2.08 – 11/2016

EKE 05-0018-5E-Ix
EKE 05-0040-5E-Ix

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	Warning Before installing and commissioning the EC-Controller, you must read all safety instructions and warnings carefully including all the warning labels attached to the equipment. Make sure that the warning labels are kept in a legible condition and replace missing or damaged labels.

	Nicotra Gebhardt reserves the right to change without notice.

Information is also available from:

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Definitions and Warnings

Warning	**Warning** For the purpose of this documentation and the product warning labels, "Warning" indicates that death, severe personal injury or substantial damage to property can result if proper precautions are not taken.

Caution	**Caution** For the purpose of this documentation and the product warning labels, "Caution" indicates that minor personal injury or material damage can result if proper precautions are not taken.

	Note For the purpose of this documentation, "Note" indicates important information relating to the product or highlights part of the documentation for special attention.

Qualified personnel
- For the purpose of this Instruction Manual and product labels, a "Qualified person" is someone who is familiar with the installation, mounting, start-up and operation of the equipment and the hazards involved.
- He or she must have the following qualifications:
- Trained and authorized to energize, de-energize, clear, ground and tag circuits and equipment in accordance with established safety procedures.
- Trained in the proper care and use of protective equipment in accordance with established safety procedures.
- Trained in rendering first aid.

Use for intended purpose only
The equipment may be used only for the application stated in the manual and only in conjunction with devices and components recommended and authorized by Nicotra Gebhardt GmbH.

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Approvals

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European Low Voltage Directive
The EC-Controller complies to the requirements of the Low Voltage Directive 2006/95/EC. The unit has been manufactured according to the standard EN 60146-1-1 (Semiconductor converters - General requirements and line commutated converters).

European Machinery Directive
The EC-Controller does not impinge on the application field of the Machinery Directive 2004/108/EC.

European EMC Directive
The EC-Controller is supplied exclusively in connection with products of the company Nicotra Gebhardt. The unit is fully integrated in the corresponding products and then complies to all requirements of the EMC directive, and according to the EMC product standard for electrical drives with variable speed EN 61800-3.

Underwriters Laboratories

UL recognized: E 235828
the usage only in a pollution degree 2 environment

The following device types are UL recognized:

EKE 05-0018-5E-IG
EKE 05-0018-5E-IM

	Note Motor over temperature sensing according UL 508C is not provided by the drive, but the current regulation limits the current within 1 msec at a level of 1.7 Amp. If this leads to speed reduction below the set point, the controller will disable the motor after 1 minute because of speed controller error.

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Safety Instructions

The following Warnings, Cautions and Notes are provided for your safety and as a means of preventing damage to the product or components in the machines connected. This section lists Warnings, Cautions and Notes, which apply generally when handling the Nicotra Gebhardt EC-Controller, classified as **General**, **Transport & Storage**, **Commissioning**, **Operation** and **Repair**.

Specific Warnings, Cautions and Notes that apply to particular activities are listed at the beginning of the relevant chapters and are repeated or supplemented at critical points throughout these sections.

Please read the information carefully, since it is provided for your personal safety and will also help prolong the service life of your *EC-Controller* and the equipment you connect to it.

General

⚠️ **Warning**	**Warnings** This equipment contains dangerous voltages and controls potentially dangerous rotating mechanical parts. Non-compliance with Warnings or failure to follow the instructions contained in this manual can result in loss of life, severe personal injury or serious damage to property. Only suitable **qualified personnel** should work on this equipment, and only after becoming familiar with all safety notices, installation, operation and maintenance procedures contained in this manual. The successful and safe operation of this equipment is dependent upon its proper handling, installation, operation and maintenance. **Risk of electric shock!** The DC link capacitors remain charged for 10 minutes after power has been removed. **It is not permissible to open the equipment until 10 minutes after the power has been removed.**
⚠️ **Caution**	**Caution** Children and the general public must be prevented from accessing or approaching the equipment! This equipment may only be used for the purpose specified by the manufacturer. Unauthorized modifications and the use of spare parts and accessories that are not sold or recommended by the manufacturer of the equipment can cause fires, electric shocks and injuries.
☝️	**Notes** Keep these operating instructions within easy reach of the equipment and make them available to all users. Whenever measuring or testing has to be performed on live equipment suitable electronic tools should be used. Before installing and commissioning, please read these safety instructions and warnings carefully and all the warning labels attached to the equipment. Make sure that the warning labels are kept in a legible condition and replace missing or damaged labels.

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Transport & Storage

⚠ Warning	**Warning** Correct transport, storage, erection and mounting, as well as careful operation and maintenance are essential for proper and safe operation of the equipment.

⚠ Caution	**Caution** Protect the inverter against physical shocks and vibration during transport and storage. Also be sure to protect it against water (rainfall) and excessive temperatures.

Commissioning

⚠ Warning	**Warnings** Work on the device/system by **unqualified** personnel or failure to comply with warnings can result in severe personal injury or serious damage to material. Only suitably qualified personnel trained in the setup, installation, commissioning and operation of the product should carry out work on the device/system. This equipment must be grounded. The following terminals can carry dangerous voltages even if the EC-Controller is inoperative: • the power supply terminals L1, N • the motor terminals U, V, W • rotor position sensor terminals

Operation

⚠ Warning	**Warnings** The EC-Controller operates at high voltages. Certain parameter settings may cause the inverter to restart automatically after an input power failure. The MaxSpeed Parameter must be accurately configured for motor overload protection to operate correctly.

☛	**Remark** The unit is exclusively UL-certified for operation in working areas of contamination class 2.

Repair

⚠ Warning	**Warnings** Repairs on equipment may only be carried out by Nicotra Gebhardt. Disconnect the power supply before opening the equipment for access and wait for at least 10 minutes until the secondary circuit condenser is completely discharged!

Table of Contents

1 Overview

1.1 The Nicotra Gebhardt EC-Controller

The EC-Controller EKE 05-00xx-5E-Ix is an inverter for controlling the speed of motor-impeller-units with Brushless-DC motors. The inverter is DSP-controlled and uses modern Insulated Gate Bipolar Transistor (IGBT) technology for electrical power conversion. This makes them reliable and versatile. The EC-Controller provides inverter and motor overload protection.

The EC-Controller can be used in both stand-alone applications as well as in large fan systems using the integrated network interface for controlling and monitoring purposes.

1.2 Features

1.2.1 Main Characteristics

- Wide range of supply voltage (EKE05-0018 only)
- Integrated Power Factor Controller
- Easy installation and commissioning
- Simple cable connection with plugs
- Integrated network interface (LONWORKS®, Modbus RTU or Nicotra Gebhardt G-B**US** modules available)
- Analogue interface module available (0-5V, 0-10V, ERROR dry contact)

1.2.2 Performance Characteristics

- Closed-loop speed control function
- Up and down ramp
- Storage of the last speed set value
- Self-acting restart after power loss with customisable delay
- Restart in right direction from any rotating speed and direction after power-on
- Electronically braking function (EKE05-0018 only)
- High efficiency
- Available with 400W (EKE 05-0018) and 1000W (EKE 05-0040) maximum input power
- Power Factor >97%

1.2.3 Protection Characteristics

- Under voltage protection
- Overload protection
- Impeller lock-up protection
- Adjustable maximum speed according to the impeller size

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2 Installation

Warnings
Work on the device/system by **unqualified** personnel or failure to comply with warnings can result in severe personal injury or serious damage to material.

Only suitably qualified personnel trained in the set-up, installation, commissioning and operation of the product should carry out work on the device/system.

This equipment must be grounded.

The following terminals can carry dangerous voltages even if the EC-Controller is inoperative:
• the power supply terminals L1, N
• the motor terminals U, V, W
• rotor position sensor terminals

2.1 Ambient Operating Conditions

Humidity Range
90% Non-condensing

Altitude
If the inverter is to be installed at an altitude > 1000m, derating will be required.

