

# SINAMICS DCM

DC Converter

EMERGENCY OFF, EMERGENCY STOP application

Edition 01 - 12/2012



SINAMICS drives

**SIEMENS**

## SINAMICS DCM EMERGENCY OFF, EMERGENCY STOP application Compact User Manual

### Legal information

#### Warning notice system

This manual contains notices you have to observe in order to ensure your personal safety, as well as to prevent damage to property. The notices referring to your personal safety are highlighted in the manual by a safety alert symbol, notices referring only to property damage have no safety alert symbol. These notices shown below are graded according to the degree of danger.

 <b>DANGER</b>
indicates that death or severe personal injury <b>will</b> result if proper precautions are not taken.
 <b>WARNING</b>
indicates that death or severe personal injury <b>may</b> result if proper precautions are not taken.
 <b>CAUTION</b>
indicates that minor personal injury can result if proper precautions are not taken.
<b>NOTICE</b>
indicates that property damage can result if proper precautions are not taken.

If more than one degree of danger is present, the warning notice representing the highest degree of danger will be used. A notice warning of injury to persons with a safety alert symbol may also include a warning relating to property damage.

#### Qualified Personnel

The product/system described in this documentation may be operated only by **personnel qualified** for the specific task in accordance with the relevant documentation, in particular its warning notices and safety instructions. Qualified personnel are those who, based on their training and experience, are capable of identifying risks and avoiding potential hazards when working with these products/systems.

#### Proper use of Siemens products

Note the following:

 <b>WARNING</b>
Siemens products may only be used for the applications described in the catalog and in the relevant technical documentation. If products and components from other manufacturers are used, these must be recommended or approved by Siemens. Proper transport, storage, installation, assembly, commissioning, operation and maintenance are required to ensure that the products operate safely and without any problems. The permissible ambient conditions must be complied with. The information in the relevant documentation must be observed.

# 1 Instructions

## Note

This application document does not claim to contain all details and versions of units, or to take into account all conceivable operational cases and applications.

The standard applications do not represent specific customer solutions, but are only intended to provide support in the implementation of typical applications. The operator is responsible for the correct operation of the products described.

Should you require further information or encounter specific problems which have not been handled in enough detail, please contact your local Siemens office.

The contents of this application document are not part of an earlier or existing contract, agreement or legal relationship, nor do they change such contracts, agreements or legal relationships. The contract of sale in each case outlines all the obligations of the I DT Drive Technologies Division of Siemens AG. The warranty conditions specified in the contract between the parties are the only warranty conditions accepted by the I DT Drive Technologies Division. Any statements contained herein neither create new warranties nor modify the existing warranty.

## WARNING

### Observe safety notices in the associated operating instructions

The units listed here contain dangerous electric voltages, dangerous rotating machine parts (fans) and control rotating mechanical parts (drives). Failure to follow the relevant operating instructions may result in death, serious injury or extensive material damage.

## Technical Support

You can also find help for technical issues through our Technical Support:

[www.siemens.de/automation/support-request](http://www.siemens.de/automation/support-request) (German)

[www.siemens.com/automation/support-request](http://www.siemens.com/automation/support-request) (English)

# 2 Introduction

This application document describes the implementation of the EMERGENCY OFF functions

- EMERGENCY OFF / stop category 0 for uncontrolled stop in accordance with EN 60204-1
- EMERGENCY STOP / stop category 1 for controlled stop in accordance with EN 60204-1

using two examples.

## WARNING

When the EMERGENCY OFF / EMERGENCY STOP functions are used, ensure that switching off the described type does not cause any danger.

## NOTICE

### Parallel circuit, series circuit and 12-pulse operation not tested

The functions described in this application document have not been tested for use in plants with parallel or series connected SINAMICS DC MASTER devices and for 12-pulse applications.

Our Technical Support can provide support for these applications.

## Instructions

- When a large direct-current smoothing reactor is used in the armature circuit the current-decay time before switching the firing pulses off may possibly not suffice for EMERGENCY OFF / stop category 0. If the armature current at this instant is not pulsating, inverter shoot-through can occur. Consequently, the use of EMERGENCY OFF / stop category 1 with a delay of 0.5 seconds is recommended in this case.
- When the 2Q-field option that does not contain any free-wheeling diode for the field current is used, the use of EMERGENCY OFF / stop category 1 is recommended to protect the field contactor. This is necessary because the braking voltage of the opening contacts for a field contactor (line side) does not suffice to activate the free-wheeling function of the thyristor bridges.

