Brake control

Brake sequence control with Sinamics drives in connection with Simotion
Brake control

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mailto:applications.erlf@siemens.com
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Qualified personnel

In the sense of this documentation qualified personnel are those who are knowledgeable and qualified to mount/install, commission, operate and service/maintain the products which are to be used. He or she must have the appropriate qualifications to carry-out these activities e.g.:

- Trained and authorized to energize and de-energize, ground and tag circuits and equipment according to applicable safety standards.
- Trained or instructed according to the latest safety standards in the care and use of the appropriate safety equipment.
- Trained in rendering first aid.

There is no explicit warning information in this documentation. However, reference is made to warning information and instructions in the Operating Instructions for the particular product.

Reference regarding export codes

AL: N
ECCN: N
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1 Question

When disabling the axis (command "_disableAxis" or in case of alarms with the global reaction "Release disable"), Simotion sets the bits ON/OFF, OFF2, OFF3 and operating enable (pulse enabling) simultaneously to zero. Doing so, the axis might twist between pulse blocking and closing of the brake due to the missing torque. This can lead to a slight sagging of suspended axes (Z-axes).

- How can you avoid this?
- What is the process like?
- How shall the drive be parameterized?
- How to deal with the release?
- How can you recognize if Release_Disable has been triggered for an error?
- After about 200 ms (brake closing time) it is even necessary to disable the performance.
- Is the expanded Sinamics brake control required?
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2 Solution

Process:

1. If the drive shall be disabled, this is only done with OFF1 first. This starts a simultaneous closing of the holding brake, but the pulse enable and thus the torque remain available until the end of the brake closing time. During the brake closing time, the axis cannot twist any more.
2. After the brake closing time is finished, the drive is completely disabled.

Parameterization:

With the following adaptations in the parameters of the drive object and the corresponding axis a desired brake control is achieved:

Drive configuration
- Select the desired Profibus telegram (e.g. telegram 105).
- The quick ramp-down (OFF3) is set in parameter P1135.
- Set value 1 in parameter P1215 in the corresponding drive object (motor holding brake according to sequence control).
- Enter the closing time of the brake in ms in parameter P1217.
- The parameters P9xxx represented on the screen are only relevant when using the safe stop.
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Axis configuration

- Set to value 1 the parameter
  `TypeOfAxis.DriveControlConfig.releaseDisableMode` of the according axis
  object in the user program.
- As an alternative, you can also parameterize the axis via the following
  dialog (in mask “axis configuration” and button „settings for the Drive”).

![Settings for the Drive](image)

Doing so, Simotion only resets OFF1 automatically in case of an error with „Release
disable“. You can request this axis state cyclically in the user program and then react
accordingly by a controlled disabling. Then the procedure as described above has to
be applied. For the request, the following terms are used:

```c
Axis_Error := ActPosAxis.errorreaction = release_disable ;
```
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Safe stop:

If the functionality of the safe stop shall be applied, it is necessary to ensure that the signals of the two “safety channels” are connected with the I/O-area of the CU and with the according drive module on the hardware side. If Sinamics recognizes that at least one of the two security channels is open, the axes are ramped down at the brake ramp being adjustable in parameter P1135. Then they are disabled automatically avoiding an uncontrolled sagging of the drive. For this, it is necessary to set the parameters P9652 (safe stop 1 Control Unit) as well as P9852 (Safe stop Motor Module) to your desired values except zero (e.g. 1 s).

If the function „safe stop“ is active, the axis is ramped down at the OFF3 ramp first and then the pulses at the motor are disabled. The desired OFF3 ramp can be adjusted in parameter P1135.

The expanded brake control is not necessary.
Appendix

3 Project data

3.1 Test project

A test project has been created to solve the problem (brake_FW40.zip). For this, a D435 system with Sinamics double axis module (Simotion demonstration case). A motor of type 1-FK7022-5AK71-1UH0 with holding brake and SMI interface has been applied as a drive. Of course, this functionality can also be applied to similar drives. Important: To check the described functionality, a motor WITH holding brake is absolutely indispensable. The common drives in the demonstration cases are not equipped with holding brakes. The communication to the PU/PC is done via the second (lower) Ethernet interface of the Control Unit.

In the start-up task (program Startup of the project, the number of axes as well as their designation are entered. Furthermore, the parameter

\[
\text{ActPosAxis.setconfigdata.TypeOfAxis.DriveControlConfig.releaseDisableMode:=1;}
\]

is written for ALL indicated positioning axes.