Shock
Do not drop the inverter or expose to sudden shock.

Vibration
Do not install the inverter in an area where it is likely to be exposed to constant vibration.

Electromagnetic Radiation
Do not install the inverter near sources of electromagnetic radiation.

Atmospheric Pollution
Do not install the inverter in an environment, which contains atmospheric pollutants such as dust, corrosive gases, etc.

Water
Take care to site the inverter away from potential water hazards, e.g. do not install the inverter beneath pipes that are subject to condensation. Avoid installing the inverter where excessive humidity and condensation may occur.

Installation and overheating

Warning
Do not cover the inverter casing.

Installation

2.2 Mechanical Installation

⚠ Warning	**Warnings**
	• The inverter must always be grounded. If the inverter is not grounded correctly, extremely dangerous conditions may arise within the inverter, which could prove potentially fatal.
	• To ensure the safe operation of the equipment, it must be installed and commissioned by qualified personnel in full compliance with the warnings laid down in these operating instructions.
	• Take particular note of the general and regional installation and safety regulations regarding work on dangerous voltage installations (e.g. EN50178), as well as the relevant regulations regarding the correct use of tools and personal protective equipment (PPE).
	• The mains input and motor terminals can carry dangerous voltages even if the inverter is inoperative; wait 10 minutes to allow the unit to discharge after switching off before carrying out any installation work.

Figure 1: Drill pattern

all dimensions in mm (in)	A	B	C
EKE 05-0018	142 (5.59)	144 (5.669)	71 (2.795)
EKE 05-0040	187 (7.362)	189 (7.441)	93.5 (3.681)

2.3 Electrical Installation

|	Warnings
⚠️ **Warning**	• **The inverter must always be grounded.** If the inverter is not grounded correctly, extremely dangerous conditions may arise within the inverter, which could prove potentially fatal. • To ensure the safe operation of the equipment, it must be installed and commissioned by qualified personnel in full compliance with the warnings laid down in these operating instructions. • Take particular note of the general and regional installation and safety regulations regarding work on dangerous voltage installations (e.g. EN50178), as well as the relevant regulations regarding the correct use of tools and personal protective equipment (PPE). • The mains input and motor terminals can carry dangerous voltages even if the inverter is inoperative; wait **10 minutes** to allow the unit to discharge after switching off before carrying out any installation work.

2.3.1 Connection Terminals

Power Supply Connector   Communication Connector   ServiceButton   Service LED   Error LED   Ready LED
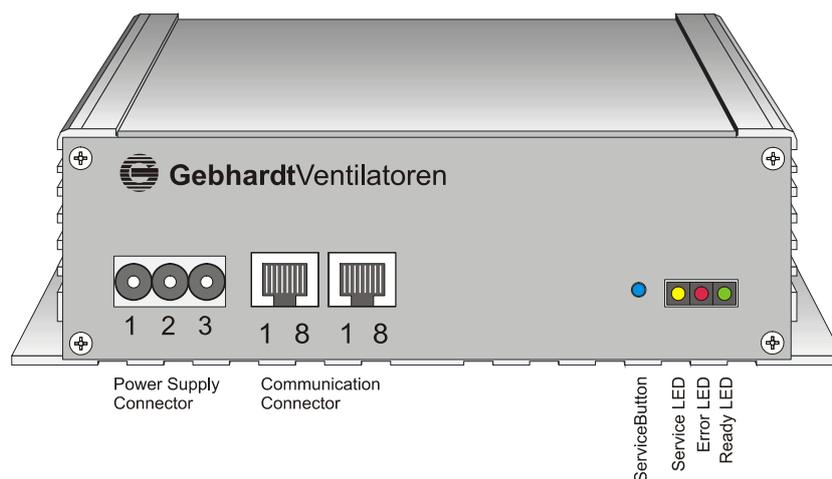
Figure 2: Front panel terminals of type EKE05-00xx-5E-IL (LONWORKS® interface)

Power Supply Connector   Communication Connector   Address Switch   Error LED   Ready LED
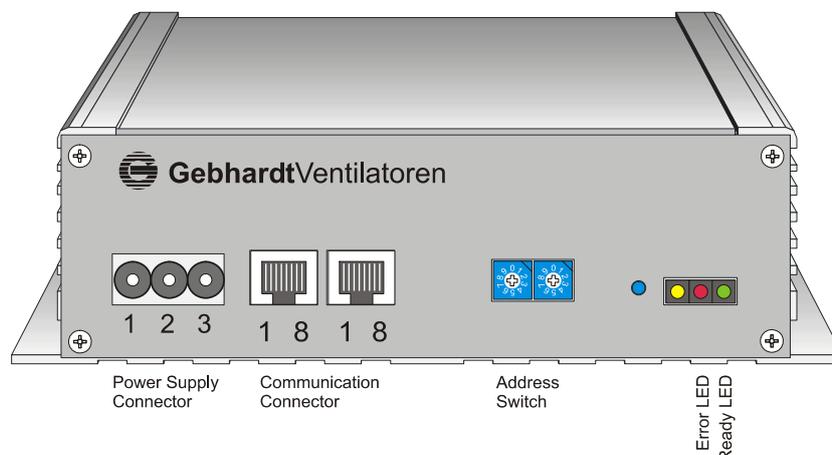
Figure 3: Front panel terminals of type EKE05-00xx-5E-IM/-IG (Modbus and GBUS interface)

Installation
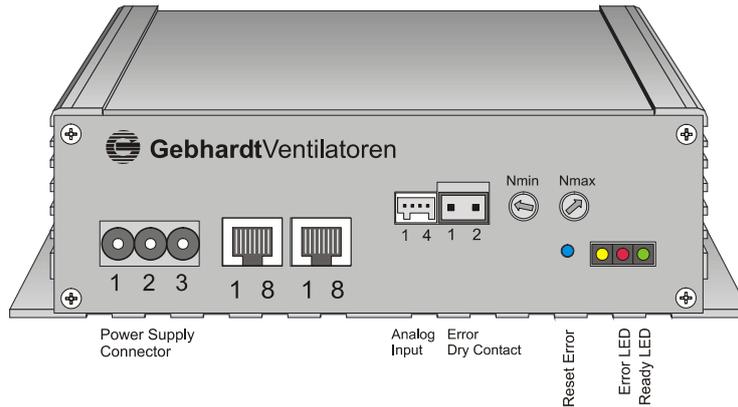
**Figure 4: Front panel terminals of type EKE05-00xx-5E-IA (analogue interface)**
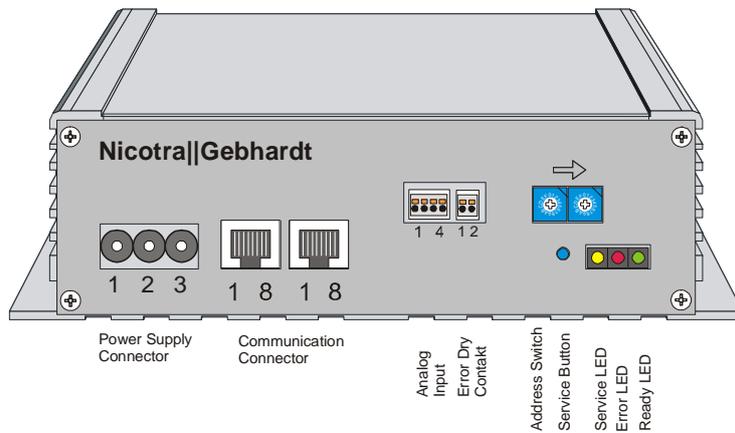