## Components

The components used in the examples are in addition to the SINAMICS DC MASTER:

Unit	Manufacturer order number	Details
SIRIUS Safety relay	Siemens 3TK2827-2BB40	- ( <a href="http://support.automation.siemens.com/WW/view/en/22925478/all">http://support.automation.siemens.com/WW/view/en/22925478/all</a> ) 24 VDC power supply, spring contacts, 30 second delay of contacts 47 to 58
SIRIUS safety relay Expansion unit	Siemens 3TK2830-2CB30	- ( <a href="http://support.automation.siemens.com/WW/view/en/22925034/all">http://support.automation.siemens.com/WW/view/en/22925034/all</a> ) 24 VDC coil voltage, spring contacts
Power supply SITOP PSU100C	Siemens 6EP1331-5BA10	- ( <a href="http://support.automation.siemens.com/WW/view/en/43043605">http://support.automation.siemens.com/WW/view/en/43043605</a> ) 24 VDC / 1.3 A, see also the warning below
EMERGENCY OFF button	-	-
Reset button	-	-
EMERGENCY OFF LED active	-	With integrated series resistor for 24 V

Notes for the cable routing are contained in the "EMC-conform design of drives (installation notes)" section of the SINAMICS DCM DC Converter Operating Instructions.

SINAMICS DCM DC Converter Operating Instructions  
(<http://support.automation.siemens.com/WW/view/en/52233399/133300>)

 <b>WARNING</b> <b>Use a separate 24 V power pack to ensure the safe electrical separation.</b> The safety-relay expansion unit does not guarantee the safe electrical separation between the contacts but only the base insulation. A single fault would cause the line voltage (230 V) to reach the 24 V circuit. Consequently, to prevent a possible potential transfer of a dangerous voltage to exposed parts, a separate 24 V power pack (e.g. SITOP) rather than the general 24 V power supply must be deployed. The minus pin must be grounded and the 230 V phase protected with a slow fuse with maximum 4 A rating.
 <b>WARNING</b> <b>Hazard due to electric shock</b> The 24 V power supply and the wiring must be designed so that the circuits of the EMERGENCY OFF pushbutton and the Reset pushbutton satisfy the property of the protective separation in accordance with the requirements for protection from electric shock as specified in EN61800-5-1.

### Notes for the plant planning

- The armature-contactor exciter winding is supplied from the 230 VAC line voltage via the 4 A fuse, the contacts in the safety-relay expansion unit and the auxiliary contact of the field contactor (see circuit examples).  
The specifications in the data sheets of the individual components with regard to the loading and current requirement must be considered for the plant planning.
- As also shown in the circuit examples, the line contactor is normally switched off using an auxiliary contact of the field contactor.  
Although this is not generally required, it serves to reduce the load on the contacts in the safety-relay expansion unit.

### 3 EMERGENCY OFF / stop category 0 for uncontrolled stopping in accordance with EN 60204-1

#### Description

EMERGENCY OFF / stop category 0 allows the energy feed for the rectifier to be interrupted (armature circuit and field circuit) via the main contactor or via the circuit-breaker bypassing the microprocessor controller of the SINAMICS DC MASTER using a safety relay. The motor current is interrupted, the torque becomes zero and the motor (drive) coasts down.

#### Function

When the EMERGENCY OFF pushbutton is pressed, the E-STOP function will be activated on the SINAMICS DC MASTER by opening the connection between terminals 105 and 106.

The armature current is reduced to zero and the firing pulses are inhibited. At the same time, the armature contactor and the field contactor are directly opened via the 3TK2830 expansion device. The time delay that can be adjusted at the 3TK2827 safety relay is not active in this case.

The E-STOP function is described in the "Safety shutdown (E-STOP)" section of the SINAMICS DCM DC Converter Operating Instructions.

SINAMICS DCM DC Converter Operating Instructions  
(<http://support.automation.siemens.com/WW/view/en/52233399/133300>)

#### Notes for the plant planning

The time required for the current decay depends on the load. Although the addition of the decay delays of the expansion unit and the armature contactor cause a time delay, it cannot be guaranteed that the shutdown will be performed after the current has been removed. This means the relay must be designed for shutdown under load.

#### Parameter assignment

p51616 = 0	E-STOP acts like OFF2: The armature current is reduced to zero and the firing pulses then inhibited.
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Other settings for the E-STOP function are described in the "Safety shutdown (E-STOP)" section of the SINAMICS DCM DC Converter Operating Instructions.

