Functional description | EN

TF5200 | TwinCAT 3 CNC

Gantry operation
Notes on the documentation

This description is only intended for the use of trained specialists in control and automation engineering who are familiar with the applicable national standards. It is essential that the documentation and the following notes and explanations are followed when installing and commissioning the components. It is the duty of the technical personnel to use the documentation published at the respective time of each installation and commissioning.

The responsible staff must ensure that the application or use of the products described satisfy all the requirements for safety, including all the relevant laws, regulations, guidelines and standards.

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General and safety instructions

Icons used and their meanings

This documentation uses the following icons next to the safety instruction and the associated text. Please read the (safety) instructions carefully and comply with them at all times.

Icons in explanatory text

1. Indicates an action.
   ➔ Indicates an action statement.

---

**DANGER**

Acute danger to life!
If you fail to comply with the safety instruction next to this icon, there is immediate danger to human life and health.

---

**CAUTION**

Personal injury and damage to machines!
If you fail to comply with the safety instruction next to this icon, it may result in personal injury or damage to machines.

---

**NOTE**

Restriction or error
This icon describes restrictions or warns of errors.

---

Tips and other notes
This icon indicates information to assist in general understanding or to provide additional information.

---

General example
Example that clarifies the text.

---

NC programming example
Programming example (complete NC program or program sequence) of the described function or NC command.

---

Specific version information
Optional or restricted function. The availability of this function depends on the configuration and the scope of the version.
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1 Overview

Description
In addition to default path programming, axes can also be operated in coupled state. This is referred to as gantry mode. Contrary to normal synchronous mode, additional monitoring mechanisms for position deviation are active and specific error reactions apply.

Characteristics
The following conditions apply to gantry mode with several axes

- identical drive types
- identical axis dynamic and control parameters
- identical error response (or no internal drive error response)

A distinction is made between:

- Soft gantry (programmable): Machines that do not require any mechanical gantry mode due to their basic structure can be operated by programming them in gantry mode
- Hard gantry (mechanical): Static gantry mode is defined by configuration since the axis are firmly coupled to one another due to the machine structure.

Parametrisation
Extensive settings are required in the channel and axis parameter lists to configure soft and hard gantry modes.

Programming
Soft gantry: The #SET AX LINK and #AX LINK NC commands are provided in extended syntax for the programmable gantry mode:

Hard gantry: Only the master axis in the channel is known for a hard gantry coupling. This can be programmed in the NC program.

Links to other documents
For the sake of clarity, links to other documents and parameters are abbreviated, e.g. [PROG] for the Programming Manual or P-AXIS-00001 for an axis parameter.

For technical reasons, these links only function in the Online Help (HTML5, CHM) but not in pdf files since pdfs do not support cross-linking.
2 Description

Hard gantry (mechanical)

In the case of mechanical (also static) gantry, the axes are firmly coupled to one another due to the machine structure and are defined by the machine configuration (see figure).

In the case of a mechanical gantry, a dynamic change to gantry coupling is not possible after controller start-up.

![Figure 1: Mechanical gantry mode](image1)

Soft gantry (programmable)

Machines that require no mechanical gantry mode due to their basic structure, for example milling machines with two independent slides, can be run by programming them in gantry mode. For example, this is necessary when slides must be linked to one another for clamping and machining large workpieces (see figure below).

![Figure 2: Programmable gantry ("soft gantry")](image2)
**Monitoring functions**

- The axes specified in the gantry combination are coupled by setpoints. Coupling is monitored by actual values.
- A coupling offset can be specified between individual gantry axes.
- Two limits can be specified for monitoring.
- Monitoring is absolute after axis referencing or relative before referencing.
3 Soft gantry

3.1 Configuration

Dynamic gantry mode

Additional monitoring mechanisms to monitor the deviation of axis positions and special strategies to compensate for these deviations apply to gantry axes.

Dynamic gantry mode can be defined in the NC program. In addition, the axis and channel parameters listed in the table below must be assigned:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Required for dynamic Gantry mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>P-AXIS-00070</td>
<td>gantry_ax_nr</td>
</tr>
<tr>
<td>P-AXIS-00072</td>
<td>gantry_max_diff_resetable</td>
</tr>
<tr>
<td>P-AXIS-00071</td>
<td>gantry_max_diff_reset_locked</td>
</tr>
<tr>
<td>P-AXIS-00073</td>
<td>gantry_offset</td>
</tr>
<tr>
<td>P-AXIS-00074</td>
<td>gantry_slave_no_homing</td>
</tr>
<tr>
<td>P-AXIS-00075</td>
<td>gantry_vb_korr</td>
</tr>
<tr>
<td>P-AXIS-00249</td>
<td>gantry_diff_check_without_homing</td>
</tr>
<tr>
<td>P-AXIS-00253</td>
<td>gantry_synchronous_slave_homing   **</td>
</tr>
<tr>
<td>P-AXIS-00254</td>
<td>cnc_controlled_stop_after_error   **</td>
</tr>
<tr>
<td>P-CHAN-00104</td>
<td>restore_coupling_after_reset</td>
</tr>
<tr>
<td>P-CHAN-00105</td>
<td>preserve_coupling_after_prog_end</td>
</tr>
</tbody>
</table>