Figure 5: Front panel terminals of type EKE05-00xx-5E-IMA (Analogue / Modbus interface)
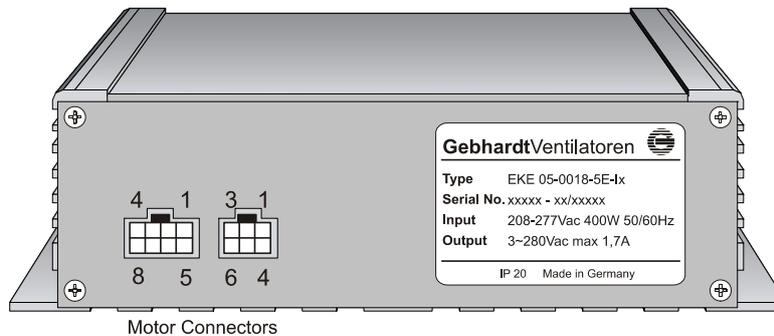

Figure 6: Back panel terminal of EKE05-00xx-5E (all interface types)

2.3.2 Pin Assignment

Type	Pin	Funktion
Wieland GST 18i3	1	L1
	2	Ground PE
	3	N

Table 1: Power supply connector

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Type	Pin	Function	Wire Colour
Power Connector (8 pole)	1	Motor phase W	blue
	2	n.c.	-
	3	Motor phase U	black
	4	n.c.	-
	5	n.c.	-
	6	Motor phase V	red
	7	n.c.	-
	8	Ground PE	yellow/green
Sensor Connector (6 pole)	1	Hall sensor B	white
	2	Hall sensor supply voltage (-)	brown
	3	Hall sensor supply voltage (+)	grey
	4	Hall sensor A	yellow
	5	Hall sensor C	green
	6	n.c.	-

Table 2: Motor connectors (all types)

Type	Pin	Funktion
RJ45 8/8 pole Western plug shielded	1	Net A
	2	Net B
	3	n.c.
	4	Ground
	5	Ground
	6	n.c.
	7	Ground
	8	Ground

Table 3: Communication connector (LONWORKS®, Modbus and GBUS interface only)

> **Remark**
> Both network connectors are internally electrically combined and thus have an identical function.

Type	Pin	Funktion
WAGO series 733-364	1	+5V
	2	0-10V
	3	0-5V
	4	Ground
WAGO series 231-832	1	dry fault contact (nc)
	2	
Potentiometer	min	min speed
	max	max speed

Table 4: Analogue input connectors and speed control elements (Analogue interface only)

Type	Pin	Funktion
WAGO picoMAX® series 2091	1	+5V
	2	0-10V
	3	0-5V
	4	Ground
WAGO picoMAX® series 2091	1	dry fault contact (nc)
	2	

Table 5: Analogue input connectors (combined Analogue/Modbus interface only)

Installation

2.3.3 Power, Motor and Network Connection

	Warning
Warning	Don't switch the PE or N wire! Dangerous voltages may occur at the power connectors between different devices, which can result in severe personal injury or serious damage to material.

	Warning
Warning	Connect motor cable first before connecting mains! Do not disconnect motor cable before all operation indicators are extinguished! The motor will produce dangerous voltages due to back EMF. Don't touch the motor plug during the motor is turning!

	Caution
Caution	Choose fuses and power supply cable carefully with respect to the number of connected devices and the total power consumption!
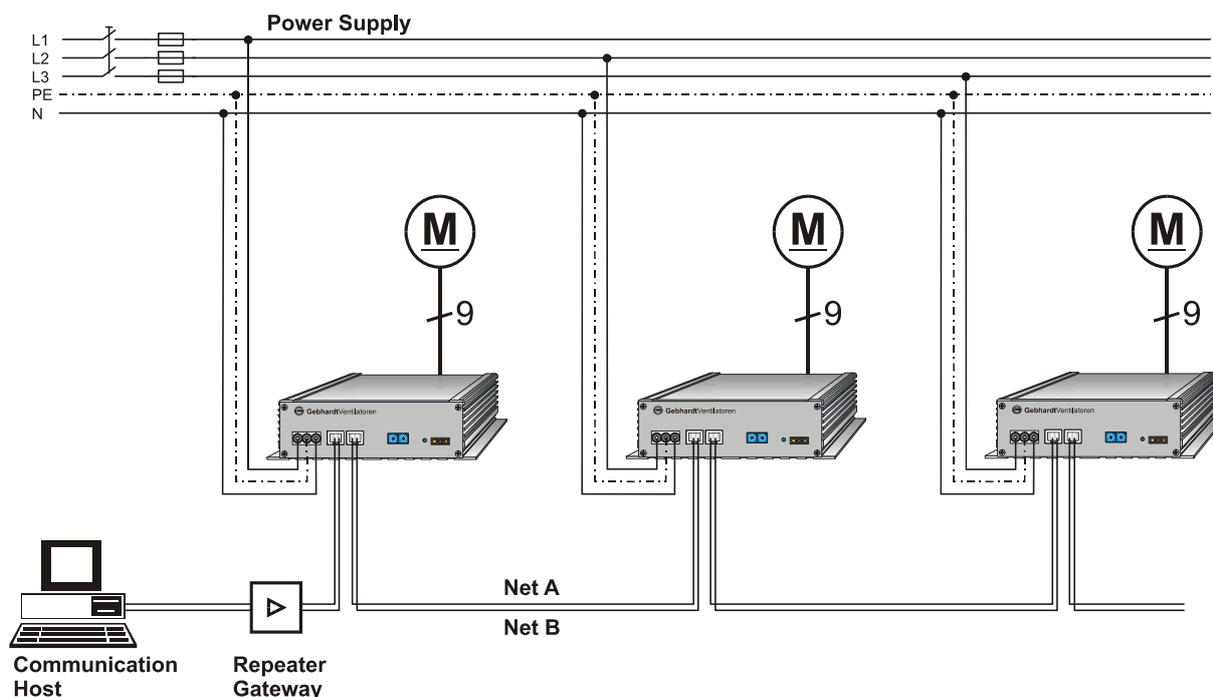
Figure 7: Connecting EKE05-00xx-5E-IL/-IG/-IM with power supply, motor and network

Installation

2.3.4 Analogue Interface Connection[1]
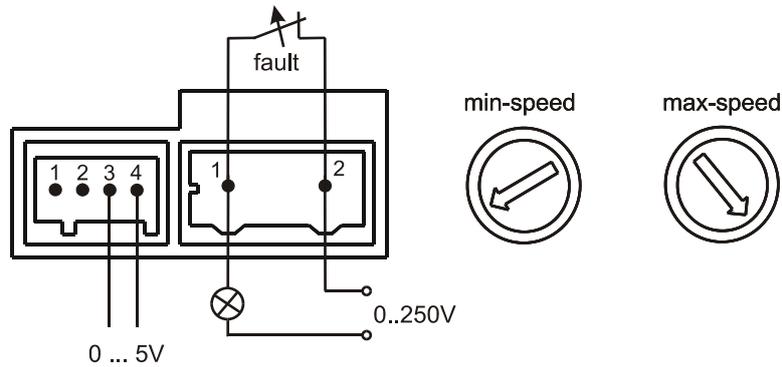
Figure 8: 0-5V analogue input
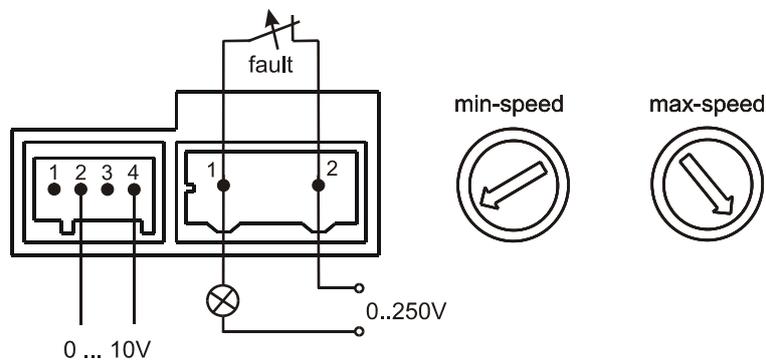
Figure 9: 0-10V analogue input
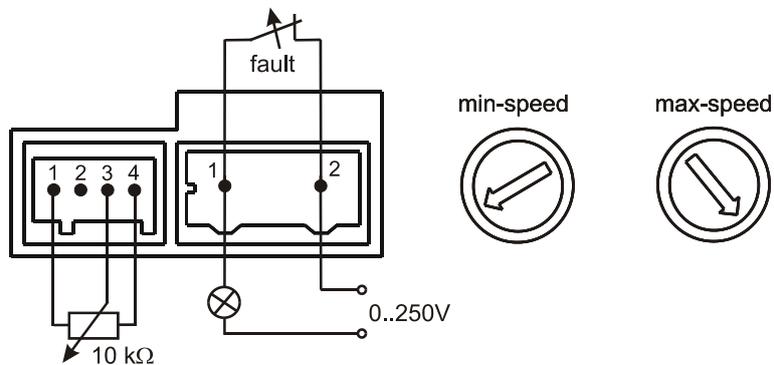
Figure 10: Potentiometer input

