COMBIVERT G6

GB Safety Manual
COMBIVERT G6

Safety Function
SSM with level f=0 Hz

Translation of original manual
Mat.No.         Rev.
00G6NEZ-E000    1D
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1. **Preface**

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

1.1 **Information on special measures**

The used pictograms have following significance:

<table>
<thead>
<tr>
<th>Pictogram</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>! Danger</td>
<td>Is used, when death or serious bodily injury may be the consequence of non-observance of the measure.</td>
</tr>
<tr>
<td>! Warning</td>
<td>Is used, when bodily injury and/or substantial property damage may be the consequence of non-observance of the measure.</td>
</tr>
<tr>
<td>! Caution</td>
<td>Is used, when property damage may be the consequence of non-observance of the measure.</td>
</tr>
<tr>
<td>! Attention</td>
<td>Is used, when noise sensitive or unrequested operation may be the consequence of non-observance of the measure.</td>
</tr>
<tr>
<td>! Info</td>
<td>Is used, when a better or simpler result can be the consequence of the measure.</td>
</tr>
</tbody>
</table>

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

1.2 **Documentation**

**Attention** ! **Documentation via www.keb.de**

Prior to performing any work on the unit, it is absolutely necessary to download and read the documentation, especially the safety precautions and instructions for use. Follow these steps to get the documentation:

**Step 1** Read the material number (Mat.No.) from nameplate

**Step 2** Input the material number at "www.keb.de => Service => Downloads" and click "search".

**Downloads**

Search for specific material numbers

Please enter a complete (11-digit) material number.

Search for: 15G6DCD3510

[search]

continued on the next page
Step 3

The entire documentation associated with the device will be displayed, including the instruction manuals in German and English. If available, other translations are also indicated. Make sure that the user understands the provided language.

⚠️ Should you be unable to read or understand the documentation, do not take any further steps. Please inform our support network for further assistance.

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

1.3 Validity and liability

The use of our units in the target products is beyond of our control and therefore exclusively the responsibility of the machine manufacturer, system integrator or customer. The information contained in the technical documentation, as well as any user-specific advice in spoken and written and through tests, are made to best of our knowledge and information about the application. However, they are considered for information only without responsibility. This also applies to any violation of industrial property rights of a third-party.

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

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

Danger ⚠️ by tamper from unauthorized personnel

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

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

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

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

1.4 Copyright

The customer may use the instruction manual as well as further documents or parts from it for internal purposes. Copyrights are with KEB and remain valid in its entirety.
KEB®, COMBIVERT®, COMBICONTROL® and COMBIVIS® are registered trademarks of Karl E. Brinkmann GmbH.

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

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

1.5 Specified application

The used semiconductors and components of the Karl E. Brinkmann GmbH are developed and dimensioned for the use in industrial products. If the KEB COMBIVERT F5 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.

The operation of our products outside the indicated limit values of the technical data leads to the loss of any liability claims.

The safety function is limited to a service life of 20 years. After this time the unit must be replaced.
1.6 **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 inverter with SSM with level f=0 Hz correspond to the following numerical code:

<table>
<thead>
<tr>
<th>xx</th>
<th>G6</th>
<th>x</th>
<th>x</th>
<th>-</th>
<th>xxxx</th>
</tr>
</thead>
<tbody>
<tr>
<td>H, I, K, L</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Table 1: Product code**

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.

1.7 **Valid range**

The safety function "Safe Speed Monitoring (SSM) with level f=0 Hz" is optionally available on control boards in combination with the safety function STO.

