



COMBIVERT G6

SAFETY MANUAL | SAFETY FUNCTION SSM WITH LEVEL $f=0$ Hz

Translation of the original manual
Document 20222640 EN 04






Preface

The hardware and software described in this document are products of KEB. The information contained in this document is valid at the time of publishing. KEB reserves the right to update this document in response to misprints, mistakes or technical changes.

Signal words and symbols

Certain procedures within this document can cause safety hazards during the installation or operation of the device. Refer to the safety warnings in this document when performing these procedures. Safety signs are also located on the device where applicable. A safety warning is marked by one of the following warning signs:

 DANGER	Dangerous situation, which will cause death or serious injury if this safety warning is ignored.
 WARNING	Dangerous situation, which may cause death or serious injury if this safety warning is ignored.
 CAUTION	Dangerous situation, which may cause minor injury if this safety warning is ignored.
NOTICE	Situation, which can cause damage to property if this safety warning is ignored.

RESTRICTION

Used when the following statements depend on certain conditions or are only valid for certain ranges of values.



Used for informational messages or recommended procedures.

More symbols

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



Note to further documentation.
www.keb.de/service/downloads



Laws and guidelines

KEB Automation KG confirms with the EC declaration of conformity and the CE mark on the device nameplate that it complies with the essential safety requirements.

The EC declaration of conformity can be downloaded on demand via our website.

Warranty and liability

The warranty and liability on design, material or workmanship for the acquired device is given in the general sales conditions.



Here you will find our general sales conditions.
www.keb.de/terms-and-conditions



Further agreements or specifications require a written confirmation.

Support

Although multiple applications are referenced, not every case has been taking into account. If you require further information or if problems occur which are not referenced in the documentation, you can request the necessary information via the local KEB agency.

The use of our units in the target products is outside of our control and therefore lies exclusively in the area of responsibility of the 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 intended use. However, they are regarded as being only informal and changes are expressly reserved, in particular due to technical changes. 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 intended end use of the product (application) by the customer. They must be repeated, even if only parts of hardware, software or the unit adjustment are modified.

Copyright

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

This KEB product or parts thereof may contain third-party software, including free and/or open source software. If applicable, the license terms of this software are contained in the instructions for use. The instructions for use are already available to you, can be downloaded free of charge from the KEB website or can be requested from the respective KEB contact person.

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Glossary

0V	Earth-potential-free common point	Endat	Bidirectional encoder interface of the company Heidenhain
1ph	1-phase mains	EtherCAT	Real-time Ethernet bus system of the company Beckhoff
3ph	3-phase mains	Ethernet	Real-time bus system - defines protocols, plugs, types of cables
AC	AC current or voltage	FE	Functional earth
AFE	From 07/2019 AIC replaces the previous name AFE	FSoE	Functional Safety over Ethernet
AFE filter	From 07/2019 AIC filter replaces the previous name AFE filter	FU	Drive converter
AIC	Active Infeed Converter	GND	Reference potential, ground
AIC filter	Filter for Active Infeed Converter	GTR7	Braking transistor
Application	The application is the intended use of the KEB product	HF filter	High frequency filter to the mains
ASCL	Asynchronous sensorless closed loop	Hiperface	Bidirectional encoder interface of the company Sick-Stegmann
Auto motor ident.	Automatically motor identification; calibration of resistance and inductance	HMI	Human machine interface (touch screen)
AWG	American wire gauge	HSP5	Fast, serial protocol
B2B	Business-to-business	HTL	Incremental signal with an output voltage (up to 30V) -> TTL
BiSS	Open source real-time interface for sensors and actuators (DIN 5008)	IEC	International standard
CAN	Fieldbus system	IP xx	Degree of protection (xx for level)
CDF	Cyclic duration factor	KEB product	The KEB product is subject of this manual
CDM	Complete drive module including auxiliary equipment (control cabinet)	KTY	Silicium temperature sensor (polarized)
COMBIVERT	KEB drive converters	Manufacturer	The manufacturer is KEB, unless otherwise specified (e.g. as manufacturer of machines, engines, vehicles or adhesives)
COMBIVIS	KEB start-up and parameterizing software	MCM	American unit for large wire cross sections
Customer	The customer has purchased a KEB product from KEB and integrates the KEB product into his product (customer product) or resells the KEB product (dealer)	Modulation	Means in drive technology that the power semiconductors are controlled
DC	DC current or voltage	MTTF	Mean service life to failure
DI	Demineralized water, also referred to as deionized (DI) water	NN	Sea level
DIN	German Institut for standardization	OC	Overcurrent
DS 402	CiA DS 402 - CAN device profile for drives	OH	Overheat
EMC	Electromagnetic compatibility	OL	Overload
Emergency stop	Shutdown of a drive in emergency case (not de-energized)	OSSD	Output signal swithcing device; - an output signal that is checked in regular intervals on its shutdown. (safety technology)
Emergency switching off	Switching off the voltage supply in emergency case	PDS	Power drive system incl. motor and measuring probe
EMS	Energy Management System	PE	Protective earth
EN	European standard	PELV	Protective Extra Low Voltage
Encoder emulation	Software-generated encoder output	PFD	Term used in the safety technology (EN 61508-1...7) for the size of error probability
End customer	The end customer is the user of the customer product		

GLOSSARY

PFH	Term used in the safety technology (EN 61508-1...7) for the size of error probability per hour
PLC	Programmable logic controller
PT100	Temperature sensor with $R_0=100\Omega$
PT1000	Temperature sensor with $R_0=1000\Omega$
PTC	PTC-resistor for temperature detection
PWM	Pulse width modulation
RJ45	Modular connector with 8 lines
SCL	Synchronous sensorless closed loop
SELV	Safety Extra Low Voltage (<60V)
SIL	The security integrity level is a measure for quantifying the risk reduction. Term used in the safety technology (EN 61508 -1...7)
SS1	Safety function „Safe stop 1“ in accordance with IEC 61800-5-2
SSI	Synchronous serial interface for encoder
STO	Safety function „Safe Torque Off“ in accordance with IEC 61800-5-2
TTL	Incremental signal with an output voltage up to 5V
USB	Universal serial bus
VARAN	Real-time Ethernet bus system

Standards for drive converters / control cabinets

Product standards that apply directly to the drive converter

EN61800-2	Adjustable speed electrical power drive systems - Part 2: General requirements - Rating specifications for low voltage adjustable frequency a.c. power drive systems (VDE 0160-102, IEC 61800-2)
EN61800-3	Speed-adjustable electrical drives. Part 3: EMC requirements and specific test methods (VDE 0160-103, IEC 61800-3)
EN61800-5-1	Adjustable speed electrical power drive systems - Part 5-1: Safety requirements - Electrical, thermal and energy (IEC 61800-5-1); German version EN 61800-5-1
EN61800-5-2	Adjustable speed electrical power drive systems - Part 5-2: Safety Requirements - Functional (IEC 22G/264/CD)
UL61800-5-1	American version of the EN61800-5-1 with „National Deviations“