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[1] The connection diagram is valid for both Analogue interface and combined Analogue/Modbus interface.

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3 Commissioning

	Warning
Warning	Connect motor cable first before connecting mains! Do not disconnect motor cable before all operation indicators are extinguished! Certain inverter parameter settings may cause the motor to start automatically after mains connection. The MaxSpeed Parameter must be configured accurately for motor overload protection to operate correctly.

3.1 Status Display

Status LED	Function	Indication	Controller State
Service LED (yellow)	LON® state indication	Flashing (approx. 1 sec)	LON® node "unconfigured"
		OFF	LON® node "configured online"
	Analogue programming	Flashing	Counting Maximum speed index
Error LED (red)	Error indication	OFF	No error
		ON	Error
		Flashing	Error Internal Communication
		Alternately flashing with Ready LED	Wave function activated
Ready LED (green)	Ready indication	Flashing (approx. 0.5 sec)	Device ready (during speed change)
		Flashing (approx. 1 sec)	Device ready (speed at setpoint)
		OFF	Device not ready
		Alternately flashing with Error LED	Wave function activated

Table 6: Function of status LEDs

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3.2 LONWORKS® Interface

	Note
	For all actions regarding the LONWORKS® technology please see also the manual of your LONWORKS® network service tool and if necessary related LONWORKS® technology literature.

3.2.1 Set the EC-Controller into Operation

Step	Action	Condition	Expected Reaction
1	Connect motor cable	Mains not connected	
2	Connect mains	Motor is already connected	Green Ready-LED will start flashing
3	Connect Communication Interface to the Nicotra Gebhardt FFU Control network or to a suitable LONWORKS® network service tool		
In case of using the Nicotra Gebhardt FFU Control Server please see the concerning documentation for further commissioning steps.			
4	Set the LON® node into "Configured online" state	only necessary if the node is at unconfigured state (yellow LED flashing)	Yellow LED will stop flashing LON® Node gets a Subnet- and Node-ID (=Address)
5	Set **nviMinSpeed**, **nviMaxSpeed** to the desired values (in rpm units)		
6	Set **nviSpeed** to the desired speed value (in rpm units)		
7	Set **nviEnable** to "4"		Motor will start and speed up to the set value If the speed value is higher than **nviMaxSpeed**, motor speed will be limited

	Note
	All parameters including **nviSpeed** and **nviEnable** remain stored even if mains is removed. In case of power supply fail followed by return of mains voltage, the motor will start and speed up to the last set value without the need to communicate with the host or a comparable LONWORKS® network tool.

3.2.2 Set the EC-Controller out of Operation

1. Way:

Step	Action	Condition	Expected Reaction
1	Set **nviEnable** to "0"	Motor running	Speed set value remains stored Motor stops
2	Set **nviSpeed** to "0"		

2. Way:

Step	Action	Condition	Expected Reaction
1	Remove mains	Motor running	Motor stops All set values remain stored

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3.3 G-BUS Interface

3.3.1 Addressing

The controller address inside the GBUS network can be chosen in the range from "0" to "99" using the 2 turn-switches at the front panel of the fan controller. The new settings will take effect after a power-down-reset (restart of the device).

Figure 11: Fan Controller Address Switches

⚠ Caution	**Caution** Take care not to give any controller address double. System instability or access fail within the RS485 network can result because of address conflict.

Alternating Front Design

The GBUS controller is also available with an alternative front design with same features and operation as shown in Figure 12.

Figure 12: Alternative GBUS front

3.3.2 Set the EC-Controller into Operation

Step	Action	Condition	Expected Reaction
1	Adjust the intended address to the 2 blue addressing switches 00 .. - .. 99	Mains not connected use each address only one time within the network segment	address will be set during power-on
2	Connect motor cable	Mains not connected	
3	Connect mains supply	Motor is already connected	Green Ready-LED will start flashing
4	Connect communication interface to a Nicotra Gebhardt Ethernet-RS485-Gateway		
5	Connect Ethernet-RS485-Gateway to FFU Control Server		
In case of using the Nicotra Gebhardt FFU Control Server please see the concerning documentation for further commissioning steps.			
6	Set **Speed** to the desired speed value (in rpm units)		Motor will start and speed up to the set value If the speed value is higher than Maximum Speed, motor speed will be limited

Note
All parameters including **Speed** remain stored even if mains is removed.

In case of power supply fail and following return the motor will start and speed up to the last set value without the need to communicate with the host.

3.3.3 Set the EC-Controller out of Operation

1. Way:

Step	Action	Condition	Expected Reaction
1	Set **speed** to "0"	Motor running	Speed set value remains stored Motor stops

2. Way:

Step	Action	Condition	Expected Reaction
1	Remove mains plug	Motor running	Motor stops All set values remain stored

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3.4 Modbus RTU

3.4.1 Addressing

3.4.1.1 Hexadecimal coded address switches

The address of the Modbus interface can be adjusted by the two 16-stage DIP switches (hexadecimal coded) on the front of the controller. The address ranges from 1(0x01) to 247(0xF7). If the address is set outside of the valid range, the standard address 47(0x2F) will be used. The new settings will take effect after a power-down-reset (restart of the device).

Figure 13: Fan Controller Address Switches

⚠ Caution	**Caution** Take care not to give any controller address double. System instability or access fail within the RS485 network can result because of address conflict.

3.4.1.2 Decimal Address Switches

The address of the Modbus interface can be adjusted alternatively for newer devices by the two 10-stage DIP switches (decimal coded) on the front of the controller. The address ranges from 1 to 100. When the switches adjusted "0" "0", the address is "100". The new settings will take effect after a power-down-reset (restart of the device).

Figure 14: Alternatively Fan Controller Address Decimal Switches

Commissioning

3.4.2 Changing Communication Parameters and Password

The communication parameters and the password can only be changed after entering the valid password into output register 40005. Every change on these parameters without entering the password will be ignored.

The new settings will take effect after a power-down-reset (restart of the device).

3.4.3 Timeout-Stop Function

The parameter „timeout communication" can force the motor to stop in case the fan has no communication to any Modbus-Master after the adjusted timeout period. This Timeout-Stop function will be indicated by alternately flashing the red and green LEDs.

If the communication returns or a power-down-reset occurs, the fan will restart **automatically** and the timeout will also be restarted.

Setting this parameter to "0" disables this function.

3.4.4 Setting Maximum Speed

The parameter „maximum speed" (register 40003) has to be equal to the maximum speed of the fan. If the maximum speed is wrong, the fan may not work in a proper way or can be damaged by overload.

3.4.5 Reserved Registers

The register 40004 is reserved for hidden functions, all changes on this will be ignored.