The OFF2 function is described in the "OFF2 (voltage de-energization) - control word bit 1" section of the SINAMICS DCM DC Converter Operating Instructions.

SINAMICS DCM DC Converter Operating Instructions  
(<http://support.automation.siemens.com/WW/view/en/52233399/133300>)

#### Commissioning

All switching states must be tested during the commissioning.

## Recommended connection

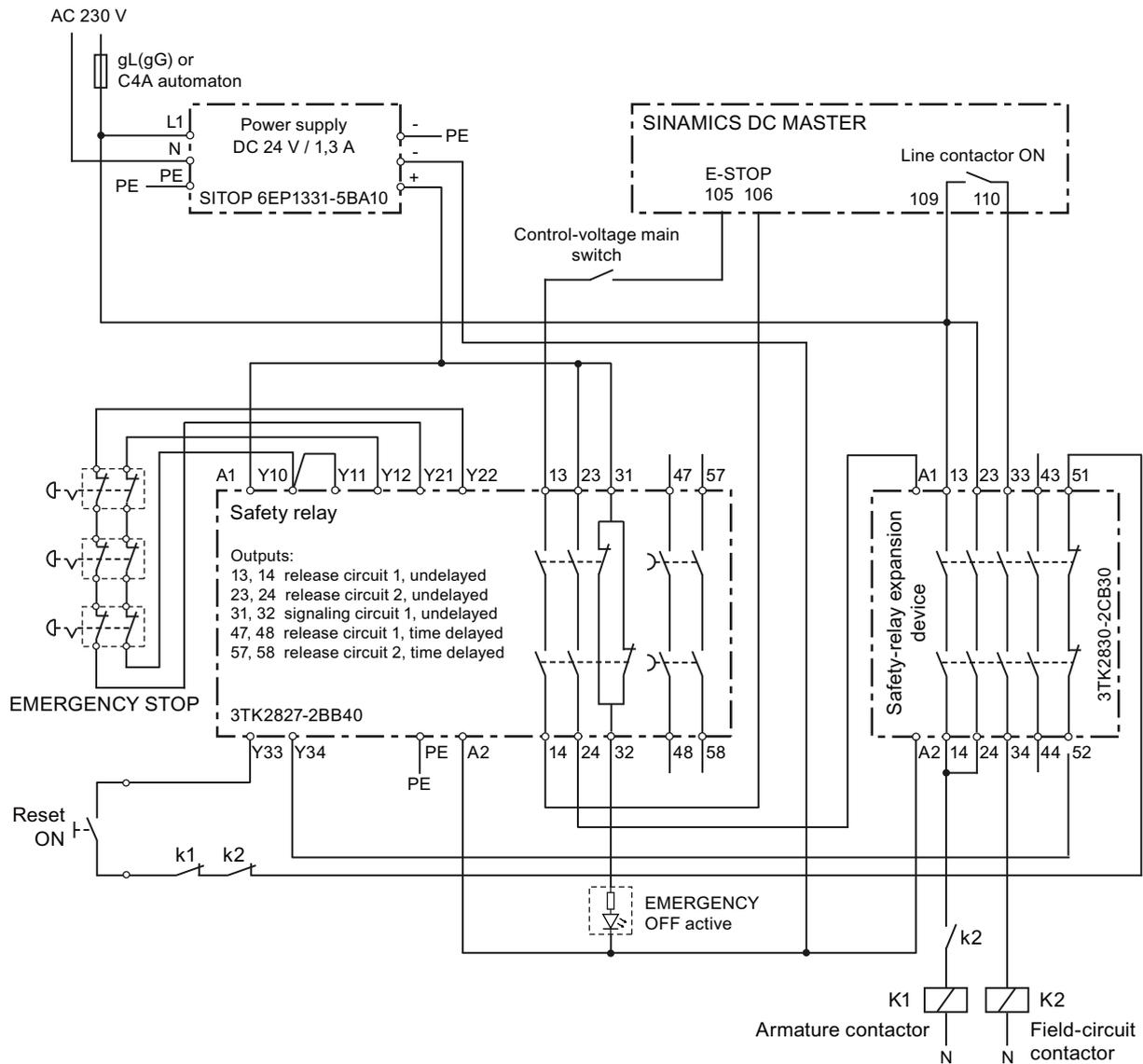


Figure 3-1 EMERGENCY OFF, stop category 0 connection example

### Details

#### 3TK2827-2BB40 safety relay

- 24 VDC power supply, spring contacts, 30 seconds delay of contacts 47 to 58.
- Contacts 13 and 14 switch the E-STOP of the SINAMICS DC MASTER
- Contacts 23 and 24 switch the 24 V (A1) relay coil of the 3TK2830 expansion unit
- A control-voltage main switch can be added in series to the E-STOP
- The delay of contacts 47 to 58 is not used