Basic standards to which drive converter standards refer directly

EN 55011	Industrial, scientific and medical equipment - Radio frequency disturbance characteristics - Limits and methods of measurement (CISPR 11); German version EN 55011
EN 55021	Interference to mobile radiocommunications in the presence of impulse noise - Methods of judging degradation and measures to improve performance (IEC/ CISPR/D/230/FDIS); German version prEN 55021
EN 60529	Degrees of protection provided by enclosures (IP Code) (IEC 60529)
EN 60664-1	Insulation coordination for equipment within low-voltage systems Part 1: Principles, requirements and tests (IEC 60664-1)
EN 60721-3-1	Classification of environmental conditions - Part 3-1: Classification of groups of environmental parameters and their severities - Section 1: Storage (IEC 60721-3-1); German version EN 60721-3-1
EN 60721-3-2	Classification of environmental conditions - Part 3: Classification of groups of environmental parameters and their severities - Section 2: Transportation and handling (IEC 104/670/CD)
EN 60721-3-3	Classification of environmental conditions - Part 3: Classification of groups of environmental parameters and their severities; section 3: Stationary use at weatherprotected locations; Amendment A2 (IEC 60721-3-3); German version EN 60721-3-3
EN 61000-2-1	Electromagnetic compatibility (EMC) - Part 2: Environment - Section 1: Description of the environment - Electromagnetic environment for low-frequency conducted disturbances and signalling in public power supply systems
EN 61000-2-4	Electromagnetic compatibility (EMC) - Part 2-4: Environment; Compatibility levels in industrial plants for low-frequency conducted disturbances (IEC 61000-2-4); German version EN 61000-2-4
EN 61000-4-2	Electromagnetic compatibility (EMC) - Part 4-2: Testing and measurement techniques - Electrostatic discharge immunity test (IEC 61000-4-2); German version EN 61000-4-2
EN 61000-4-3	Electromagnetic compatibility (EMC) - Part 4-3: Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test (IEC 61000-4-3); German version EN 61000-4-3
EN 61000-4-4	Electromagnetic compatibility (EMC) - Part 4-4: Testing and measurement techniques - Electrical fast transient/burst immunity test (IEC 61000-4-4); German version EN 61000-4-4

STANDARDS FOR DRIVE CONVERTERS/CONTROL CABINETS

EN61000-4-5	Electromagnetic compatibility (EMC) - Part 4-5: Testing and measurement techniques - Surge immunity test (IEC 61000-4-5); German version EN 61000-4-5
EN61000-4-6	Electromagnetic compatibility (EMC) - Part 4-6: Testing and measurement techniques - Immunity to conducted disturbances, induced by radio-frequency fields (IEC 61000-4-6); German version EN 61000-4-6
EN61000-4-34	Electromagnetic compatibility (EMC) - Part 4-34: Testing and measurement techniques - Voltage dips, short interruptions and voltage variations immunity tests for equipment with mains current more than 16 A per phase (IEC 61000-4-34); German version EN 61000-4-34
EN61508-1...7	Functional safety of electrical/electronic/programmable electronic safety-related systems – Part 1...7 (VDE 0803-1...7, IEC 61508-1...7)
EN62061	Safety of machinery - functional safety of electrical, electronic and programmable electronic safety-related systems (VDE 0113-50, IEC 62061)
EN ISO 13849-1	Safety of machinery - safety-related parts of control systems - Part 1: General principles for design (ISO 13849-1); German version EN ISO 13849-1

Standards that are used in the environment of the drive converter

DGUV regulation 3	Electrical installations and equipment
DIN 46228-1	Wire-end ferrules; Tube without plastic sleeve
DIN 46228-4	Wire-end ferrules; Tube with plastic sleeve
DIN IEC 60364-5-54	Low-voltage electrical installations - Part 5-54: Selection and erection of electrical equipment - Earthing arrangements, protective conductors and protective bonding conductors (IEC 64/1610/CD)
DIN VDE 0100-729	Low-voltage electrical installations - Part 7-729: Requirements for special installations or locations - Operating or maintenance gangways (IEC 60364-7-729:2007, modified); German implementation HD 60364-7-729:2009
DNVGL-CG-0339	Environmental test specification for electrical, electronic and programmable equipment and systems
EN 1037	Safety of machinery - Prevention of unexpected start-up; German version EN 1037
EN 12502-1...5	Protection of metallic materials against corrosion - Part 1...5
EN 60204-1	Safety of machinery - electrical equipment of machines Part 1: General requirements (VDE 0113-1, IEC 44/709/CDV)
EN 60439-1	Low-voltage switchgear and controlgear assemblies - Part 1: Type-tested and partially type-tested assemblies (IEC 60439-1); German version EN 60439-1
EN 60947-7-1	Low-voltage switchgear and controlgear - Part 7-1: Ancillary equipment - Terminal blocks for copper conductors (IEC 60947-7-1:2009); German version EN 60947-7-1:2009
EN 60947-8	Low-voltage switchgear and controlgear - Part 8: Control units for built-in thermal protection (PTC) for rotating electrical machines (IEC 60947-8:2003 + A1:2006 + A2:2011)
EN 61373	Railway applications - Rolling stock equipment - Shock and vibration tests (IEC 61373); German version EN 61373
EN 61439-1	Low-voltage switchgear and controlgear assemblies - Part 1: General rules (IEC 121B/40/CDV); German version FprEN 61439-1
VGB R 455 P	Water treatment and use of materials in cooling systems
DIN EN 60939-1	Passive filter units for electromagnetic interference suppression - Part 1: Generic specification (IEC 60939-1:2010); German version EN 60939-1:2010

1 Basic Safety Instructions

The COMBIVERT is designed and constructed in accordance with state-of-the-art technology and the recognized safety rules and regulations. However, the use of such devices may cause functional hazards for life and limb of the user or third parties, or damages to the system and other material property.

The following safety instructions have been created by the manufacturer for the area of electric drive technology. They can be supplemented by local, country- or application-specific safety instructions. This list is not exhaustive. Violation of the safety instructions by the customer, user or other third party leads to the loss of all resulting claims against the manufacturer.

NOTICE



Hazards and risks through ignorance.

- ▶ Read the instructions for use !
- ▶ Observe the safety and warning instructions !
- ▶ If anything is unclear, please contact KEB Automation KG !

1.1 Target group

This instruction manual is determined exclusively for electrical personnel. Electrical personnel for the purpose of this instruction manual must have the following qualifications:

- Knowledge and understanding of the safety instructions.
- Skills for installation and assembly.
- Start-up and operation of the product.
- Understanding of the function in the used machine.
- Detection of hazards and risks of the electrical drive technology.
- Knowledge of *DIN IEC 60364-5-54*.
- Knowledge of national safety regulations.