3.4.6 Set the EC-Controller into Operation

Step	Action	Condition	Expected Reaction
1	Adjust the intended address to the 2 blue addressing switches 00 .. - .. 247	Mains not connected use each address only one time within the network segment	address will be set during power-on
2	Connect motor cable	Mains not connected	
3	Connect mains supply	Motor is already connected	Green Ready-LED will start flashing
4	Connect communication interface to a Modbus RTU Master		
5	Set **Speed** register to the desired speed value (in rpm units)		Motor will start and speed up to the set value If the speed value is higher than Maximum Speed, motor speed will be limited

> **Note**
> All parameters including **Speed** remain stored even if mains is removed.
>
> In case of power supply fail and following return the motor will start and speed up to the last set value without the need to communicate with the host.

3.4.7 Set the EC-Controller out of Operation

1. Way:

Step	Action	Condition	Expected Reaction
1	Set **speed** to "0"	Motor running	Speed set value remains stored Motor stops

2. Way:

Step	Action	Condition	Expected Reaction
1	Remove mains plug	Motor running	Motor stops All set values remain stored

3.4.8 Reset the communication settings

To reset the communication settings (baudrate and parity to default values) press the service button in front of the device longer than 5 seconds. The device answers with alternate flashing of red and green LED. The settings will be active after turn off/on of the device.

3.5 Analogue Interface

3.5.1 Programming of Maximum Speed According to Connected Fan

The programming has to be done by „Reset-button" left beside the LEDs (see Appendix 5.4 for detailed maximum speed information).

Step	Response by EKE05
Press reset button longer than 5 sec	If programming mode is launched, red and green LED flashing alternating and the drive is being stopped
Programming of max. speed step numbers of press to button = program index	The yellow LED is lighting as soon as button is pressed
Waiting time app. 5 sec	
Check of steps by watching yellow LED	Yellow LED shows program index by flashing
Programming is finished	Red LED stops flashing

Table 7: Programming EKE 05-00xx-5E-IA

3.5.2 Set the EC-Controller into Operation

Step	Action	Condition	Expected Reaction
1	Connect motor cable	Mains not connected	
2	Connect mains	Motor is already connected	Green Ready-LED will start flashing
3	Connect the analogue input	see Figure 8 to Figure 10	
4	Set min-speed and max-speed to the desired values using the 2 potentiometers	see Figure 8 to Figure 10	
5	Use 0-5V, 0-10V or 10kΩ potentiometer for speed setting	see Figure 8 to Figure 10	Motor will start and speed up to the set value

3.5.3 Set the EC-Controller out of Operation

1. Way:

Step	Action	Condition	Expected Reaction
1	Set **max speed** to "0"	Motor running set speed value > 0 rpm	Motor stops

2. Way:

Step	Action	Condition	Expected Reaction
1	Set **Speed** to "0"	Motor running max speed > 0 rpm	Motor stops

3. Way:

Step	Action	Condition	Expected Reaction
1	Remove mains plug	Motor running	Motor stops

3.6 Analogue / Modbus Interface

3.6.1 Analogue Interface

The combined Analogue/Modbus interface supports both ways of speed control. The analogue mode is preset. The maximum speed can be changed with the service button. The procedure is the same like analogue interface. As well the maximum speed can be changed by Modbus.

3.6.2 Modbus RTU

The procedure is similar to the modbus interface explained in chapter 3.4 „*Modbus RTU*":

- Adjust the Modbus address
- Check the communication parameters with your controll software
- Change operation mode to "Modbus"
- Change set speed value to start the motor
- Stop the motor

To change the operation mode to „Modbus" set output register 40011=1. At next step the speed value can be set by changing the output register 40002. The maximum speed value can be set with output register 40003. For more information see the register table in the appendix.

3.6.3 Error Dry Contact

A dry contact (relay, normally closed) indicates the error state of the device. The contact behaviour can be set with Modbus register 40010. It is possible to change between the information „no error" (= ready) and "no error AND motor runs".

3.6.4 Service Button

The service button is used for two different functions:

3.6.4.1 *Reset the Modbus communication parameters to default*

For this purpose press this button during power-on of the controller. The device answers with alternate flashing of red and green LED

3.6.4.2 *Set the maximum speed value*

The procedure is the same like analogue interface, see chapter 3.5.1 "Programming of Maximum Speed According to Connected Fan"

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4 Technical Data

4.1 Electrical Characteristics

		Value		Unit	Comments
		EKE 05-0018	EKE 05-0040		
Mains Operating Voltage		208-277 (+5/-10%°)	230 (+/-10%)	V	°) see derating diagram Figure 16
Input Frequency		50/60		Hz	
Rated Input Power		400°)	1000	W	°) see derating diagram Figure 16
Input Current	208V	1,98	-	A	
	230V	1,79	4,48	A	cos φ=0,97
	277V	1,49	-	A	
Power Limitation (DC-Link Power)		480	°)	W	°) see limitation diagram Figure 17
Efficiency		>93		%	at rated power
Power Factor (cos φ)		>0,97			at rated power
Total Harmonic Distortion Current (THDC)		<8		%	at rated power[2,3] (Figure 15)
Fuse		4	10	A	slow characteristic

Table 8: Electrical characteristics

4.2 Performance Characteristics

	Value	Unit	Comments
Speed Control Accuracy	< +/-2	rpm	
Protection Features	DC-Link voltage low, overload, impeller lock-up		
Set Point Resolution	1	rpm	
Pulse Frequency	15,6	kHz	
Output Frequency Range	0..100	Hz	
Braking threshold speed (at set speed =0)	<800	rpm	EKE05-0018 only
Interface	LONWORKS® network interface		
	Nicotra Gebhardt G-BUS interface (RS485)		
	Modbus RTU		
	Analogue interface (0..5V, 0..10V, ERROR dry contact 1000VDC, 0,5ADC, max. 10W)		

Table 9: Performance characteristics

4.3 Mechanical Characteristics

	Value		Unit
	EKE 05-0018	EKE 05-0040	
Dimensions (w x h x d)	227(8.94)x65(2.56)x146(5.75)	227(8.94)x65(2.56)x189(7.44)	mm (in)
Weight	1,25	1,65	kg
Cooling	free convection		
Power Supply Connector	Wieland GST18i3		
Communication Connector	RJ45 Western Plug 8 pole		
Communication Connector (analogue)	WAGO 733-364 (analogue link) WAGO 231-832 (error dry contact)		
Motor Power Connector	AMP: MATE-N-Lok, 8-pole		
Motor Sensor Connector	AMP: MATE-N-Lok 6-pole		
Input Cable Min.	0,75		mm^2
Motor Output Cable Min.	0,75		mm^2
Position Sensor Cable Min.	0,25		mm^2
Motor Cable Length Max.	1,5		m

Table 10: Mechanical characteristics

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[2] see diagrams: THD vs. input power, voltage and current
[3] Condition: THD of supply voltage less than 2%

Technical Data

4.4 Ambient Conditions

	Value	Unit	Comments
Storage Temperature	-40 to +70	°C	
Operating Temperature	0 to 40	°C	
Operating Altitude	<1000 (<3000)	m (ft)	above sea level[4]
Humidity % RH	90	%	non-condensing
Protection Level	IP20		