This manual contains only supplements and is only valid in connection with the instruction manuals

- EMC and safety instruction
- Installation manual power unit
- Installation manual control circuit
- Safety function STO.
2. Safety function SSM with level f=0 Hz

2.1 Functional Description
In order to stop the drive, the following steps must be carried out successively:
- decelerate the drive with ramp
- activate the DC braking for at least two seconds
- drive must stop within two seconds by DC braking
- switching off the modulation
- message of the standstill via two series-connected relay outputs (see “2.9 Application example”)

2.2 Classification of SSM according IEC 61508

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>PFH</td>
<td>2,36 *10^-7 1/h</td>
</tr>
<tr>
<td>PFD</td>
<td>4,6 * 10^-2 on demand</td>
</tr>
<tr>
<td>Proof-Test-Interval</td>
<td>20 years</td>
</tr>
</tbody>
</table>

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

2.3 Classification of SSM according EN ISO 13849

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category</td>
<td>2</td>
</tr>
<tr>
<td>$MTTF_D$</td>
<td>&gt;400 years</td>
</tr>
<tr>
<td>DC</td>
<td>low</td>
</tr>
</tbody>
</table>

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

2.4 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 instruction manual 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 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 of the inverter
- after the end of the deceleration ramp the drive must be stopped at maximum occurring inertia within at least two seconds by DC braking. The output of the 0Hz relay is not set if a DC braking time < two seconds is preset.

2.5 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
- fast braking occurs via DC voltage which is applied to the motor winding.

Upon activation of the DC braking

- the modulation is switched off
- the base-block time is awaited at actual value dependent braking time
- the DC voltage is switched to the motor (modulation on)

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

<table>
<thead>
<tr>
<th>Index</th>
<th>Id-Text</th>
<th>Name</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x241C</td>
<td>Pn28</td>
<td>DC braking mode</td>
<td>defines whereby the DC braking is triggered.</td>
</tr>
<tr>
<td>0x241E</td>
<td>Pn30</td>
<td>DC braking time</td>
<td>defines the braking time (either direct or depending on the actual value)</td>
</tr>
<tr>
<td>0x241F</td>
<td>Pn31</td>
<td>DC braking max. voltage</td>
<td>limits the maximum braking voltage</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DC braking start level</td>
<td>&quot;Start level&quot; adjusts the speed/frequency which triggers the DC braking when falling below (depending on Pn28)</td>
</tr>
</tbody>
</table>
2.5.1 Triggering of DC braking

<table>
<thead>
<tr>
<th>Pn28</th>
<th>DC-braking mode</th>
<th>0x241C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Value</td>
<td>Function</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>no DC braking</td>
</tr>
</tbody>
</table>
| 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. 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. 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! |

2.5.2 Adjustment of the braking time

**Attention**  
**minimum braking time**

The DC braking must be active for at least two seconds in order that this condition of the SSM function is met.
2.5.2.1 Direct setting of the braking time

<table>
<thead>
<tr>
<th>Pn30</th>
<th>DC braking time</th>
<th>0x241E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value</td>
<td>Meaning</td>
<td></td>
</tr>
<tr>
<td>0…100.00 s</td>
<td>Direct setting of the braking time when Pn28 = “1”.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>dir.rot.:</th>
<th>Rotation setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>f:</td>
<td>Frequency</td>
</tr>
<tr>
<td>n:</td>
<td>Speed</td>
</tr>
<tr>
<td>U:</td>
<td>Voltage</td>
</tr>
<tr>
<td>t:</td>
<td>Time</td>
</tr>
<tr>
<td>Pn30</td>
<td>DC braking time</td>
</tr>
<tr>
<td>Pn31</td>
<td>DC braking max. voltage</td>
</tr>
</tbody>
</table>

**Figure 1:** Braking time independent of the actual value

2.5.2.2 Setting of the actual value-dependent braking time

<table>
<thead>
<tr>
<th>Pn30</th>
<th>DC braking time</th>
<th>0x241E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value</td>
<td>Meaning</td>
<td></td>
</tr>
<tr>
<td>0…100.00 s</td>
<td>The braking time is dependent on the actual value at Pn28 = “4”. The braking time behaves according to the following formula:</td>
<td></td>
</tr>
</tbody>
</table>

\[
\text{Braking time} = \frac{\text{Pn30} \times \text{Pn32}}{\text{Reference value}}
\]

The reference value is determined from the adjusted mode in ud02.