1.1 Validity of this manual

This manual describes the control part of the COMBIVERT S6 control (A)pplication. The manual

- contains only supplementary safety instructions.
- is only valid in connection with the power unit manual of COMBIVERT S6.

1.2 Electrical connection

⚠ DANGER



Voltage at the terminals and in the device !

Danger to life due to electric shock !

- ▶ For any work on the unit switch off the supply voltage and secure it against switching on.
- ▶ Wait until the drive has stopped in order, that perhaps regenerative energy can be generated.
- ▶ Wait until the DC-Link capacitors are discharged (5 minutes). Verify by measuring the DC voltage at the terminals.
- ▶ Never bridge upstream protective devices (even for testing purposes.).

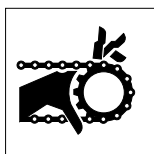
For a trouble-free and safe operation, please pay attention to the following instructions:

- The electrical installation shall be carried out in accordance with the relevant requirements.
- Cable cross-sections and fuses must be dimensioned by the user accordly to the specified minimum / maximum values for the operation.
- Within systems or machines the person installing electrical wiring must ensure that on existing or new wired safe ELV circuits the EN requirement for safe insulation is still met!
- For drive converters that are not isolated from the supply circuit (in accordance with [EN 61800-5-1](#)) all control lines must be included in other protective measures (e.g. double insulation or shielded, earthed and insulated).
- When using components without isolated inputs/outputs, it is necessary that equipotential bonding exists between the components to be connected (e.g. by the equipotential line). Disregard can cause destruction of the components by equalizing currents.

1.3 Start-up and operation

The drive controller must not be started until it is determined that the installation complies with the machine directive; Account is to be taken of [EN 60204-1](#).

⚠ WARNING



Software protection and programming !

Hazards caused by unintentional behavior of the drive!

- ▶ Check especially during initial start-up or replacement of the drive controller if parameterization is compatible to application.
- ▶ Securing a unit solely with software-supported functions is not sufficient. It is imperative to install external protective measures (e.g. limit switch) that are independent of the drive controller.
- ▶ Secure motors against automatic restart.

2 Product Description

The following safety manual describes the function of a safe output on the condition that an encoderless drive is brought into standstill. This safe output shall control at internal driven motors e.g. for safety door locking.

The COMBIVERT G6 with safe output f=0 Hz corresponds to the requirements in accordance with the performance level c (ISO13849-1) and SIL1 (IEC 61508 & IEC 62061).

In case of proper project design, installation and operation the safety function protects people against injured by moving parts.

COMBIVERT G6 drive controller with SSM with level f=0 Hz correspond to the following numerical code:

xx	G6	x	x	x	-	xxxx	
							H, I, L
<i>Table 1: Product code</i>							

NOTICE



Validity of certificates

- ▶ The certification of controllers with safety technology is only valid if the material number corresponds with the specified numerical code **and** the FS logo is printed on the type plate.

2.1 Classification of SSM according IEC 61508

PFH	$2.36 \cdot 10^{-7}$ 1/h
PFD	$4.6 \cdot 10^{-2}$ on demand
Proof-Test-Interval	20 years

For SIL classification in connection with the applications consider the failure rates of the external switch devices for final evaluation.

2.2 Classification of SSM according EN ISO 13849

Category	2
MTTF _D	>400 years
DC	low

For the classification within a performance level in connection with the applications consider the failure rates of the external switch devices for final evaluation.

3 Safety Function SSM with Level f=0 Hz

3.1 Functional description

A switching condition for an output may only be set when the drive is at a safe standstill. This is implemented by the safety function SSM with level f=0 Hz.

In order that the safety function SSM with level f=0 Hz is fulfilled, the drive must be brought into standstill with the following requirements:

- Decelerate the drive with ramp.
- Activate DC braking function (Pn28).
- Trigger DC braking time (Pn30) for at least 2 s (recommended: 3 s).
- Adjust DC braking current via DC braking voltage (Pn31) (observe maximum current limits and minimum modulation level).
- The drive must be reliably brought to a standstill in the first 2 s of the DC braking time.
- Switching off the modulation
- Message of the standstill via two series-connected relay outputs (see application examples).
- The exact setting instructions can be found on the following pages.

3.2 Adjustment of the deceleration ramps

Deceleration ramps are generated from the ramp time plus s-curve times and the minimum and maximum setpoint. They can be preset separately for both directions of rotation. See the instructions for use or the programming manual for details.

Target setting:

- the drive must be able **to follow** the deceleration ramps (no hardware current limit in open-loop mode and/or no limitation of the torque in the closed-loop mode during the ramps).
- The minimum current at breakdown torque of the asynchronous motor must be higher than the hardware current limit (E_OC) of the drive controller.
- **After the end of the deceleration ramp the drive must be stopped at maximum occurring inertia within at least two seconds by DC braking.**
- If a DC braking time of less than 2 seconds is specified, the output from the 0Hz relay is not reliably set.

3.3 DC braking

DC braking is only possible for open-loop units or in open-loop mode. At closed-loop mode it does automatically switch into the open-loop mode at DC braking.

At DC braking

- the motor is not decelerated via ramp.
- the rapid deceleration occurs by means of a DC voltage on the motor winding.

Upon activation of the DC braking

- the modulation is switched off.
- the motor de-excitation time is awaited at actual value dependent braking time.
- the DC voltage is switched to the motor (modulation on again).

The following parameters define the function of the DC braking for SSM:

Index	Id-Text	Name	Function
0x241C	Pn28	DC braking mode	defines whereby the DC braking is triggered.
0x241E	Pn30	DC braking time	defines the braking time (either direct or depending on the actual value)
0x241F	Pn31	DC braking max. voltage	limits the maximum braking voltage
0x2420	Pn32	DC braking start level	"Start level" adjusts the speed/frequency which triggers the DC braking when falling below (depending on Pn28)

3.3.1 Triggering of DC braking

Pn28	DC-braking mode	0x241C
Value	Function	Triggering of DC braking
0	no DC braking	never
1	no direction of rotation + actual value (see figure 1)	if no direction of rotation is preset and ru02 „ramp output display“ has reached 0 Hz (or 0 rpm) The braking time is independent of the actual value ru02. It is preset directly with Pn30. The DC braking is interrupted when a new rotation setting is given.
2...3	–	Do not use at SSM!
4	no direction of rotation + actual value < Pn32	If no direction of rotation is preset and ru02 „ramp output display“ is fallen below the „DC-braking start level“ (Pn32) The braking time is dependent on the actual value ru02. The setting occurs via Pn30 and Pn32. The DC braking is not interrupted when a new rotation setting is given.
5...506	–	Do not use at SSM!