**only for SERCOS-drives
3.2 Programming

Syntax, definition of a gantry coupling

The `#SET AX LINK` and `#AX LINK` NC commands are provided in extended syntax for the programmable gantry mode:

```
#SET AX LINK [ <Kopplungsgruppe>, [ <Slave>=<Master>,G [,<limit_1>, limit_2>] ]
                  {, [ <Slave>=<Master>,G [,<limit_1>, limit_2>] ] }
```

or alternatively

```
#AX LINK [NBR] [ <Kopplungsgruppe>, [ <Slave>=<Master>,G [,<limit_1>, limit_2>] ]
                  {, [ <Slave>=<Master>,G [,<limit_1>, limit_2>] ] }
```

- `<Kopplungsgruppe>`: Number of the coupling group
  
  1 ... [Max. number of coupling groups - 1], positive integer.

- `<Slave>`: Designation or logical axis number of the slave axis of coupling pair i

- `<Master>`: Designation or logical axis number of the master axis of coupling pair i

- `NBR`: The logic switch NBR switches over evaluation from axis names to logical axis names. The axis couplings must then be defined with logical axis numbers. The axes need not be present in NC channel. Their presence is only checked when the coupling group is activated.

- `G`: Keyword for gantry coupling. With a gantry coupling the position difference is checked between the actual positions of the coupled axes and the `<limit_1>` and `<limit_2>` positions in the specified limits. Any existing position offset is taken into account when gantry coupling is activated.

With a gantry coupling the following values are used for two-stage monitoring of the permitted position difference between the gantry axes. Specified in [mm]. Positive real number:

- `<limit_1>`: 1. Monitoring limit:
  
  If this limit is exceeded, the motion is aborted and the controller assumes the error state. In the default case, the position difference is cancelled during RESET. Depending on the specific application, a deviating motion can also be implemented.

- `<limit_2>`: 2. Monitoring limit:
  
  If this limit is exceeded, an error that cannot be reset is output. The controller must be switched off and the position difference must be eliminated manually.

If the monitoring limits are not programmed, the defaults apply from the axis parameter data records P-AXIS-00072 and P-AXIS-00071 of the slave axis.

Handling and method of operation

- Gantry coupling takes place at precisely the positions where the axes are located at the time when coupling is selected. There is no need to specify an offset in the NC command because the offset is calculated internally in the position controller via the command positions.

- The dynamic data of the slave axis is taken into account in the contouring motion.

- If programmed accordingly (P-CHAN-00104/P-CHAN-00105), a coupling that is still active on RESET or at program end is implicitly restored for safety reasons the next time the program is started.
3.3 Programming examples

Soft gantry coupling

```
: N10 #SET AX LINK[1, [Y2 = Y1,G,0.01,0.25]]
# Gantry coupling of Y1 as master axis and Y2 as slave
# axis. 1. Limit is 10 µm 2. Limit is 250 µm.
N20 #SET AX LINK[2, [Y2 = Y1,G]]
# Gantry coupling of Y1 (master) and Y2 (slave). The
# monitoring limits of the axis parameter data record of Y2 apply.
N30 #SET AX LINK [3,[Y2 = Y1]]
# Default coupling of Y2 with Y1. No gantry mode.
# or alternative
N10 #AX LINK[1, [Y2 = Y1,G,0.01,0.25]]
N20 #AX LINK NBR[2, [8 = 2,G]]
# Gantry coupling via logical axis numbers
```

Parallel machining of workpieces with a symmetrical or scaled contour can also be programmed by an extended syntax of the #SET AX LINK command. Position differences are not monitored in these modes (mirroring or scaling).

```
#SET AX LINK [ <coupling_group>, [ <Slave>=<Master>,<nominator>, <denominator> ]
{, [ <Slave>=<Master>,<nominator>, <denominator> ] } ]
or alternative
#AX LINK [NBR] [ <coupling_group>, [ <Slave>=<Master>,<nominator>, <denominator>]
{, [ <Slave>=<Master>,<nominator>, <denominator> ] } ]
```

- `<coupling_group>` Number of the coupling group
  1 ... [Max. number of coupling groups\(^{(1)}\) -1], positive integer.
- `<Slave>` Designation or logical axis number of the slave axis of the coupling pair i
- `<Master>` Designation or logical axis number of the master axis of the coupling pair i
- `NBR` Max. number of coupling pairs (2)
- `<nominator>, <denominator>` Integers are used to calculate a coupling factor between:
  - `-1` : Mirror coupling
  - `1` : Default coupling; equivalent to the previous syntax
  - `0` : Output of an error message

**NOTE**

Coupling factors unequal to -1 or 1 that have a scaling effect are not permitted. A warning is output and the coupling factor is assigned the value 1 (default coupling).