The program OFF is called cyclically in the background task, where the signals are evaluated to disable successively the axes. Axis errors are detected, too, and the axes are disabled automatically.
3.2 Source texts

- ST source „Startup“ (is processed once when starting the Central Unit):

```plaintext
INTERFACE
USEPACKAGE CAM;
PROGRAM Startup;
VAR_GLOBAL CONSTANT
MaxNumberOfAxes : INT := 2 ; //Machine with 2 Axes
END_VAR
VAR_GLOBAL
AchsArray   : ARRAY[0..MaxNumberOfAxes-1] OF PosAxis  ;
AchsIndex   : INT ;
ActPosAxis  : PosAxis ;
my_TON      : ton ;
my_TRIG_FLP_ON : r_trig ;
my_TRIG_FLN_ON : f_trig ;
enable_finished : BOOL ;
enable_active  : BOOL ;
disable_active : BOOL ;
disable_step_1 : BOOL ;
disable_step_2 : BOOL ;
END_VAR
END_INTERFACE
IMPLEMENTATION
PROGRAM Startup
AchsArray[0]    :=  Axis_brake    ;
AchsArray[1]    :=  Axis_blue     ;
//Execution for ALL positioning axes of machine
FOR AchsIndex := 0  TO  MaxNumberOfAxes-1 DO
   ActPosAxis  :=  AchsArray[Achsindex];
   IF ActPosAxis  <>  TO#NIL THEN
      //in case of "release disable" reset only AUS 1 [Bit 0 => 2^0 = 1] automatically
      ActPosAxis.setconfigdata.TypeOfAxis.DriveControlConfig.releaseDisableMode:=1;
   END_IF
END_FOR
END_PROGRAM
END_IMPLEMENTATION
```
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- ST source „OFF“ (is processed cyclically in the background task):

```plaintext
INTERFACE
USEPACKAGE CAN;
USES Startup;
PROGRAM OFF;
END_INTERFACE
IMPLEMENTATION
PROGRAM OFF
VAR
  RetDINT : DINT
END_VAR
VAR_TEMP
  Error_active : BOOL := 0;
END_VAR
// Get negative flank of clamp X123.0
my_TRIG_FLN_ON(clk:=clamp_x123_0);
// Execution for all positioning axes of machine
FOR AchsIndex := 0 TO MaxNumberOfAxes-1 DO
  ActPosAxis := AchsArray[AchsIndex];
  IF ActPosAxis <> TO#NIL THEN
    // Read, if there is a release disable
    Error_active := ActPosAxis.errorreaction = release_disable OR Error_active;
  END_IF
END_FOR
// Start disabling at negative flank of clamp X123.0 or active error
IF my_TRIG_FLN_ON.q OR Error_active THEN
  enable_active := 0;
  enable_finished := 0;
  disable_active := 1;
  disable_step_1 := 0;
  disable_step_2 := 0;
END_IF
// Disable step 1
IF disable_active AND NOT disable_step_1 THEN
  // Execution for all positioning axes of machine
  FOR AchsIndex := 0 TO MaxNumberOfAxes-1 DO
    ActPosAxis := AchsArray[AchsIndex];
    IF ActPosAxis <> TO#NIL THEN
      // Reset signal OFF
      RetDINT := _disableAxis(axis:=ActPosAxis
        ,disableNode:=BY_STW_BIT
        ,stwbitset:=1
        ,servoControlMode:=INACTIVE
        ,servoCommandToActualMode:=ACTIVE
        ,nextCommand:=IMMEDIATELY
        ,commandId:=getCommandId()
        ,forcecontrolMode:=INACTIVE);      
    END_IF
  END_FOR
  disable_step_1 := 1;
END_IF
// Wait time until complete disable
my_TON(in:=disable_active
  ,pt:=T#200ms);
// Disable step 2
IF disable_active AND my_TON.q AND NOT disable_step_2 THEN
  // Execution for all positioning axes of machine
  FOR AchsIndex := 0 TO MaxNumberOfAxes-1 DO
    ActPosAxis := AchsArray[AchsIndex];
    IF ActPosAxis <> TO#NIL THEN
      // Complete disable axis
      RetDINT := _disableAxis(axis:=ActPosAxis
        ,disableNode:=ALL
        ,servoControlMode:=INACTIVE
        ,servoCommandToActualMode:=ACTIVE
        ,nextCommand:=IMMEDIATELY
        ,commandId:=getCommandId()
        ,forcecontrolMode:=INACTIVE);  
    END_IF
  END_FOR
  disable_step_2 := 1;
  // Quit TO-alarms
  RetDINT := _resetTechnologicalErrors();
END_IF
END_PROGRAM
END_IMPLEMENTATION
```

Subject to technical changes.

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Version 1.0
4 Revision

Table 4-1: Revision/Authors

<table>
<thead>
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<td>31st January 2007</td>
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</table>

5 Contact partners

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