#### Reset the EMERGENCY OFF

- The auxiliary contacts (break contacts) for the armature contactor, field contactor and the feedback from the 3TK2830 expansion unit (contacts 51, 52) are switched in series with the Reset pushbutton.

The reset of the EMERGENCY OFF (drive switch-on) is possible only when all contacts are closed.

### **3TK2830-2CB30 safety-relay expansion unit**

- 24 VDC supply, spring contacts.
- The contacts 13 and 14 parallel with 23 and 24 control the armature contactor.
- Contacts 33 and 34 control the field contactor. Contacts 109 and 110 (line contactor) of the SINAMICS DC MASTER are also in series.
- The field contactor controls the armature contactor. This circuit protects the contacts of the expansion unit because the switching action is best controlled with the auxiliary contact of the field contactor. The safety unit interrupts first only for EMERGENCY OFF.

### **Power supply SITOP**

- Input 100 to 230 VAC, output 24 VDC / 1.3 A
- The minus pin of the power supply must be connected with the protective ground

## 4 EMERGENCY STOP / stop category 1 for controlled stopping in accordance with EN 60204-1

### Description

EMERGENCY STOP / stop category 1 permits the stopping of the drives using a down ramp set by the user. The energy feed to the rectifier (armature circuit and field circuit) is then interrupted via the main contactor or via the circuit-breaker, bypassing the microprocessor controller of the SINAMICS DC MASTER using a safety relay after a time set on it. The motor current is interrupted, the torque becomes zero and the motor is no longer subject to torque.

### Function

When pressing the EMERGENCY STOP button, the quick stop (OFF3) function is triggered at the drive. The speed is reduced corresponding to the down ramp defined using parameters p50296, p50297 and p50298. The time delay to be set at safety relay 3TK2827 to interrupt the energy feed must be equal to or greater than this down ramp and the time set for the current decay.

After the time delay has expired, the E-STOP function will be activated on the SINAMICS DC MASTER by opening the connection between terminals 105 and 106. At the same time, the armature contactor and the field contactor are directly opened via the 3TK2830 safety-relay expansion unit.

The time delay that can be set on the safety relay is used to switch the line contactor only after drive shutdown and the current decay. This avoids the coasting down of the drive.

The E-STOP function is described in the "Safety shutdown (E-STOP)" section of the SINAMICS DCM DC Converter Operating Instructions.

The OFF3 function is described in the "OFF3 (quick stop) - control word bit 2" section of the SINAMICS DCM DC Converter Operating Instructions.

SINAMICS DCM DC Converter Operating Instructions

(<http://support.automation.siemens.com/WW/view/en/52233399/133300>)

### Important note

When the 2Q-field option that does not contain any free-wheeling diodes for the field current is used, to protect the field contactor against direct-current arc formation, it is expressly recommended to set an appropriately long time (on the safety relay) after the down ramp and the brake closing time. This is necessary because the braking voltage of the opening contacts of a field contactor (line side) does not suffice to activate the free-wheeling function of the thyristor bridge. The time delay to be set on the 3TK2827 safety relay must be chosen sufficiently large so that the field current has fallen below 0.3 A (after closing the brake).

**Commissioning**

- Set the parameters as specified in the "Parameter setting" table.
- Set the delay time on the safety relay (setting range 0.5 to 30 seconds).  
This time (taking any tolerances into consideration) must be longer than the return time set for quick stop (p50296). Check that the drive can also be brought electrically to a standstill within this time taking account of all boundary conditions.

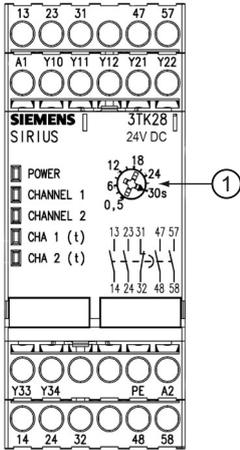


Figure 4-1 Safety relay time setting 0.5 to 30 seconds ①

- Check the functionality in all of the used command data sets (CDS) and drive data sets (DDS).
- Document all of the settings.