Soft gantry: Mirror and default coupling

```
: N10 #SET AX LINK[1, [Y2 = Y1,1,-1]] Mirror coupling (factor -1)
N20 #SET AX LINK[1, [Y2 = Y1,-1,1]] Mirror coupling (factor -1)
N30 #SET AX LINK[1, [Y2 = Y1,-2,2]] Mirror coupling (factor -2)
N40 #SET AX LINK[1, [Y2 = Y1,1,1]] Default coupling
N50 #SET AX LINK[1, [Y2 = Y1,2,2]] Default coupling
N60 #SET AX LINK[1, [Y2 = Y1,1,1]] Error message, program is aborted
N70 #SET AX LINK[1, [Y2 = Y1,1,1]] Error message, program is aborted
N80 #SET AX LINK[1, [Y2 = Y1,3,5]] Warning (factor 0.5), default cpl.
```
N90 #SET AX LINK[1, [Y2 = Y1,2,3]] Warning (factor 0.666), default cpl.
N100 #SET AX LINK[1, [Y2 = Y1,3,2]] Warning (factor 1.5), default cpl.
N110 #SET AX LINK[1, [Y2 = Y1,-1,2]] Warning (factor 0.5), default cpl.
N120 #SET AX LINK[1, [Y2 = Y1,-3,2]] Warning (factor 1.5), default cpl.

or alternatively

N40 #AX LINK[1, [Y2 = Y1,1,1]] Default coupling
N50 #AX LINK _NBR[1, [8 = 2,2,2]]_ Default cpl. via _logical axis numbers_
Syntax, selecting and deselecting a gantry coupling

A (gantry) coupling group can be activated and deactivated with the following NC commands:

```plaintext
#ENABLE AX LINK [ <coupling_group> ]
oder
#ENABLE AX LINK (Coupling group 0, defined in the channel parameter list)
or alternative
#AX LINK ON [ <coupling_group> ]
oder
#AX LINK ON (Coupling group 0, defined in the channel parameter list)
```

```plaintext
#DISABLE AX LINK [ <coupling_group> ]
oder
#DISABLE AX LINK (Deselect the last activated coupling group)
or alternative
#AX LINK OFF [ <coupling_group> ]
oder
#AX LINK OFF (Deselect the last activated coupling group)
#AX LINK OFF ALL (Deselect all active coupling groups)
```

Handling and operating principle

- No coupling group is active after start-up in the initial position of the NC kernel. Activation of axis coupling begins with programming in the NC program and ends, if not cancelled, when the program ends (M30, M02). If active axis couplings are to remain effective for the next program (program global), a specific channel parameter P-CHAN-00105 must be set.
- Several coupling groups can be activated simultaneously.
- Unassigned coupling groups cannot be activated. A coupling group is considered assigned if at least one valid master-slave coupling pair was defined.
- The NC command must be a single instruction in the NC block.
- The number of the coupling group can also be programmed via mathematical expressions.
- WRK must not be selected when synchronous operation is selected or cancelled.
- Manual mode with parallel interpolation (G201) may not be active for the slave axes when synchronous mode is selected.
- Positions of slave axes may not be addressed in the NC program when synchronous mode is active.
Tool change and subroutine for contour machining

Axis designations used:

- Master axis system X, Y, Z, C
- Slave axis system Y_S, Z_S, C_S

(Initialisation program)

%L UP_INIT_ACHS_KOPPL

(initialise axis coupling 1)

N10 #SET AX LINK[1, Y_S=Y, Z_S=Z, C_S=C]
(or #AX LINK[1, Y_S=Y, Z_S=Z, C_S=C]
N20 M17

(tool changing program)

%L UP WZ

N30 #DISABLE AX LINK (oder #AX LINK OFF)
(Initialising tool change position)

N40 G01 G90 Y1000 Z100 C0 Y_S=1000 Z_S=100 C_S=0
(Tool change; T10 contains all tool axis offsets and the tool lengths of master and slave tools; or
these values are explicitly included in the calculation.)
N50 T10 D10
:
(Further commands for physical tool change)

N80 G01 G90 X20 Y20 Z40 C50 Y_S=20 Z_S=40 C_S=50
N90 #ENABLE AX LINK[1] (or #AX LINK ON[1])
N110 M17

(Subroutine for contour machining)

%L UP1

N150 G01 G91 X10 Y10 Z-20 C90
N160 G02 X20 Y20 I10 J10
N170 LL UP WZ
N180 G01 G91 X10 Y10 Z-20 C90
N190 G02 X20 Y20 I10 J10
N200 M17

(Main program; initial condition: Both tools were changed.)

(Move both axis systems to coupling position first.)

N300 G01 G91 X20 Y20 Z40 C50 Y_S=20 Z_S=40 C_S=50 F300
(Start synchronous operation)
N310 #ENABLE AX LINK[1] (or #AX LINK ON[1])
N320 LL UP1
:
N400 #DISABLE AX LINK (or #AX LINK OFF)
N410 M30
4 Hard gantry

4.1 configuration

Static gantry mode
Additional monitoring mechanisms to monitor the deviation of axis positions and special strategies to compensate for these deviations apply to gantry axes.

Static (mechanical) gantry mode is defined by configuration since the axes are always firmly coupled to one another due to the machine structure.

It is possible to define gantry groups that assign a master axis to several slave axes.