3.3.2 Adjustment of the braking time

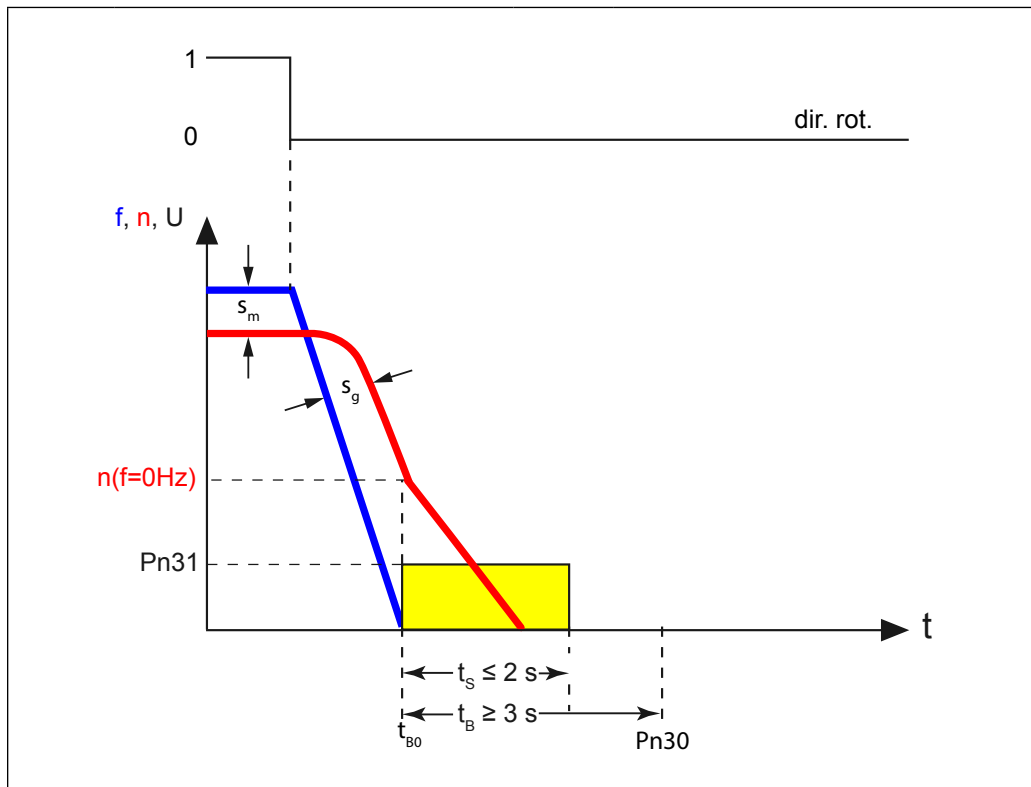
NOTICE

Minimum braking time

- ▶ In order that the safety function SSM is fulfilled, the drive must be brought into standstill within two seconds via DC braking.
- ▶ Due to control processes of the braking current, the setting of a braking time of ≥ 3 s is recommended that the DC braking is reliably detected.

3.3.2.1 Direct setting of the braking time

Pn30	DC braking time	0x241E
Value	Meaning	
0...100.00 s Setting ≥ 3 s (recommended)	Direct setting of the braking time when Pn28 = "1".	

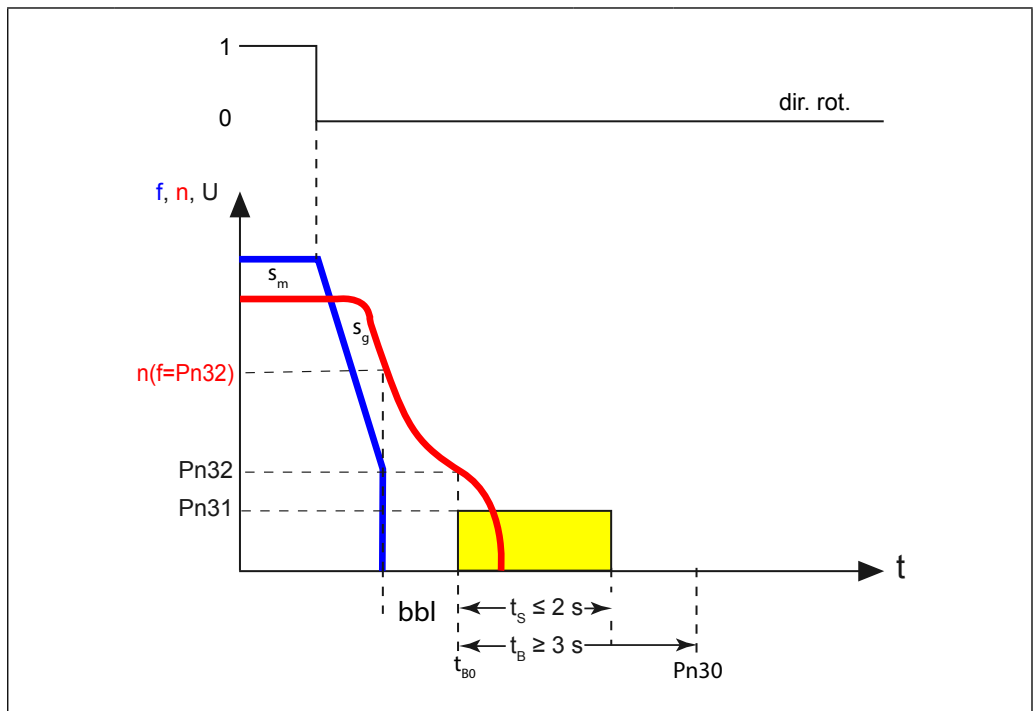


dir.rot	Rotation setting	sg	Slip (regenerative)
f	Frequency	sm	Slip (motor)
n	Speed	tB	Braking time from Pn30
U	Voltage	tB0	Start DC braking
t	Time	Pn31	DC braking max. voltage
ts	Maximum time to motor standstill		
	Range wherein the drive must be in standstill		