<table>
<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 min⁻¹</td>
<td>4000 rpm</td>
</tr>
<tr>
<td>32000 rpm</td>
<td>0…32000 rpm</td>
<td>8000 rpm</td>
</tr>
</tbody>
</table>
2.5.3 Adjustment of the maximum braking voltage

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

**Attention**

Motor overheating

The brake controllers are dimensioned 1:1 of inverter to motor. The controllers must be adjusted accordingly for other constellations.

<table>
<thead>
<tr>
<th>Pn31</th>
<th>DC braking max. voltage</th>
<th>0x241F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value</td>
<td>Meaning</td>
<td></td>
</tr>
<tr>
<td>0,0…25,5%</td>
<td>The maximum braking</td>
<td>0x241F</td>
</tr>
</tbody>
</table>

The maximum braking voltage is preset with Pn31 „DC braking max. voltage“.
- 100% correspond to the rated output voltage.
- The current is limited only by the inverter.
- 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. It is important to ensure sufficient distance to the minimum values.

2.5.4 Adjust start level at actual value dependent DC braking

<table>
<thead>
<tr>
<th>Pn32</th>
<th>DC braking start level</th>
<th>0x2420</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value</td>
<td>Meaning</td>
<td></td>
</tr>
<tr>
<td>0…800 Hz or 0…32000 rpm</td>
<td>Setting of the start</td>
<td>0x2420</td>
</tr>
</tbody>
</table>

The 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.
2.6 Conditions for DC braking

The function must at
- maximum load
- with the adjusted current level for output condition 101
- from the adjusted frequency / speed (Pn32) plus the over-current level associated to the slip frequency / speed
- within the specified two seconds

Standstill bring the drive to a standstill

2.7 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).

![Figure 3: 0Hz relay in series with relay 1](image1)

![Figure 4: 0Hz relay in series with relay 2](image2)
2.7.1 Relay specifications

<table>
<thead>
<tr>
<th>Relay</th>
<th>1…3</th>
</tr>
</thead>
<tbody>
<tr>
<td>maximum voltage</td>
<td>30 V DC</td>
</tr>
<tr>
<td>minimum current</td>
<td>0.01 A DC</td>
</tr>
<tr>
<td>maximum current</td>
<td>1 A DC</td>
</tr>
<tr>
<td>maximum number of switching cycles</td>
<td>$10^6$ mechanical; 500,000 at 1 A and 30 V DC</td>
</tr>
<tr>
<td>Other</td>
<td>only ohmic load or free-wheeling path</td>
</tr>
</tbody>
</table>

Table 2: Relay specifications

2.7.2 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.

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

Table 3: Parameterisation of the standard relay output

2.7.2.1 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.
2.7.3 Function of relay output 3

Relay output 3 is assigned with a fixed function and cannot 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.

2.7.3.1 Minimum modulation factor

A minimum modulation factor must be maintained in order to determine the frequency of 0 Hz. Table 4 describes the minimum modulation factor depending on the switching frequency.
### Table 4: Minimum modulation factor depending on the switching frequency

<table>
<thead>
<tr>
<th>Switching frequency [kHz]</th>
<th>Minimum modulation factor [%] (dead time = 1.7 µs without compensation)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>not available in connection with SSM</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>8</td>
<td>5</td>
</tr>
<tr>
<td>16</td>
<td>not available in connection with SSM</td>
</tr>
</tbody>
</table>

2.7.3.2 Minimum frequency

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

2.8 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 of the frequency inverter.
2.9 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.