4.1.1 Master axis

Master axis configuration
For gantry master axes bit 0x00010000 must be set in axis mode (P-AXIS-00015).
If required, the axis can be assigned by default to an NC channel (P-CHAN-00006, P-CHAN-00035).
Make sure that the following parameters for master and slave axes are identical:

- Modulo mode (P-AXIS-00018, P-AXIS-00015 bit 0x00000004)
- Modulo range (P-AXIS-00126, P-AXIS-00127)
- Maximum acceleration (P-AXIS-00008)
- Emergency stop delay (P-AXIS-00003)
- CNC-controlled error reaction (P-AXIS-00254)
- Homing type (P-AXIS-00299)
- Delay after PLC watchdog error (P-AXIS-00367)

If these parameters are different, a warning is output at controller start-up and the master axis values are adopted.

4.1.2 Slave axis

Slave axis configuration
For gantry slave axes bit 0x00020000 must be set in axis mode (P-AXIS-00015).
The following must also be configured for the slave axis:

- Axis number of master axis (P-AXIS-00070)
- Offset to master axis (P-AXIS-00073)
- Permitted resettable gantry error (P-AXIS-00072)
- Permitted non-resettable gantry error (P-AXIS-00071)
- Velocity to drive out the position difference to the master axis (P-AXIS-00075)

A gantry slave axis may not be assigned to any NC channel (P-CHAN-00006, P-CHAN-00035).
Make sure that the following parameters for master and slave axes are identical:

- Modulo mode (P-AXIS-00018, P-AXIS-00015 bit 0x00000004)
- Modulo range (P-AXIS-00126, P-AXIS-00127)
- Maximum acceleration (P-AXIS-00008)
- Emergency stop delay (P-AXIS-00003)
- CNC-controlled error reaction (P-AXIS-00254)
- Homing type (P-AXIS-00299)
- Delay after PLC watchdog error (P-AXIS-00367)

If these parameters are different, a warning is output at controller start-up and the master axis values are adopted.

Other axis parameters can be set in the slave axis as required.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Required for Gantry mode</th>
<th>Master axis</th>
<th>Required for Gantry mode</th>
<th>Slave axis</th>
</tr>
</thead>
<tbody>
<tr>
<td>P-AXIS-00015 achs_mode</td>
<td></td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>P-AXIS-00070 gantry_ax_nr</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>P-AXIS-00072 gantry_max_diff_resetable</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>P-AXIS-00071 gantry_max_diff_reset_locked</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>P-AXIS-00073 gantry_offset</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>P-AXIS-00074 gantry_slave_no_homing</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>P-AXIS-00075 gantry_vb_korr</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>
4.2 Programming

Only the master axis in the channel is known for a hard gantry coupling. This can be programmed in the NC program.

Gantry slave axes have no axis identifier and therefore cannot be programmed in the NC program.

4.2.1 Gantry start-up

<table>
<thead>
<tr>
<th>NOTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Only use the #GANTRY command for start-up</td>
</tr>
<tr>
<td>Possible machine damage if command used incorrectly.</td>
</tr>
</tbody>
</table>

To start up a machine, it may be helpful to disable the gantry combination of one or even several axes.

This is done by assigning the axis parameter P-AXIS-00704 with

\[ \text{kenngr.gantry_on_mode CONFIG} \]

must be set for all gantry slave axes.

The following gantry combination is defined for the programming examples below:

Combination 1:
- X (Master) with logical axis number 1
  - Axis_X1 (Slave 1), logical axis number 5
  - Axis_X2 (Slave 2), logical axis number 6

4.2.1.1 Disable gantry combination

**Disable gantry combination**

\[ \text{#GANTRY OFF [ } \{ \text{AXNR=.. | AX=.. } \} \] 

| AXNR=| Logical axis number (P-AXIS-00016) of master axis |
| AX=| Name of the master axis of a gantry combination |

**Disable all gantry combinations:**

\[ \text{#GANTRY OFF ALL} \]

To start up, the gantry combination of a gantry master axis located in the channel can be disabled by the command

\[ \text{#GANTRY OFF [AX=<master_axis_name>]} \]

Gantry slave axes are then free and cannot be assigned to any master axis. They are then treated as independent CNC axes. The gantry master axis can continue to move as an independent CNC channel axis. The previous slave axes are no longer influenced by movements of the previous gantry master axis. However, in this state they cannot be programmed or moved since they do not belong to any channel.

If the master axis is not in the channel, the combination can be disabled in the same way by the logical axis number.

\[ \text{#GANTRY OFF [AXNR=expr]} \]

If all existing gantry combinations need to be disabled, this is done by using

\[ \text{#GANTRY OFF ALL} \]

.
Disabling gantry couplings using \#GANTRY OFF is modal beyond program end and reset.
The gantry combination is only re-enabled after a controller restart or if \#GANTRY ON[ ] is programmed explicitly.

The \#GANTRY OFF command adopts no slave axes in the channel.

Use of gantry slave axes.
If free gantry slave axes are to remain programmable even after the combination is disabled, they must be previously requested by the NC channel. After a request is successful, free slave axes respond in the same way as regular CNC axes.

Request and releasing slave axes is carried out using axis exchange commands.