Figure 1: Braking time independent of actual value

3.3.2.2 Setting of the actual value-dependent braking time

Pn30	DC braking time	0x241E																					
Value	Meaning																						
0...100.00 s Setting ≥ 3 s (recommended)	The braking time is dependent on the actual value at Pn28 = "4". The braking time behaves according to the following formula: $\text{Braking time} = \frac{\text{Pn30} \times \text{Pn32}}{\text{Reference value}}$ The reference value is determined from the adjusted mode in ud02.																						
	<table border="1"> <thead> <tr> <th>ud02</th> <th>Pn32</th> <th>Reference value</th> </tr> </thead> <tbody> <tr> <td>400 Hz</td> <td>0...400 Hz</td> <td>100 Hz</td> </tr> <tr> <td>800 Hz</td> <td>0...800 Hz</td> <td>200 Hz</td> </tr> <tr> <td>4000 rpm</td> <td>0...4000 rpm</td> <td>1000 rpm</td> </tr> <tr> <td>8000 rpm</td> <td>0...8000 rpm</td> <td>2000 rpm</td> </tr> <tr> <td>16000 rpm</td> <td>0...16000 rpm</td> <td>4000 rpm</td> </tr> <tr> <td>32000 rpm</td> <td>0...32000 rpm</td> <td>8000 rpm</td> </tr> </tbody> </table>	ud02	Pn32	Reference value	400 Hz	0...400 Hz	100 Hz	800 Hz	0...800 Hz	200 Hz	4000 rpm	0...4000 rpm	1000 rpm	8000 rpm	0...8000 rpm	2000 rpm	16000 rpm	0...16000 rpm	4000 rpm	32000 rpm	0...32000 rpm	8000 rpm	
ud02	Pn32	Reference value																					
400 Hz	0...400 Hz	100 Hz																					
800 Hz	0...800 Hz	200 Hz																					
4000 rpm	0...4000 rpm	1000 rpm																					
8000 rpm	0...8000 rpm	2000 rpm																					
16000 rpm	0...16000 rpm	4000 rpm																					
32000 rpm	0...32000 rpm	8000 rpm																					



dir.rot	Rotation setting	sg	Slip (regenerative)
f	Frequency	sm	Slip (motor)
n	Speed	tB	Braking time from Pn30
U	Voltage	tB0	Start DC braking
t	Time	Pn31	DC braking max. voltage
bbl	base block time (Motor coasts freely)	Pn32	DC braking start level
ts	Maximum time to motor standstill		
	Range wherein the drive must be in standstill		

Figure 2: Braking time dependent on the actual value

3.3.3 Adjustment of the maximum braking voltage

In v/f characteristic control, a DC voltage is applied to the motor.

NOTICE

Motor overheating / drive controller load max. 95 %

- ▶ The maximum braking voltage (Pn31) must be adjusted to the maximum permissible motor current in order to avoid overheating.
- ▶ The motor current can be read out in ru15.
- ▶ Additionally the maximum load on the drive controller during DC braking must not exceed 95 %.
- ▶ The load can be read out in parameter ru13.

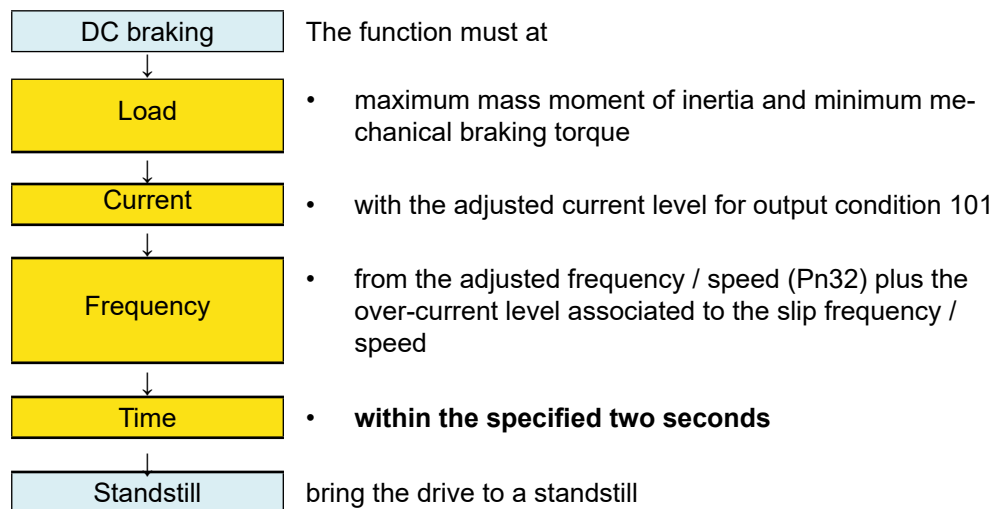
Pn31	DC braking max. voltage	0x241F
Value	Meaning	
0,0...25,5 %	The maximum braking voltage is preset with Pn31 "DC braking max. voltage". <ul style="list-style-type: none"> • 100 % correspond to the mains voltage or the output voltage (uF09). • The permissible current is limited to a maximum of 95 % drive controller utilization (ru13). • At large ratings the maximum braking voltage can lead to overcurrent errors. In this case Pn31 must be reduced. 	

The real DC braking voltage level can be checked with ru42. The minimum value (ru42) must be $\geq 4\%$.

3.3.4 Adjust start level at actual value dependent DC braking

Pn32	DC braking start level	0x2420
Value	Meaning	
0...800Hz or 0...32000rpm	Setting of the start level which triggers the DC braking when it's fallen below. The setting is done in speed or frequency depending on ud02.	

3.4 Conditions for DC braking

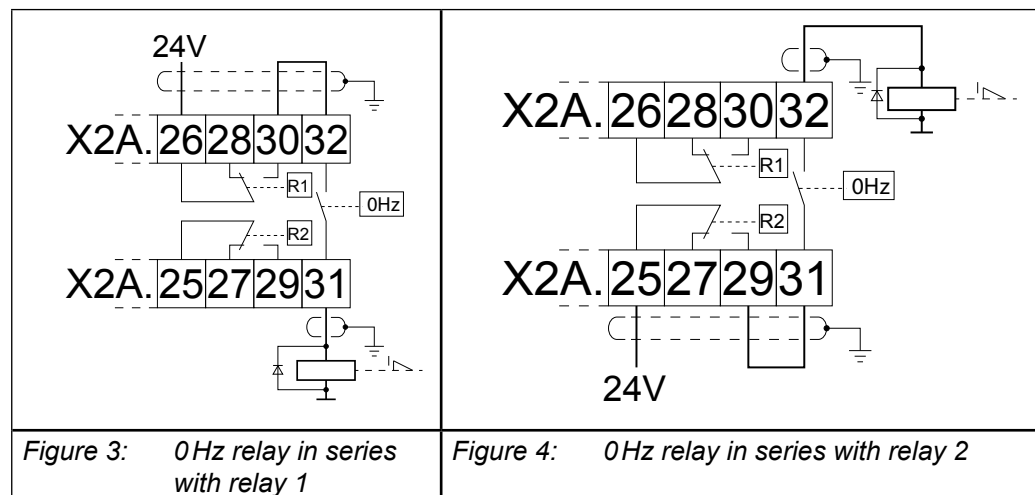


3.5 Adjustment of the relay outputs

The KEB COMBIVERT with Safe Speed Monitoring has three relay outputs on the control:

- Relay output 1: freely definable with switching condition SB 2
- Relay output 2: freely definable with switching condition SB 3
- Relay output 3: f=0 Hz relay

Relay 3 is connected in series with relay 1 or relay 2 (=> Figure 3 and => Figure 4).