All switching states must be tested during the commissioning.

**Parameter assignment**

The digital input DI/DO 4 (X177-15 terminal on the electronic component CUD) must be used on the SINAMICS DC MASTER for the OFF3 (quick stop) function.

For a description of the parameters, see the SINAMICS DCM List Manual.

Table 4-1 Parameter settings

p50789.0 = 0	DI/DO 4 (X177.15) as input
p00849.0 = r53010.8 p00849.1 = r53010.8	DI/DO 4 as quick stop (OFF3)
p50296.0 = x	Return time of the drive to speed 0 for quick stop (OFF3) This time must be set appropriately based on the mechanical characteristics of the drive. For the factory setting (0.00 seconds), the braking is made at the current limit.
p50296.1 = x p50296.2 = x p50296.2 = x	Same as index 0
p50297.0 = 0	OFF3 initial rounding (corresponds to the factory setting)
p50297.1 = 0 p50297.2 = 0 p50297.3 = 0	Same as index 0
p50298.0 = 0	OFF3 final rounding (corresponds to the factory setting)
p50298.1 = 0 p50298.2 = 0 p50298.3 = 0	Same as index 0

p50370.0 = 0.5	Threshold for message $n < n_{min}$ (corresponds to the factory setting)
p50370.1 = 0.5 p50370.2 = 0.5 p50370.3 = 0.5	Same as index 0
p50371.0 = 0.5	Hysteresis for message $n < n_{min}$ (corresponds to the factory setting)
p50371.1 = 0.5 p50371.2 = 0.5 p50371.3 = 0.5	Same as index 0
p50088 = x	<p>Brake closing time for the brake control (factory setting = 0.00 seconds)</p> <p>The firing pulse lock is delayed by this time for "close brake". During this time, the drive is in the operating state o1.1, o1.2 or o1.0 and still provides torque.</p> <p>The description of the brake control (with execution diagrams) is contained in the SINAMICS DCM DC Converter operating instructions in the "Switch-on command for the holding or operating brake" section and in the SINAMICS DCM List Manual in function plan 2750.</p> <p>Setting notes: The time between invoking the brake until it acts must be set. If the value is set too small, there is the danger that a suspended load "sags". If the value is set too large, in unfavorable situations, the drive can apply torque against the closed brake.</p>
p50330.0 = 0	The time unit for the ramp sensor settings is seconds (corresponds to the factory setting)
p50330.1 = 0 p50330.2 = 0 p50330.3 = 0	Same as index 0