For example, the following command requests an axis:

```
#CALL AX[Axis_X1, 5, 4]
```

Similarly, the following command releases a CNC axis as usual:

```
#PUT AX[Axis_X1]
```

All other NC commands applicable to an axis can also be released for slave axes.

Request free gantry slave axes

```
#GANTRY OFF [AX=X]
; Request free slave axes
#CALL AX [Axis_X1, 5, 4]; log. axis no.4 at Index 3
#CALL AX [Axis_X2, 6, 5]; log. axis no.5 at Index 4
; Move axes as independent CNC axes
G0 X=47;X previous master axis of gantry combination 1
G0 Axis_X1=11; Axis_X1 previous slave axis 1 of X
G0 Axis_X2=12; Axis_X2 previous slave axis 2 of X
M30/
```

4.2.1.2 Restore gantry combination

Restore a gantry combination

```
#GANTRY ON [ { AXNR=.. | AX=.. } ]
```

**AXNR=**<expr> applies Logical axis number (P-AXIS-00016) of master axis

**AX=**<master_axis_name> Name of the master axis of a gantry combination

Restore all gantry combinations:

```
#GANTRY ON ALL
```

The command

```
#GANTRY ON [AX=<master_axis_name>]
```
restores the gantry combination of the master axis <master_axis_name> based on the original machine data. All previous slave axes in the NC channel are implicitly released.

Similarly, the gantry combination can also be restored by the logical axis number.

```
#GANTRY ON [AXNR=<expr>]
```

The gantry difference is not cleared as long as parameter (P-AXIS-00704)
kenngr.gantry_on_mode = CONFIG

is set.

### Restore a gantry combination

```plaintext
#GANTRY OFF [AX=X]
; Request free slave axes
#CALL AX [Axis_X1, 5, 4]
#CALL AX [Axis_X2, 6, 5]
; Move axes as independent CNC axes
G0 X=47 ; X previous master axis of gantry combination 1
G0 Axis_X1=11 ; Axis_X1 previous slave axis 1 of X
G0 Axis_X2=12 ; Axis_X2 previous slave axis 2 of X
;
#GANTRY ON [AX=X] ; Restore gantry combination 1
G0 X=65 ; Assigned slave axes 1 and 2 also move with
M30
```

In analogy to #GANTRY OFF ALL the command

```plaintext
#GANTRY ON ALL
```

restores all gantry combinations.

## 4.3 Referencing

### CNC-controlled

All gantry axes are referenced sequentially if homing is performed by the CNC. The homing logic is always executed for one axis and the remaining axes in the gantry combination are also interpolated uniformly. This is then repeated for the next axis in the gantry combination until all gantry axes are referenced.

During the homing motion, no relative motion of the gantry axes to one another occurs.

### Drive-controlled

Intelligent drives (e.g. SERCOS) execute homing independently. In a gantry system, it must also be ensured that the gantry combination always moves uniformly. In other words,

- the parameter definitions must ensure that the drive covers an identical path during homing motion (RPF).
- The homing motion is started simultaneously for all gantry axes.

This behaviour is set by the parameter P-AXIS-00253.

- Drive-controlled reference point travel must run identically in the case of both drives (e.g. without cam and distance-coded measurement system). This must be initiated by respective parameters.

### NOTE

For security reasons the torque can be reduced during homing procedure.

### Only on the master side

The parameter P-AXIS-00074 (gantry_slave_no_homing) can suppress homing for gantry slave axes.

When master axis homing is completed, the reference positions entered in the axis parameter list of slaves axes are adopted. Monitoring is started for the gantry difference between master and slave axes.

### Monitoring before referencing

The parameter P-AXIS-00249 (gantry_diff_check_without_homing) is used to activate monitoring of the gantry difference between master and slave axes before homing is executed.
The offset between the master and slave axes at the time of controller start-up is used as the position offset.
4.4 Error handling

Error handling for gantry systems

In case of an error an intelligent drive executes an error reaction by itself in most cases and reports this to the CNC. Then the CNC can stop the other related axis.

With gantry axes, it is not permitted for one axis in the gantry combination to stop independently. This is why the CNC can stop the entire gantry combination in a controlled operation if an error occurs in one axis.

The functions for master and slave axes are set using the parameter P-AXIS-00254 (cnc_controlled_stop_after_error). A check is made whether the settings for master and slave axes are identical and this is corrected in the slave axes if necessary.

NOTE

The parameter P-AXIS-00254 is currently used for SERCOS axes only.
In addition, the drive must be parameterised so that no or possibly a delayed error response is executed (see EcoDrive P-0-0117).