3.5.1 Relay specifications

Relay	1...3
maximum voltage	DC 30V
minimum current	DC 0.01A
maximum current	DC 1A
maximum number of switching cycles	10 ⁸ mechanical; 500,000 at 1A and DC 30V
Other	only ohmic load or free-wheeling path
<i>Table 2: Relay specifications</i>	

3.5.2 Parameterisation of relay output 1 or 2

The following adjustments are based on the factory setting. Extensive information on the programming of the digital outputs can be found in the programming manual G6. The settings must be checked/adjusted according to the used relay output.

Output	Relay output 1	Relay output 2
Allocate outputs (do51)	„228“: R1=R1; R2=R2	
Invert outputs (do42)	Do not invert R1 and R2	
Connect outputs (do41)	Outputs R1 and R2 not AND-connected	
Select flag	do35=value "4" for flag 2	do36=value "8" for flag 3
Invert flag	do27: Do not invert flag 2	do28: Do not invert flag 3
Connect flag (do24)	Flag 2 and 3 not AND-connected	
Allocate flag condition	do18=value "4" for condition 2	do19=value "8" for condition 3
Invert condition	do10: Do not invert condition 2	do11: Do not invert condition 3
Adjust condition	do02: Value "101"	do03: Value "101"
Adjust switching level referring to the rated current	LE02	LE03
	The average value of the apparent current (corresponds to the load) during DC braking must exceed the level safely.	
<i>Table 3: Parameterisation of the standard relay output</i>		

3.5.2.1 Functional sequence of the output switching condition

The switching condition "101" is set at "Stop after DC braking and current > level". I.e. the switching condition is met when the DC braking is completed and the average value of the apparent current during DC braking was higher than the adjusted level referring to the rated current.

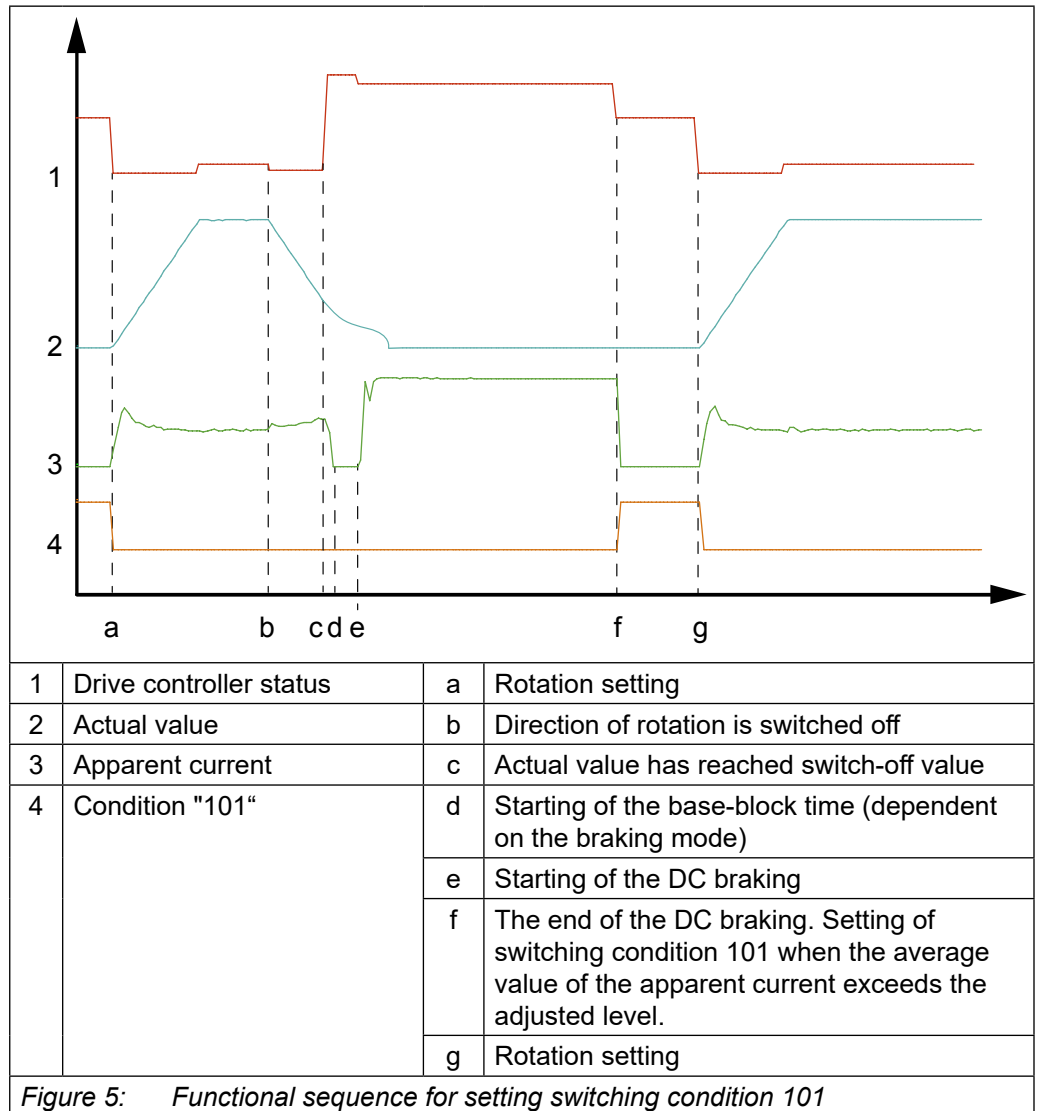


Figure 5: Functional sequence for setting switching condition 101

3.5.3 Function of relay output 3

Relay output 3 is assigned with a fixed function and can not be parameterized. It is controlled by the safety CPU. The safety CPU measures the pulse width of the power module control. This provides conclusions about the output frequency.

If the pulse width of the power module control does not change for a period of at least two seconds, a frequency of 0 Hz is indicated (stop vector).

Relay output 3 (no contact) is set if there is a frequency of 0 Hz **and** the modulation is switched off.

3.5.3.1 Minimum modulation factor

In order for the frequency of 0 Hz to be determined, a minimum modulation depth $\geq 4\%$ (ru42) must be maintained (dead time = 1.7 μ s without compensation).

3.5.3.2 Minimum frequency

By internally defined limits there is a minimum frequency of 0.04 Hz. Lower frequencies are evaluated as 0Hz.