Table 11: Ambient conditions

4.5 THD Characteristics
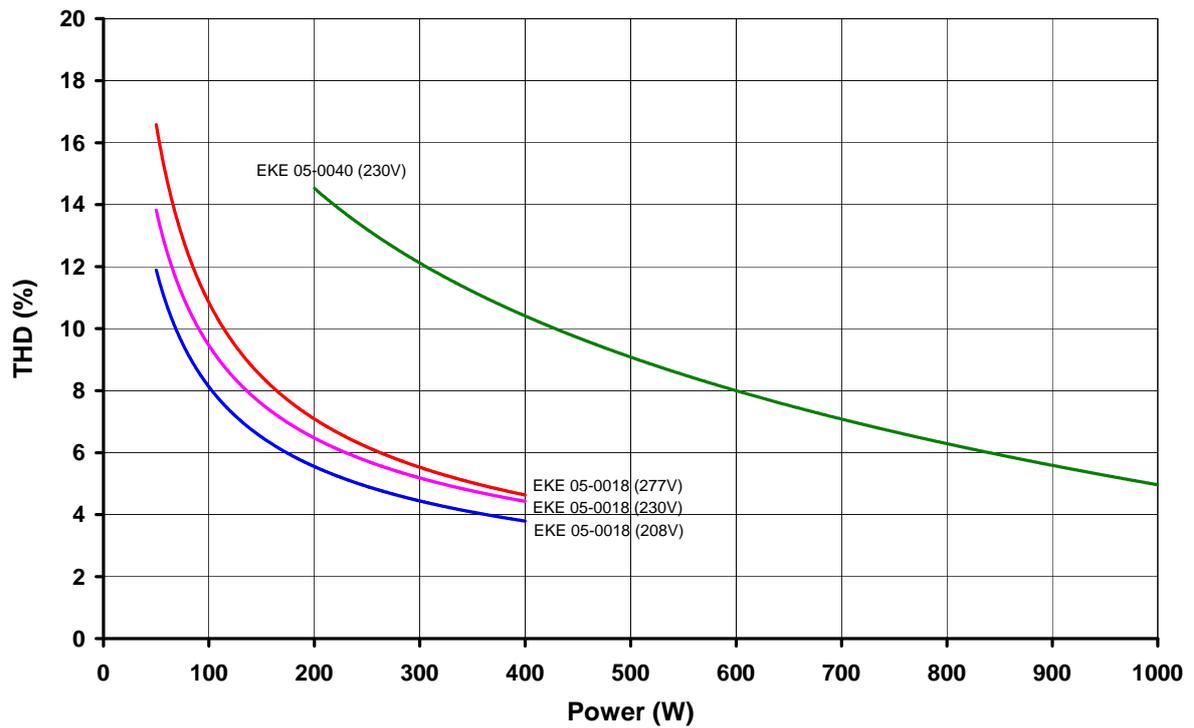

Figure 15: THD (current) vs. input power and input voltage

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[4] Altitude derating of maximum operating temperature: -2°C per 300m (1000ft) over 1000m (3000ft)

Technical Data

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4.6 Power Limitations
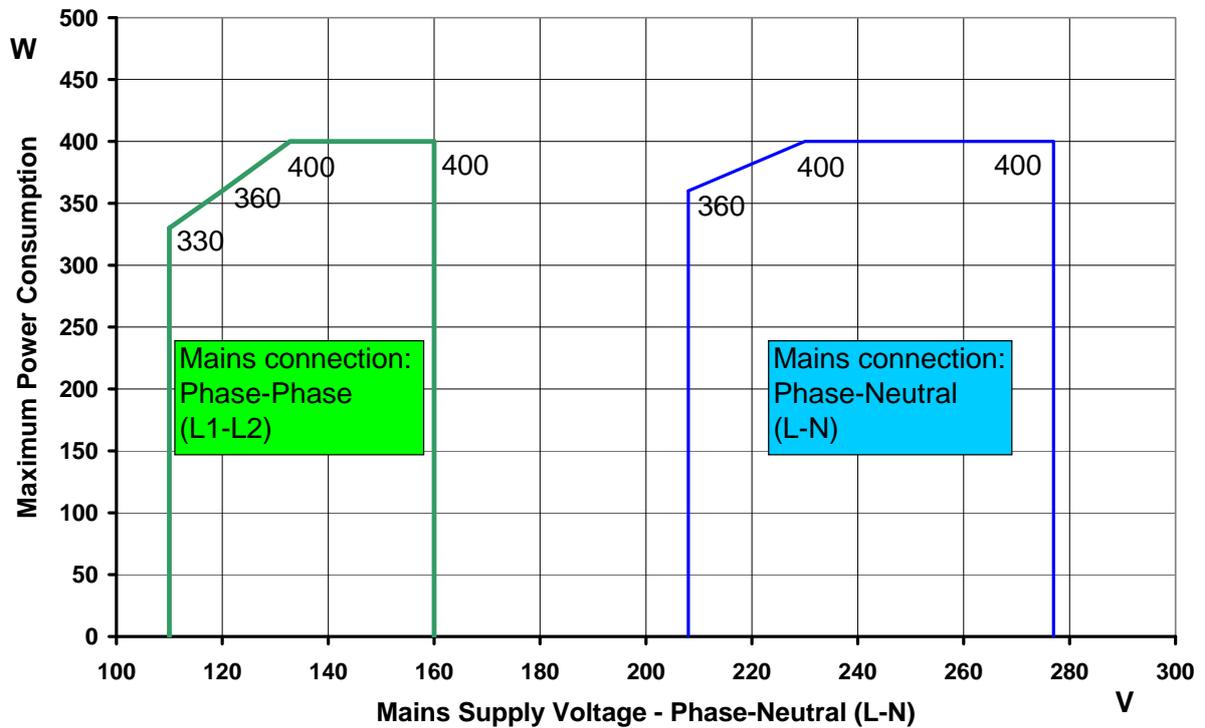
Figure 16: Power derating vs. supply voltage (EKE05-0018-5E only)
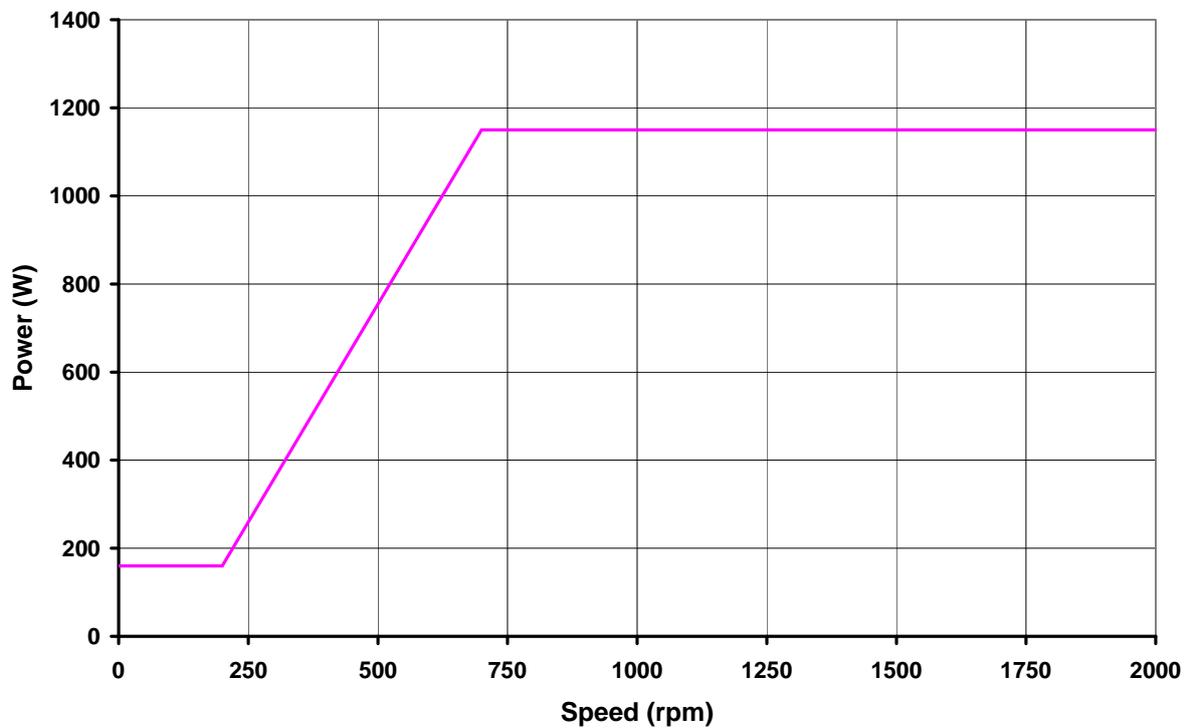
Figure 17: Power limitation vs. motor speed (EKE05-0040-5E only)