In a CNC-controlled error reaction the system is stopped at the defined emergency deceleration P-AXIS-00003 (a_emergency).
5 Parameter

5.1 Overview

5.1.1 Channel parameters for dynamic gantry mode

<table>
<thead>
<tr>
<th>ID</th>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>P-CHAN-00104</td>
<td>restore_coupling_after_reset</td>
<td>Restore coupling after reset</td>
</tr>
<tr>
<td>P-CHAN-00105</td>
<td>preserve_coupling_after_prog_end</td>
<td>Restore coupling at program end</td>
</tr>
</tbody>
</table>

5.1.2 General axis parameters

<table>
<thead>
<tr>
<th>ID</th>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>P-AXIS-00003</td>
<td>a_emergency</td>
<td>Emergency axis acceleration</td>
</tr>
</tbody>
</table>

5.1.3 Axis parameters for dynamic gantry mode

<table>
<thead>
<tr>
<th>ID</th>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>P-AXIS-00071</td>
<td>gantry_max_diff_reset_locked</td>
<td>Maximum path difference</td>
</tr>
<tr>
<td>P-AXIS-00072</td>
<td>gantry_max_diff_resetable</td>
<td>Resettable path difference</td>
</tr>
<tr>
<td>P-AXIS-00075</td>
<td>gantry_vb_korr</td>
<td>Compensation velocity</td>
</tr>
</tbody>
</table>

5.1.4 Axis parameters for static gantry mode

<table>
<thead>
<tr>
<th>ID</th>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>P-AXIS-00015</td>
<td>achs_mode</td>
<td>Axis mode</td>
</tr>
<tr>
<td>P-AXIS-00070</td>
<td>gantry_ax_nr</td>
<td>Axis number of the master axis</td>
</tr>
<tr>
<td>P-AXIS-00071</td>
<td>gantry_max_diff_reset_locked</td>
<td>Maximum path difference</td>
</tr>
<tr>
<td>P-AXIS-00072</td>
<td>gantry_max_diff_resetable</td>
<td>Resettable path difference</td>
</tr>
<tr>
<td>P-AXIS-00073</td>
<td>gantry_offset</td>
<td>Static offset</td>
</tr>
<tr>
<td>P-AXIS-00074</td>
<td>gantry_slave_no_homing</td>
<td>Suppress homing for gantry slave axis</td>
</tr>
<tr>
<td>P-AXIS-00075</td>
<td>gantry_vb_korr</td>
<td>Compensation velocity</td>
</tr>
<tr>
<td>P-AXIS-00249</td>
<td>gantry_diff_check_without_homing</td>
<td>Monitor gantry difference before homing</td>
</tr>
<tr>
<td>P-AXIS-00253</td>
<td>gantry_synchronous_slave_homing</td>
<td>Drive-controlled referencing of gantry combination</td>
</tr>
<tr>
<td>P-AXIS-00254</td>
<td>cnc_controlled_stop_after_error</td>
<td>CNC-controlled error reaction</td>
</tr>
<tr>
<td>P-AXIS-00297</td>
<td>kopf.log_achs_name</td>
<td>Default axis name</td>
</tr>
<tr>
<td>P-AXIS-00704</td>
<td>kenngr.gantry_on_mode</td>
<td>Conditions for clearing the gantry difference</td>
</tr>
</tbody>
</table>
## 5.2 Description

### 5.2.1 Channel parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Data type</th>
<th>Data range</th>
<th>Default value</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>P-CHAN-00104</td>
<td><strong>Restore coupling after reset (synchronous operation)</strong></td>
<td>An active axis coupling (synchronous operation) is deselected by NC reset. Set this parameter to 1 if the axis coupling is to be reactivated automatically in the following NC program.</td>
<td><strong>synchro_data.restore_coupling_after_reset</strong></td>
<td>BOOLEAN</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Data type</th>
<th>Data range</th>
<th>Default value</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>P-CHAN-00105</td>
<td><strong>Restore coupling at program end (synchronous operation)</strong></td>
<td>An active axis coupling (synchronous operation) is deselected at NC program end (#DISABLE AXLINK) if it is not ended explicitly in the NC program. Set this parameter to 1 if the axis coupling is to be reactivated automatically in the following NC program.</td>
<td><strong>synchro_data.preserve_coupling_after_prog_end</strong></td>
<td>BOOLEAN</td>
<td>0</td>
</tr>
</tbody>
</table>
5.2.2 Axis parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Data type</th>
<th>Data range</th>
<th>Axis types</th>
<th>Dimension</th>
<th>Default value</th>
<th>Drive types</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>P-AXIS-00003</td>
<td>Deceleration for an emergency stop</td>
<td>getriebe[i].dynamik.a_emergency</td>
<td>1 ≤ a_emergency ≤ 2*P-AXIS-00008</td>
<td>T, R, S</td>
<td>T: mm/s², R,S: °/s²</td>
<td>0</td>
<td>----</td>
<td>When the parameter has the value 0, the value of P-AXIS-00008 (a_max) is used.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Data type</th>
<th>Data range</th>
<th>Axis types</th>
<th>Dimension</th>
<th>Default value</th>
<th>Drive types</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>P-AXIS-00015</td>
<td>Operating mode of an axis</td>
<td>kenngr.achs_mode</td>
<td>0x00000001 - 0x10000000</td>
<td>T, R, S</td>
<td>R:S: ----</td>
<td>0x00000001</td>
<td>----</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Data type</th>
<th>Data range</th>
<th>Axis types</th>
<th>Dimension</th>
<th>Default value</th>
<th>Drive types</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>P-AXIS-00070</td>
<td>Axis number of master axis</td>
<td>kenngr.gantry_ax_nr</td>
<td>1 ≤ gantry_ax_nr ≤ MAX (UNS16)</td>
<td>T, R</td>
<td>T: ----, R: ----</td>
<td>0</td>
<td>----</td>
<td>These entries are not taken over when the axis parameters list is updated. To change them, a reboot is required.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Data type</th>
<th>Data range</th>
<th>Axis types</th>
<th>Dimension</th>
<th>Default value</th>
<th>Drive types</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>P-AXIS-00071</td>
<td>Non resettable path distance between master- and slave axis</td>
<td>kenngr.gantry_max_diff_reset_locked</td>
<td>0 &lt; gantry_max_diff_resetable &lt; gantry_max_diff_reset_locked &lt; MAX(UNS32)</td>
<td>T, R</td>
<td>T: 0.1µm, R: 0.0001°</td>
<td>0</td>
<td>----</td>
<td></td>
</tr>
</tbody>
</table>
### P-AXIS-00072 Resettable path distance