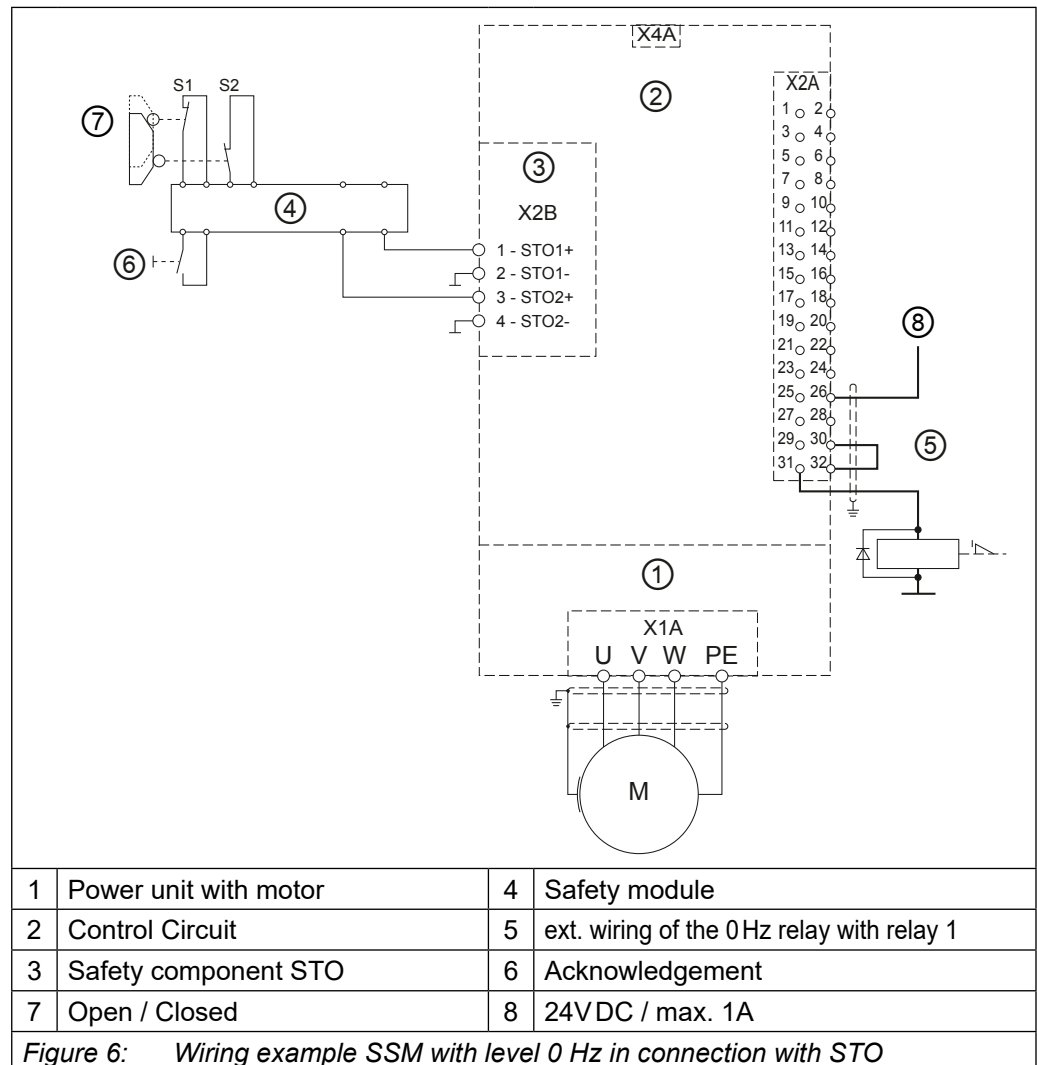
3.6 Error message

If an error occurs during operation, the inverter turns into a "safe condition" within 25 ms. ru00 displays "28: Error! Safety function".

The "Error! Safe condition" can only be reset by a power-on reset.

3.7 Application example

The following example shows the wiring of a door locking with safety module and Safe Speed Monitoring (SSM) with level $f = 0$ Hz.



The following conditions must be observed for the example above:

- The position of the locking system must be checked by the application.
- The wiring must be arranged by way that no cross circuits can control the door locking.
- The switching contact of the relay must be protected against overcurrent by appropriate measures (e.g. fuse).
- If relay output 2 shall be used for the standard function, the terminals must be used according => **Figure 4. Check list for the SSM function**
- Function only applicable when no external forces operate at the drive.
- No inductive load at the relay output or use free-wheeling diode.
- No limitation by hardware current limit (uF15) or torque/current limit.
- The minimum current at breakdown torque of the asynchronous motor must be higher than the hardware current limit (E.OC) of the drive controller.
- The motor must follow the deceleration ramp.
- Parameter Pn28 use only value 1 or 4.

- DC braking must bring the motor to a standstill within 2 seconds at maximum mass moment of inertia and minimum mechanical braking torque.
- In DC braking, the current level set for output switching condition 101 must be exceeded (=> „*DC braking*“ and „*Conditions for DC braking*“).
- Check the real level of the DC braking voltage with ru42
 - leave sufficient distance to the preset minimum values ($ru42 \geq 4\%$)
 - Observe voltage compensation (uf09 =) -> if the DC link voltage rises, the modulation factor decreases
- Check the load during DC braking with ru13. The maximum value shall not exceed 95 %.
- Check the switch-off capability of the relay contacts annually.

4 Certification

4.1 EU Declaration of Conformity

EU DECLARATION OF CONFORMITY

Document No. / month.year: ce_dr_rsafety-g6-e_en / 01.2019

Manufacturer: KEB Automation KG
Südstraße 38
32683 BARNTRUP
Germany

Product type: Inverter type yyG6zxx - xxxx
Inverter size yy = 07 up to 19
Control type z = A, B, C, D or H, I, K, L
Voltage category 230 / 400 V ac

The above given product is in accordance with the following directives of the European Union

Number: **Machine: 2006 / 42 / EU**
Text: Directive on machinery.

Number: **EMC : 2014 / 30 / EU**
Text: Directive on the approximation of the laws of the Member States relating to electromagnetic compatibility.

Number: **Low voltage : 2014 / 35 / EU**
Text: Directive on the approximation of the laws of the Member States relating to all electrical equipment that has a voltage rating between 50V and 1000V AC or 75V and 1500V DC.

Number: **Hazardous Substances: 2011 / 65 / EEC (incl. 2015 / 863 / EU)**
Text: Directive on the approximation of the laws of the Member States relating on the restriction of the use of certain hazardous substances in electrical and electronic equipment.

Responsible: KEB Automation KG
Südstraße 38
32683 BARNTRUP

Place, date Bartrup, 28. December 2018

Issued by:



i. A. W. Hovestadt / Conformance Officer



W. Wiele / Technical Manager

This declaration certifies the conformity with the named directives, but does not contain any assurance of quality.

The safety instructions, described in the instruction manual are to be followed.