Technical Data

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5 Appendix

5.1 LONWORKS® Interface

In.	Name	Type	1)	Default	Description	Send after
Node Object, ID #0						
0	nviRequest	SNVT_obj_request	i	-		
1	nvoStatus	SNVT_obj_status	o	-		change
FFU Object, ID #1						
2	nviSpeed	SNVT_rpm	i	0	Set value (rpm)	
3	nvoSpeed	SNVT_rpm	o	0	Actual value (rpm)	change/ heartbeat
4	nviEnable	SNVT_lev_disc	i	0	Start/stop	
5	nvoFfuStatus	SNVT_char_ascii	o	0	Error code	change/ heartbeat
Configuration						
6	nciMaxSpeed	SNVT_rpm	c	1000 rpm	Maximum speed (rpm)	
7	nciMinSpeed	SNVT_rpm	c	250 rpm	Minimum speed (rpm)	
8	nciSndOnDelta	SNVT_rpm	c	20 rpm	Speed change to trigger sending	
9	nciMaxSndTm	SNVT_time_sec	c	500 (50,0s)	Heartbeat control: cycl. sending of nvoVisual	
10	nciMinSndTm	SNVT_time_sec	c	100 (10,0s)	Minimum time between two heartbeats	
User specific						
11	struct { Speed FfuStatus Enable } nvoVisual	SNVT_rpm SNVT_char_ascii SNVT_lev_disc	o	0 0 0	=nvoSpeed =nvoFfuStatus =f(Statuswort.Bit1)	change/ heartbeat
12	struct { Address R_W Data } nviParameter	unsigned int:7 unsigned int:1 unsigned long	i		No function / not used, only present for downwardly compatibility.	
13	struct { Address Error Data } nvoParameter	unsigned int:7 unsigned int:1 unsigned long	o			
14	nciRestartDelay	SNVT_time_sec	c	10 (1,0s)	Wait time before start after power-on	
15	nciPWMLimit	SNVT_count		0xE000	No function / not used, only present for downwardly compatibility.	
16	nciIFaktor	SNVT_time_sec		10 (1.0s)		
17	nciIMax	SNVT_count		300		
18	nciIOffset	SNVT_count		0		
19	nciSpeedSetDelay	SNVT_time_sec		150 (15.0s)		
20	nciGradLimit	SNVT_rpm		30 rpm		
21	nciSamples	SNVT_count		4		
22	nvoPower	SNVT_power	o	0	Actual power value	
23	nciSndOnDeltaPwr	SNVT_power	c	200 (20,0W)	Power change to trigger sending	
24	struct { Speed FfuStatus Enable Power }nvoVisualPwr	SNVT_rpm SNVT_char_ascii SNVT_lev_disc SNVT_power	o	0 0 0 0	=nvoSpeed =nvoFfuStatus =f(Statuswort.Bit1) =nvoPower	change/ heartbeat
25	nciRSpeed	SNVT_rpm	c	0		

Table 12: LONWORKS® network interface

1) i ..input; o ..output; c ..input config

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5.2 G-BUS Interface

5.2.1 Interface Communication Parameters

Supported protocol	GBUS
Physical layer	EIA-485 half-douplex
Supported baud rates	9600 bps
Address range	1…99 (adjustable in decimal numbers)

5.2.2 Commands

Command	Function	Description
0	(not used)	
1	Maximum speed	rpm
2	Set speed	rpm
3	Set node status	Reset of errors: 1: Under voltage 2: Motor error 4: Speed controller error 7: All errors
4	Set restart delay	1..255s restart delay after power-on
5	Set wink function ON/OFF	switch on wink function (alternating flash of red and green LED): 1=ON 0=OFF
6	Fix address at EEPROM (normally not used)	1=fix, 0=free
7	Send node state	contains: Maximum speed Set speed Actual speed Node state (error code) Restart delay
8	Acknowledge	Slave response message sent after every command except after command 9, where command 7 will follow
9	Request node state	Request for the actual node state

5.2.3 Error Codes

Error code	Undervoltage Error	Motor Error	Speed Controller Error
0 (no error)			
1	X		
2		X	
3	X	X	
4			X
5	X		X
6		X	X
7	X	X	X

Appendix

5.3 Modbus RTU Interface

5.3.1 Interface Communication Parameters

Supported protocol	Modbus RTU
Physical layer	EIA-485
Supported baud rates	9600, 19200, **38400**, 57600 bps
Supported parities	**none**, even, odd
Data bits	8
Stopp bits	1
Address range	1…247 (adjustable in hexadecimal numbers 0x01…0xF7)
Function codes	04 – read input registers
	03 – read output registers
	06 – write single output registers
	16 – write multiple output registers

5.3.2 Register Overview

Register No.	Description	Range	Default settings
Input Registers (function code: 04) read only			
30001	Error code	0…7	-
30002	Measured speed	0…2000 rpm	-
30003	Measured power	0…2000 watts	-
Output Registers (function codes: 03, 06, 16) read / write			
40001	Reset	1	0
	Wink	2	
40002	Set speed	0, 250…2000 rpm	0
40003	Maximum speed	0…2000 rpm	1000
40004	Hidden functions	0…2000	0 (do not change)
40005	Timeout communication	0...655 s	0 (0 = function disabled)
40006	Password	0…65535	1111
40007	New password (protected)	0…65535	0
40008	New baud rate (protected)	0…3 0 = 9600 1 = 19200 2 = 38400 3 = 57600	2
40009	New parity (protected)	0…2 0 = none 1 = odd 2 = even	0

5.3.3 Error Codes

Error code	Undervoltage Error	Motor Error	Speed Controller Error
0 (no error)			
1	X		
2		X	
3	X	X	
4			X
5	X		X
6		X	X
7	X	X	X

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5.4 Analogue Interface

5.4.1 Fixed Maximum Speed Values EKE 05-0018-5E-IA / -IMA

Type of Impeller		Maximum Speed (rpm)	Program Index
RLE 21-0477-EC-00-23		1070	0
RLE 31-0455-EC-00-28		1120	1
RLE 31-0406-EC-00-37	RDA 31-3540-EC	1260	2
RLE 21-0407-EC-00-26		1350	3
RLE 31-0363-EC-00-37	RDA 31-3535-EC	1460	4
RLE 31-0323-EC-00-37	RDA 31-2531-EC	1750	5
RLE 21-0299-EC-00-30 RLE 31-0288-EC-00-37	RDA 31-2528-EC	1850	6

Table 13: Table of fixed maximum speed values EKE 05-0018-5E-IA / -IMA
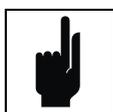
Note:
The analogue Interface has an automated power limit of 400W. If this limit is exceeded for longer period, the controller will reduce the speed with -100 rpm. This status will be shown with alternating flashing of red and green LED and could be reset by short press of black button.