**Description**
Maximum permissible distance difference between the master and slave axes. Error that can be remedied by NC reset.

**Parameter**
kenngr.gantry_max_diff_resetable

<table>
<thead>
<tr>
<th>Data type</th>
<th>UNS32</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data range</td>
<td>$0 &lt; \text{gantry_max_diff_resetable} &lt; \text{MAX(UNS32)}$</td>
</tr>
<tr>
<td>Axis types</td>
<td>T, R</td>
</tr>
</tbody>
</table>
| Dimension  | T: 0.1µm  
R, S: 0.0001° |
| Default value | 0 |

### P-AXIS-00073 Static offset between master and slave axis

**Description**
Static difference between the master and slave axes in the event of differences between the master and slave axes. The offset sign results from the calculation instruction: $\text{OFFSET} = \text{SLAVE} - \text{MASTER}$

**Parameter**
kenngr.gantry_offset

<table>
<thead>
<tr>
<th>Data type</th>
<th>SGN32</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data range</td>
<td>$\text{MIN(SGN32)} &lt; \text{gantry_offset} &lt; \text{MAX(UNS3)}$</td>
</tr>
<tr>
<td>Axis types</td>
<td>T, R</td>
</tr>
</tbody>
</table>
| Dimension  | T: 0.1µm  
R: 0.0001° |
| Default value | 0 |

### P-AXIS-00074 Suppress homing for gantry slave axis

**Description**
This parameter can suppress the homing of gantry slave axis. When homing of the master axis is completed, the axis positions from the gantry slave axis parameter lists are also taken over and monitoring of the gantry difference is started.

**Parameter**
kenngr.gantry_slave_no_homing

<table>
<thead>
<tr>
<th>Data type</th>
<th>BOOLEAN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data range</td>
<td>0/1</td>
</tr>
<tr>
<td>Axis types</td>
<td>T, R</td>
</tr>
</tbody>
</table>
| Dimension  | T: ----  
R: ---- |
| Default value | 0 |

### P-AXIS-00075 Velocity of correction for compensation of gantry difference

**Description**
Correction of slave axis position is done with velocity defined by the parameter until distance between master and slave is smaller than P-AXIS-00073.

**Parameter**
kenngr.gantry_vb_korr

<table>
<thead>
<tr>
<th>Data type</th>
<th>UNS32</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data range</td>
<td>$0 &lt; \text{gantry_vb_korr} &lt; \text{P-AXIS-00212}$</td>
</tr>
<tr>
<td>Axis types</td>
<td>T, R</td>
</tr>
</tbody>
</table>
| Dimension  | T: 1µm/s  
R: 0.001°/s |
| Default value | 0 |

Remarks
This parameter is not supported in the case of spindle axes.
### P-AXIS-00249  Gantry difference monitoring before homing

**Description**
By default position difference monitoring is active only after homing of gantry master and slave axis.

With this parameter, it is possible to already activate this monitoring function before reference point travel (*gantry_diff_check_without_homing = 1*). The P-AXIS-00072 and P-AXIS-00071 parameters are used as limits during monitoring. The position difference at start-up of the control is taken as offset instead of P-AXIS-00073. After reference point travel, P-AXIS-00073 is used as the position offset.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Data type</th>
<th>Data range</th>
<th>Axis types</th>
<th>Dimension</th>
<th>Default value</th>
<th>Drive types</th>
</tr>
</thead>
<tbody>
<tr>
<td>kenngr.gantry_diff_check_without_homing</td>
<td>BOOLEAN</td>
<td>0/1</td>
<td>T, R</td>
<td>T: ----</td>
<td>0</td>
<td>----</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>R: ----</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### P-AXIS-00253  Drive-controlled homing of gantry axis (SERCOS)

**Description**
For drive-controlled homing (digital drives, SERCOS) the homing procedure is started synchronously for all gantry axes.