## Recommended connection

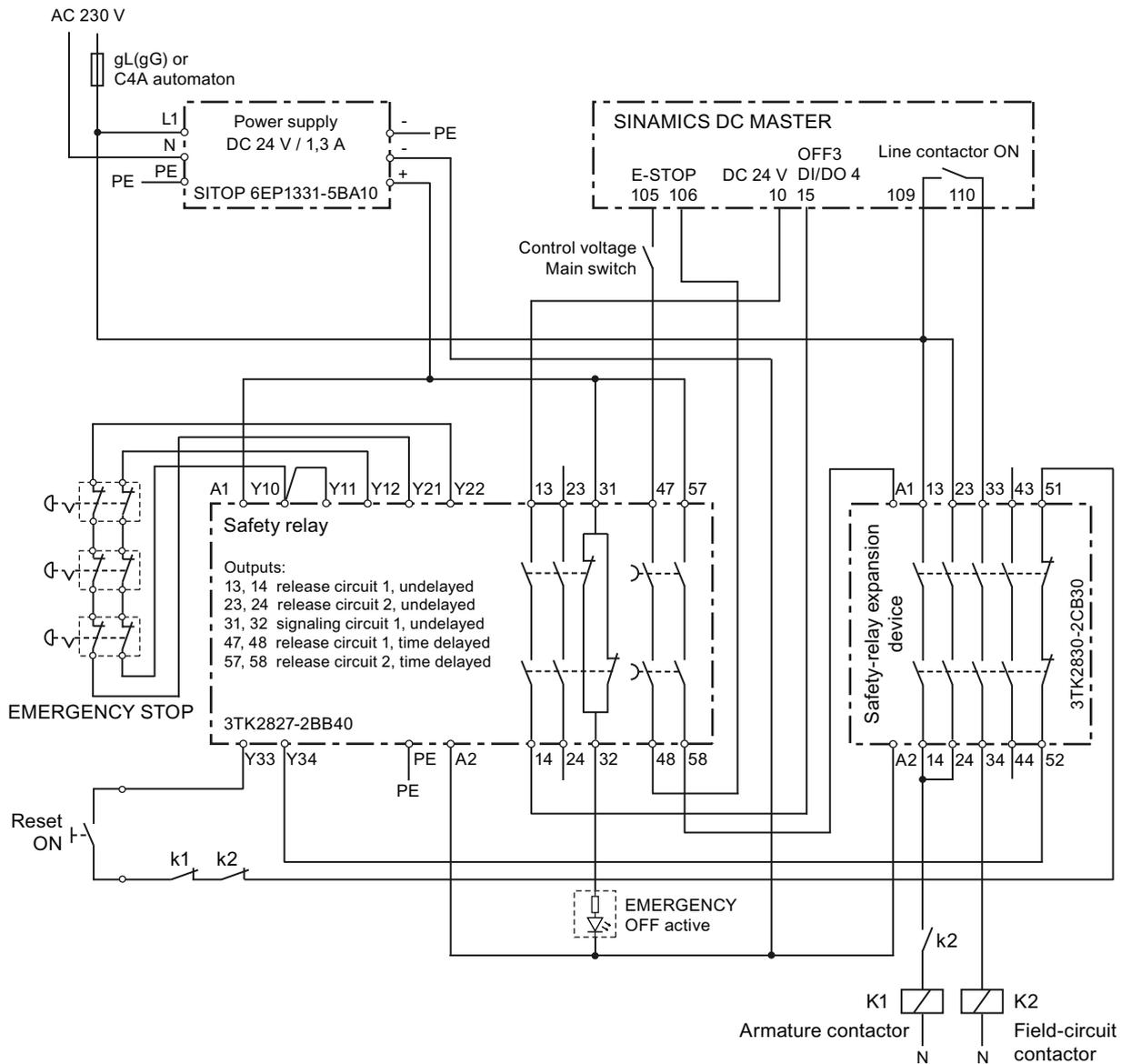


Figure 4-2 EMERGENCY STOP, stop category 1 connection example

### Details

#### 3TK2827-2BB40 safety relay

- 24 VDC power supply, spring contacts, 30 seconds delay of contacts 47 to 58.
- The contacts 13 and 14 initiate the OFF3 function on the SINAMICS DC MASTER.
- The delayed contacts 47 and 48 initiate the E-STOP function on the SINAMICS DC MASTER.
- The delayed contacts 57 and 58 switch the 24 V (A1) relay coil of the 3TK2830 expansion unit.
- A control-voltage main switch can be added in series to the E-STOP

#### Reset the EMERGENCY OFF

- The auxiliary contacts (break contacts) for the armature contactor, field contactor and the feedback from the 3TK2830 expansion unit (contacts 51, 52) are switched in series with the Reset pushbutton.
- The reset of the EMERGENCY OFF (drive switch-on) is possible only when all contacts are closed.

### 3TK2830-2CB30 safety-relay expansion unit

- 24 VDC supply, spring contacts.
- The contacts 13 and 14 parallel with 23 and 24 control the armature contactor.
- Contacts 33 and 34 control the field contactor. Contacts 109 and 110 (line contactor) of the SINAMICS DC MASTER are also in series.
- The field contactor controls the armature contactor. This circuit protects the contacts of the expansion unit because the switching action is best controlled with the auxiliary contact of the field contactor. The safety unit interrupts first only for EMERGENCY OFF.

### Power supply SITOP

- Input 100 to 230 VAC, output 24 VDC / 1.3 A
- The minus pin of the power supply must be connected with the protective ground

<b>NOTICE</b>
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When the control-voltage main switch is opened, the drive is switched current-free immediately and the return ramp for decaying the speed is not executed. The drive coasts down and the EMERGENCY STOP function cannot be performed completely.
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We have reviewed the contents of this publication to ensure consistency with the hardware and software described. Since variance cannot be precluded entirely, we cannot guarantee full consistency. However, the information in this publication is reviewed regularly and any necessary corrections are included in subsequent editions.

Siemens AG  
Industry Sector  
Postfach 48 48  
90026 NÜRNBERG

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Siemens AG  
Industry Sector  
P.O. Box 48 48  
90026 NUREMBERG  
GERMANY

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