EU DECLARATION OF CONFORMITY



ANNEX 1

Document-Nr. / month.year: ce_dr_rsafety-g6-e_en.docx / 01.2019

Product type:	Inverter type	yy G6 zxx - xxxx
	Inverter size	yy = 07 up to 19
	Control type	z = A, B, C, D or H, I, K, L
	Voltage category	230 / 400 V ac

The above given product is in accordance with the following directives of the European Union

2006 / 42 / EU Directive on Machinery
 Article 2, Definitions: c) Safety component
 Annex V Safety components: 4. Logic units to ensure safety functions

The conformity of the above given product to the European Directive 2006/42/EU (for machinery) is given by complete approval / testing to the following European harmonized standards:

EN - Norm	Text
EN 61800-5-2 / 2007	Adjustable speed electrical power drive systems – part 5-1: Safety requirements – Functional Safety
EN 60204 – 1 / 2006 + report 2010	Safety of machinery – Electrical equipment of machines – Part 1: General requirements
EN 62061 / 2005 + AC + A1	Safety of Machinery – Functional Safety of safety-related electrical, electrical and programmable electronic control systems
EN ISO 13849-1 / 2008 AC of 2009	Safety of Machinery – Safety-related parts of control systems – Part 1: General principles for design
EN61508 – 1 up to 7 / 2010	Functional Safety of electrical, electronic and programmable electronic safety-related systems – Part 1 up to 7

The conformity to above requirements within the standards were approved by:

Notified body:	TÜV – Rheinland Industrie Service GmbH
Adress:	Zertifizierungsstelle für Maschinen (NB Nr. 0035) Alboinstrasse 56 D - 12103 Berlin

No. of Certificate	01 / 205 / 5183.02 / 17	(STO)
Dated:	23.01.2017	
Valid until:	29.11.2021	

No. of Certificate	01 / 205 / 5183.01 / 17	(SSM)
Dated:	23.01.2017	
Valid until:	28.03.2021	

EU DECLARATION OF CONFORMITY



ANNEX 2

Document-Nr. / month.year: ce_dr_rsafety-g6-e_en.docx / 01.2019

Product type:	Inverter type	yy G6 zxx - xxxx
	Inverter size	yy = 07 up to 19
	Control type	z = A, B, C, D or H, I, K, L
	Voltage category	230 / 400 V ac

The conformity of the above given product to the European Directive 2014/35/EU (for electrical equipment designed for use within certain voltage limits) is given by complete approval / testing to the following European harmonized standards:

EN - standard	
EN 61800-5-1 / 2007	Adjustable speed electrical power drive systems – part 5-1: Safety requirements - Electrical, thermal and energy
EN 61800-2 / 2015	Adjustable speed electrical power drive systems – part 2: general requirements – rating specifications for low voltage adjustable speed a.c. power drive systems

The conformity of the above given product to the European Directive 2014/30/EU (for electromagnetic compatibility) is given by complete approval / testing to the following European harmonized standards. Base for the complete approval is the definition of a complete PDS (power drive system). For not exceeding the required limits or minimum levels of immunity it is necessary to use the KEB defined filters and observe the given wiring specifications. These will be delivered with every product as part 1 of the documents.

EN - standard	
EN 61800-3 / 2004 +A1 / 2012	Adjustable speed electrical power drive systems – part 5-1: EMC requirements and specific test methods

The conformity of the above given product to the European Directive 2011/65/EU with changes of 2015/863/EU (for restrictions of the use for certain hazardous substances in electrical and electronic equipment) is given by qualification of components and manufacturing process within the ISO 9001 QM system. The necessary information and declarations are documented and memorized.

The above given product was developed, manufactured and tested within an internal quality management system. This ISO 9001 QM system was approved by:

Notified body:	TÜV - CERT
Address:	Zertifizierungsstelle des RWTÜV Steubenstrasse 53 D - 45138 Essen
No. of approval	041 004 500
Dated:	20.10.1994
Valid until:	December 2021

4.2 EC type-examination

EC Type-Examination Certificate



Reg.-No.: 01/205/5183.03/21

Product tested	Safety function "Safe Torque Off" (STO) within the frequency inverter of the product family G6	Certificate holder	KEB Automation KG Südstraße 38 32683 Barntrup Germany
Type designation	xx.G6.xXx-xxxx (X=A, B, D: Option STO) (X=H, I, L: Option STO und SSM)		
Codes and standards	EN 61800-5-2:2007 EN 61800-5-2:2017 EN 61800-5-1:2007 + A1:2017 EN IEC 61800-3:2018	EN 62061:2005 + AC:2010 + A1:2013 + A2:2015 EN ISO 13849-1:2015 EN 61508 Parts 1-7:2010	

Intended application

The safety function "Safe Torque Off" (STO) complies with the requirements of the relevant standards (Cat. 3 / PL e according to EN ISO 13849-1, SIL(CL) 3 according to EN 61800-5-2 / EN 62061 / EN 61508) and can be used in applications up to these safety levels.

The safety function "Safe Speed Monitoring" (SSM, f=0Hz) complies with the requirements of the relevant standards (Cat. 2 / PL c according to EN ISO 13849-1, SIL(CL) 1 according to EN 61800-5-2 / EN 62061 / EN 61508) and can be used in applications up to these safety levels.

Specific requirements

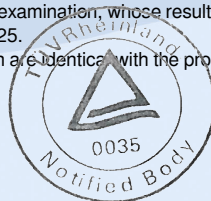
The instructions of the associated Installation and Operating Manual shall be considered.

It is confirmed, that the product under test complies with the requirements for machines defined in Annex I of the EC Directive 2006/42/EC.

Valid until 2026-10-15

The issue of this certificate is based upon an examination, whose results are documented in Report No. 968/M 330.06/21 dated 2021-08-25.

This certificate is valid only for products which are identical with the product tested.



Köln, 2021-10-15

Notified Body for Machinery, NB 0035

Jelena Stenzel

Dipl.-Ing. Jelena Stenzel

5 Revision History

Revision	Date	Description
1A	2013-08	First published version
1B	2014-01	Product description, description minimum current, conditions for the DC braking, operation with free-wheeling diode and error message safety function was expanded.
1C	2014-09	Table 2 free-wheeling path supplemented; max. current of 1A in picture 6 supplemented; check the relay contacts inserted. Chapter 2.3.2.2: Table omitted the information in 1600 and 3200 Hz, and the information of the voltage stabilization in chapter 2.3.3. Chapter 2.2 and 2.3 classification of SSM inserted.
1D	2015-05	Extension to closed-loop systems. Modification of the foreword.
Version	Date	Description
04	2021-10	Changed to document management; Complete editorial revision to the new CI; Function description changed; Aim of the setting p.15 added; Safety note under 3.3.2 extended. Figure 1 and 2 modified; Safety note under 2.5.3 modified; Text Pn31 modified; 2.6 Conditions under load modified; Figure 3 and 4 supplemented by free-wheeling diode; Characteristic curve Figure 5 changed; Checklist added under 3.8; Chapter 4 Standards modified; new certificates inserted

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