For an identical homing process the user has to additionally ensure that the homing parameter settings are the same for all drives.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Data type</th>
<th>Data range</th>
<th>Axis types</th>
<th>Dimension</th>
<th>Default value</th>
<th>Drive types</th>
</tr>
</thead>
<tbody>
<tr>
<td>kenngr.gantry_synchronous_slave_homing</td>
<td>BOOLEAN</td>
<td>0/1</td>
<td>T, R</td>
<td>T: ----</td>
<td>0</td>
<td>SERCOS</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>R: ----</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### P-AXIS-00254  CNC-controlled error reaction for gantry axes

**Description**
In case of an error an intelligent drive executes an error reaction by itself in most cases and reports this to the CNC. Then the CNC can stop the other related axis.

In the case of gantry axes, it is not allowed for one axis in the gantry network to stop independently. This is why the CNC can stop the entire gantry network in a controlled fashion in the event of an error in one axis. The functionality is set for the master and slave axes. A check is made whether the settings for master and slave axes are identical and this is corrected in the slave axes if necessary.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Data type</th>
<th>Data range</th>
<th>Axis types</th>
<th>Dimension</th>
<th>Default value</th>
<th>Drive types</th>
</tr>
</thead>
<tbody>
<tr>
<td>kenngr.cnc_controlled_stop_after_error</td>
<td>BOOLEAN</td>
<td>0: Drive-internal error reaction 1: CNC-controlled error reaction</td>
<td>T, R</td>
<td>T: ----</td>
<td>0</td>
<td>SERCOS</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>R: ----</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---
### Remarks
In the case of a CNC-controlled error response, the axis is stopped at the specified emergency stop acceleration P-AXIS-00003 (a_emergency) gestoppt.
This parameter can be used with SERCOS and CANopen drives.
In addition a SERCOS drive must be parameterised so that it does not execute any independent (or only delayed) error response (see EcoDrive P-0-0117).

### P-AXIS-00297 Default name of an axis

<table>
<thead>
<tr>
<th>Parameter</th>
<th>kopf.log_achs_name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data type</td>
<td>STRING</td>
</tr>
<tr>
<td>Data range</td>
<td>Maximum 16 characters (length of axis designation, application-specific)</td>
</tr>
<tr>
<td>Axis types</td>
<td>T, R, S</td>
</tr>
<tr>
<td>Dimension</td>
<td>T: ----</td>
</tr>
<tr>
<td></td>
<td>R,S: ----</td>
</tr>
<tr>
<td>Default value</td>
<td>X_Achse</td>
</tr>
<tr>
<td>Drive types</td>
<td>----</td>
</tr>
<tr>
<td>Remarks</td>
<td>The axis designations must begin with the letters A, B, C, U, V, W, X, Y, Z or Q. After that, all letters and digits are possible.</td>
</tr>
</tbody>
</table>

### P-AXIS-00704 Conditions for clearing the gantry difference

<table>
<thead>
<tr>
<th>Parameter</th>
<th>kenngr.gantry_on_mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data type</td>
<td>STRING</td>
</tr>
<tr>
<td>Data range</td>
<td>Mode</td>
</tr>
<tr>
<td></td>
<td>Meaning</td>
</tr>
<tr>
<td>DEFAULT</td>
<td>The gantry difference is cleared at reset or when the control unit 'gantry_on' ([HLI:1]) is set.</td>
</tr>
<tr>
<td>ONLY_CONTROL_UNIT</td>
<td>The gantry difference is only cleared when the drive enables are set, the drive status is ‘ready’ and the control unit ‘gantry_on’ is set.</td>
</tr>
<tr>
<td>EDGE_TRIGGERED</td>
<td>The gantry difference is cleared on a rising edge of the control unit ‘gantry_on’. The behaviour of this setting is equivalent to the behaviour of a set axis parameter P-AXIS-00261.</td>
</tr>
<tr>
<td>CONFIG :</td>
<td>Deactivates gantry control and prevents the clearing of a gantry difference.</td>
</tr>
<tr>
<td>Axis types</td>
<td>T, R, S</td>
</tr>
<tr>
<td>Dimension</td>
<td>T: ----</td>
</tr>
<tr>
<td></td>
<td>R,S: ----</td>
</tr>
<tr>
<td>Default value</td>
<td>DEFAULT</td>
</tr>
<tr>
<td>Drive types</td>
<td>----</td>
</tr>
<tr>
<td>Remarks</td>
<td>When the axis parameter P-AXIS-00261 is set, only DEFAULT or EDGE_TRIGGERED are used for P-AXIS-00704, otherwise the error message P-ERR-110606 is output. The parameter is available as of V2.11.2034.02.</td>
</tr>
</tbody>
</table>
6 Support and Service

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e-mail: service@beckhoff.com

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web: https://www.beckhoff.com
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<td>P-AXIS-00071</td>
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<td>P-AXIS-00072</td>
<td>27</td>
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<td>P-AXIS-00073</td>
<td>27</td>
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<td>P-AXIS-00074</td>
<td>27</td>
</tr>
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<td>P-AXIS-00075</td>
<td>27</td>
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<td>P-AXIS-00249</td>
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<td>P-AXIS-00253</td>
<td>28</td>
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<td>P-AXIS-00254</td>
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<td>P-AXIS-00297</td>
<td>29</td>
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<td>P-CHAN-00105</td>
<td>25</td>
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</tbody>
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