5.4.2 Fixed Maximum Speed Values EKE 05-0040-5E-IA / -IMA

Type of Impeller		Maximum Speed (rpm)	Program Index
RLE 31-0570-EC-01-37	RDA 31-4556-EC	880	0
RLE 21-0538-EC-01-26		1140	1
RLE 31-0510-EC-01-37	RDA 31-4550-EC	1180	2
RLE 51-0570-EC-01-18		1240	3
RLE 31-0455-EC-01-37	RDA 31-3545-EC	1470	4
RLE 21-0477-EC-01-23		1530	5
RLE 31-0455-EC-01-28		1580	6
RLE 31-0406-EC-01-37	RDA 31-3540-EC	1760	7
RLE 21-0407-EC-01-26		1970	8

Table 14: Table of fixed maximum speed values EKE 05-0040-5E-IA / -IMA

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5.5 Analogue / Modbus Interface

5.5.1 Interface Communication Parameters

Supported protocol	Modbus RTU
Physical layer	EIA-485
Supported baud rates	9600, 19200, **38400**, 57600 bps
Supported parities	**none**, even, odd
Data bits	8
Stopp bits	1
Address range	1…247 (adjustable in hexadecimal numbers 0x01…0xF7)
Function codes	04 – read input registers
	03 – read output registers
	06 – write single output registers
	16 – write multiple output registers

5.5.2 Register Overview

Register No.	Description	Range	Default settings
Input Registers (function code: 04) read only			
30001	Error code	0…7	-
30002	Measured speed	0…2000 rpm	-
30003	Measured power	0…2000 watts	-
30004	Operation mode	0 = Analogue 1 = Modbus	-
30005	Analogue input	0…1000	-
30006	Firmwareversion	0...65535	-
Output Registers (function codes: 03, 06, 16) read / write			
40001	Reset	1	0
	Wink	2	
40002	Set speed	0, 250…2000 rpm	0
40003	Maximum speed	0…2000 rpm	1000
40004	Hidden functions	0…2000	0 (do not change)
40005	Timeout communication	0...655 s	0 (0 = function disabled)
40006	Password	0…65535	1111
40007	New password (protected)	0…65535	0
40008	New baud rate (protected)	0…3 0 = 9600 1 = 19200 2 = 38400 3 = 57600	2
40009	New parity (protected)	0…2 0 = none 1 = odd 2 = even	0
40010	Function error contact* (protected)	0…1 0 = Ready 1 = Ready AND Motor runs	0
40011	Operation mode	0...1 0 = Analogue 1 = Modbus	0

*The dry contact is closed, if:
    0: Ready: device: no error
    1: Ready AND Motor runs   device: no error AND Motor runs (speed > 250min^{-1})

5.5.3 Error Codes

Error code	Undervoltage Error	Motor Error	Speed Controller Error
0 (no error)			
1	X		
2		X	
3	X	X	
4			X
5	X		X
6		X	X
7	X	X	X

5.6 Table to convert address values decimal-to-hexadecimal

dec	hex	dec	hex	dec	hex	dec	hex	dec	hex	dec	hex	dec	hex
0	0	40	28	80	50	120	78	160	A0	200	C8	240	F0
1	1	41	29	81	51	121	79	161	A1	201	C9	241	F1
2	2	42	2A	82	52	122	7A	162	A2	202	CA	242	F2
3	3	43	2B	83	53	123	7B	163	A3	203	CB	243	F3
4	4	44	2C	84	54	124	7C	164	A4	204	CC	244	F4
5	5	45	2D	85	55	125	7D	165	A5	205	CD	245	F5
6	6	46	2E	86	56	126	7E	166	A6	206	CE	246	F6
7	7	47	2F	87	57	127	7F	167	A7	207	CF	247	F7
8	8	48	30	88	58	128	80	168	A8	208	D0		
9	9	49	31	89	59	129	81	169	A9	209	D1		
10	A	50	32	90	5A	130	82	170	AA	210	D2		
11	B	51	33	91	5B	131	83	171	AB	211	D3		
12	C	52	34	92	5C	132	84	172	AC	212	D4		
13	D	53	35	93	5D	133	85	173	AD	213	D5		
14	E	54	36	94	5E	134	86	174	AE	214	D6		
15	F	55	37	95	5F	135	87	175	AF	215	D7		
16	10	56	38	96	60	136	88	176	B0	216	D8		
17	11	57	39	97	61	137	89	177	B1	217	D9		
18	12	58	3A	98	62	138	8A	178	B2	218	DA		
19	13	59	3B	99	63	139	8B	179	B3	219	DB		
20	14	60	3C	100	64	140	8C	180	B4	220	DC		
21	15	61	3D	101	65	141	8D	181	B5	221	DD		
22	16	62	3E	102	66	142	8E	182	B6	222	DE		
23	17	63	3F	103	67	143	8F	183	B7	223	DF		
24	18	64	40	104	68	144	90	184	B8	224	E0		
25	19	65	41	105	69	145	91	185	B9	225	E1		
26	1A	66	42	106	6A	146	92	186	BA	226	E2		
27	1B	67	43	107	6B	147	93	187	BB	227	E3		
28	1C	68	44	108	6C	148	94	188	BC	228	E4		
29	1D	69	45	109	6D	149	95	189	BD	229	E5		
30	1E	70	46	110	6E	150	96	190	BE	230	E6		
31	1F	71	47	111	6F	151	97	191	BF	231	E7		
32	20	72	48	112	70	152	98	192	C0	232	E8		
33	21	73	49	113	71	153	99	193	C1	233	E9		
34	22	74	4A	114	72	154	9A	194	C2	234	EA		
35	23	75	4B	115	73	155	9B	195	C3	235	EB		
36	24	76	4C	116	74	156	9C	196	C4	236	EC		
37	25	77	4D	117	75	157	9D	197	C5	237	ED		
38	26	78	4E	118	76	158	9E	198	C6	238	EE		
39	27	79	4F	119	77	159	9F	199	C7	239	EF		

Table 1: Decimal-to-hexadecimal table

Appendix

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5.7 Electro-Magnetic Compatibility (EMC)

5.7.1 EMC Directive

All manufacturers / assemblers of electrical apparatus which "performs a complete intrinsic function and is placed on the market as a single unit intended for the end user" must comply with the EMC directive EEC/89/336.

The Nicotra Gebhardt *EC-Controller* has only an intrinsic function when connected with an Nicotra Gebhardt EC motor. Thus the controller itself can not be labelled with the CE sign, which would confirm the conformity with the EMC directive.

5.7.2 Compliance with Harmonics Regulations

From 1st January 2001 all electrical apparatus covered by the EMC Directive will have to comply with EN 61000-3-2 "Limits for harmonic current emissions (equipment input <= 16A per phase)".
Due to the integrated PFC (Power Factor Controller) the *EC-Controller* complies with the harmonics emissions specification EN 61000-3-2.

The specification of THD values complies with the EMC Product Standard for Power Drive Systems EN 68100-3.

5.7.3 Compliance with Semiconductor Processing Equipment Standards

The controller has been successfully tested to meet the Semiconductor Processing Equipment Voltage Sag Immunity Standard SEMI F47-0999.

5.7.4 General Classes of EMC Performance

5.7.4.1 Industrial Environment

Meeting the requirements in Table 15 will allow the manufacturer/assembler to self-certify their apparatus for compliance with the EMC directive for the industrial environment as regards the EMC performance characteristics of the power drive system.

EMC Phenomenon	Standard
Emissions:	
Radiated emissions	EN 55016-2-1
Conducted emissions	EN 55016-2-3
Immunity:	
Voltage fluctuations, dips, frequency variations	EN 61000-4-11
Electrostatic discharge (ESD)	EN 61000-4-2
Fast transient interferences (Burst)	EN 61000-4-4

Table 15: EMC requirements for use in industrial environment

5.7.4.2 Residential, Commercial and Light Industry Environment

Meeting the requirements in Table 16 will allow the manufacturer / assembler to self-certify compliance of their apparatus with the EMC directive for the residential, commercial and light industrial environment as regards the EMC performance characteristics of the power drive system.

EMC Phenomenon	Standard
Emissions:	
Radiated emissions	EN 55016-2-1
Conducted emissions	EN 55016-2-3
Immunity:	
Voltage fluctuations, dips, frequency variations	EN 61000-4-11
Electrostatic discharge (ESD)	EN 61000-4-2
Fast transient interferences (Burst)	EN 61000-4-4

Table 16: EMC requirements for use in residential, commercial and light industry environment

6 Notes