![Wiring Diagram]

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.
2.10 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 freewheeling
- No limit by hardware current limit or torque limit
- The minimum current at breakdown torque of the asynchronous motor must be higher than the hardware current limit of the inverter
- Parameter Pn28 use only value 1 or 4
- Check the real level of the DC braking voltage with ru42
  - Keep sufficient distance to the preset minimum values
  - Observe voltage compensation (uf09 = 1) -> as the DC link voltage rises, the modulation factor decreases
- DC braking must be able to stop the maximum load from the set frequency (Pn32) plus over-current level corresponding to the slip frequency within 2s with the adjusted current level for output condition 101 (see „2.6 Conditions for DC braking“).
- Checking of the switching frequency. Only switching frequencies of 4 and 8 kHz are permissible.
- Check the switch-off capability of the relay contacts annually.
3. **Certification**

3.1 **Annex to the declaration of conformity**

Annex to the declaration of conformity EC for systems with functional safety:

<table>
<thead>
<tr>
<th>Product designation:</th>
<th>Inverter - type series</th>
<th>xxG6xHx-xxxx</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>xxG6xIx-xxxx</td>
</tr>
<tr>
<td></td>
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Herewith we declare that the safety module described above corresponds with all relevant regulations of the machinery safety directive 2006/42/EC.

The above mentioned safety module meets the requirements of the following guidelines and standards:

- Machinery safety directive 2006/42/EC
- EMC directive 2004/108/EC
- Low-Voltage Directive 2006/95/EC

<table>
<thead>
<tr>
<th>EN standards</th>
<th>Output</th>
<th>Text</th>
<th>Reference</th>
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<tr>
<td>EN 61800-5-1</td>
<td>09/2003</td>
<td>Electrical power drive systems with adjustable speed: security requirements</td>
<td>VDE 0160 Part 105</td>
<td>09/2003</td>
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</table>

*informative:*

<table>
<thead>
<tr>
<th>EN standard</th>
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<th>Description</th>
<th>Reference</th>
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<tr>
<td>EN 50178</td>
<td>1997</td>
<td>Installation of high voltage systems with electronic equipment</td>
<td>VDE 0160</td>
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<tr>
<td>EN 60664-1</td>
<td>2007</td>
<td>Isolation coordinates for electrical equipment in low-voltage systems</td>
<td>VDE 0110</td>
<td>01/2008</td>
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<td>EN 61800-2</td>
<td>10/1998</td>
<td>Basic determinations for AC inverter</td>
<td>VDE 0160 Part 102</td>
<td>08/1999</td>
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*especially for systems with functional safety additionally:*

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<td>EN 61800-5-2</td>
<td>2007</td>
<td>Electrical power drive systems with adjustable speed: functional safety requirements</td>
<td>VDE 0160 Part 105-2</td>
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<td>EN 61508-(1…7)</td>
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<td>Functional safety of electrical/electronic/programmable electronic safety-related systems - Part 1 up to 7</td>
<td>VDE 0803</td>
<td>02/2011</td>
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<td>EN 60204-1+A1</td>
<td>2006</td>
<td>Electrical equipment of machines; Part1: General requirements</td>
<td>VDE 0113-1+A1</td>
<td>2007 10/2009</td>
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<tr>
<td>EN 62061</td>
<td>09/2013</td>
<td>Safety of machinery functional security requirements</td>
<td>VDE 0113 Part 50</td>
<td>09/2013</td>
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<tr>
<td>EN 13849-(1, 2)</td>
<td></td>
<td>Safety of machinery</td>
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<td>08/2008</td>
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</table>

continued on the next page
The conformity was confirmed by the TÜV Rheinland with the EC type examination 01/205/5381.00/14.

The number/address of the indicated constitution
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4. **Revision history**

<table>
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<tr>
<th>Revision</th>
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<tr>
<td>Rev.1A</td>
<td>2013-08</td>
<td>First published version</td>
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<tr>
<td>Rev.1B</td>
<td>2014-01</td>
<td>Product description, description minimum current, conditions for the DC braking, operation with free-wheeling diode and error message safety function was expanded</td>
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<td>Rev.1C</td>
<td>2014-09</td>
<td>Table 2 free-wheeling path supplemented; max. current of 1A in picture 6 supplemented; check the relay contacts inserted. Kapitel 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.</td>
</tr>
</tbody>
</table>
| Rev.1D   | 2015-05 | Extension to closed-loop systems. Modification of the foreword. }
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Mat.No. 00G6NEZ-E000
Rev. 1D
Date 10/2016