Functional description | EN

TF5200 | TwinCAT 3 CNC

Delete distance to go
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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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.

<table>
<thead>
<tr>
<th>DANGER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute danger to life!</td>
</tr>
<tr>
<td>If you fail to comply with the safety instruction next to this icon, there is immediate danger to human life and health.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CAUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personal injury and damage to machines!</td>
</tr>
<tr>
<td>If you fail to comply with the safety instruction next to this icon, it may result in personal injury or damage to machines.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>NOTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Restriction or error</td>
</tr>
<tr>
<td>This icon describes restrictions or warns of errors.</td>
</tr>
</tbody>
</table>

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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Overview

1 Overview

Task

The “Delete distance to go” function described in this documentation interrupts the actual path motion and starts a short cut by straight line to the target position of next block. The distance to go of the current (interrupted) block is then deleted.

The operator commands motion interruption via the PLC.

Characteristics

If the interrupted block was executed in rapid traverse (G00), the short cut is also executed in rapid traverse. Otherwise, the short cut is executed with G01 at the programmed feed rate of the next block. The interruption can also be started during a circular motion (G02/G03). In general, a short cut is always executed as a linear motion.

Path-influencing functions (G61, spline, #HSC, etc.) are not considered in the short cut.

Programming

If the delete distance to go only contains one block, a command from the PLC is sufficient. There is no need for an explicit NC command.

Deleting distance to go can contain multiple blocks. Therefore the marker denoting the end of distance to go can be set beforehand in the NC program using the NC command #DEL DIST2GO [...] [13].

A complete description of the use of this command is contained in the section Interface [25].

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 Delete distance to go

2.1 Default: Delete distance to go for a single block

2.1.1 Overview

The "Delete distance to go" function interrupts the current motion and starts a short cut on a straight line to the target position of the next block.

- The operator (PLC) can interrupt the path motion. The distance to go in the current block is then deleted.
- The block and position of the interrupt is not known in advance and not marked in the ISO program.
- Continue with linear motion to target position of next block (short cut).
- Path velocity is decelerated to 0 after interrupt at the end of the next block.

Figure 1: Interfaces of delete distance to go
Delete distance to go

%dist.nc
N05 G0 X0 Y0
N10 G1 X80 F500 ;interrupt and delete distance to go
N20 G1 Y60
N30 G1 X60 Y80
N40 M30

Figure 2: Simple example - Delete distance to go in block N10

2.1.2 Characteristics

Features:
The short cut is executed as a linear movement.

If the interrupted block was executed in rapid motion (G00), the short cut is also executed in rapid motion. Otherwise, the short cut is executed with G01 at the programmed feed rate of the next block.

The interrupt can be started within a circular motion (G02/G03) but it is not executed as a circular motion itself.

Restrictions
Path-influencing functions (G61, spline, #HSC, etc.) are not considered in the short cut.
Figure 3: Delete distance to go with circles
A “Delete distance to go” Deletes the remaining distance after stopping within an NC block.

The stopping position is only known precisely after velocity $v = 0$ is reached. This position depends on the actual path velocity and the braking distance.

For short blocks or near block end, the position can be in the current or in the next block. In this case the result of “delete distance to go” depends on the NC block in which the stop position occurs.

To avoid this effect, the user can first stop the current motion using a FEEDHOLD and then request “delete distance to go”.

Figure 4: Delete distance to go with polynomials

DANGER

The user is responsible for preventing any machine collision when a modified contour is executed.
2.2 Extension: Delete distance to go up to an explicit end marker

2.2.1 Overview

Deleting distance to go can contain multiple blocks. In addition, the distance to go marker can be predefined in the NC program.

```plaintext
#DEL DIST2GO [ [ END <32bit> ] ]
```

Afterwards the jump marks may be individually activated by the PLC online (ACTIVATION HLI extension).

Individual jump markers can also be compiled in groups using the same activation markers.

Figure 5: Delete distance to go up to a marker
Delete distance to go up to an explicit marker

```
%deldisttogo_end_mark
N029 G02 Y200 J100
N031 G01 Y220
N032 G00 X110 Y220
N033 Y230
N034 X120
N035 Y240
N040 X130
N041 #DEL DIST2GO ;default ACTIVATION = '16#01'
N050 Y250
N051 #DEL DIST2GO [END='16#01'] ;------------
N060 X150
N061 #DEL DIST2GO [END=2] ;------------
N070 Y300
N071 #DEL DIST2GO [END='16#0105'] ;------------
N080 X200
N081 #DEL DIST2GO [END=8] ;------------
N090 Y350
N100 X250
...
M30
```
Figure 7: Representation of an explicit marker
2.2.2 Characteristics

Default/short notation
If the end marker is set without an activation bit, END = 1 is set by default.

#DEL DIST2GO (corresponds to #DEL DIST2GO [ END = 1 ] )

Downwards compatibility
If no end marker is set valid by the PLC interface (control unit activation = 0), the NC moves to end of the next motion block as before.

No valid end marker
If no valid end marker is found up to the end of the NC program or the function “Delete distance to go” is commanded in the last motion block, the motion is terminated prematurely at the stop position and a warning is displayed.

All other non motion-related NC commands are still executed at this position (e.g. technology functions, M functions, etc.).

Figure 8: Delete distance to go without end marker up to M30

A valid end marker is only valid if the command (see section PLC interface (control unit and the HLU) [p. 25]) is executed.
2.3 Interface signals

Signals and status

"Delete distance to go" is started by the rising edge of the signal at the PLC interface (commanded value in the control unit on the HLI). Signal detection (rising edge) is output in the control unit.

If the signal is cleared before the short cut is started, the original programmed contour is continued.

As long as the changed contour is executed, "delete distance to go active" = TRUE is displayed on the PLC interface.

Figure 9: Delete contour path of single distance to go
* delete_distance_to_go_active_r

Figure 10: Delete PLC signal on the HLI for single distance to go

Delete multiple distances to go

If “delete distance to go” is cleared and reset during execution of a “delete distance to go” block, this block is also interrupted and a short cut is executed to the target position of the next block.

The starting point of the second short cut can be defined by the block change (block number, block count).
Figure 11: Delete contour path with multiple distances to go
* delete_distance_to_go_active_r

Figure 12: Delete PLC signal on the HLI with multiple distances to go
2.4 Commands in the deleted contour

Additional commands

If additional NC commands are programmed in the deleted contour, they are executed at the point of interrupt.

Additional command within a short cut.

%ddtg8
N00 ...
N10 X100 ;interrupt and delete distance to go

N15 M48
N16 P1=1
N17 #TIME 10

N20 Y100
N30 X90 Y110
M30

Figure 13: Additional command within a deleted distance to go
2.5 Relative programming (G91)

Even if next block after delete distance to go is defined relative by G91, the end position of the next block is not recalculated relatively to the stop position at the interrupt. The end of the next block is calculated as if no interrupt had taken place.

A “Delete distance to go” does not result in an offset of the further relative programmed contour.

Effects on relatively programmed positions

<table>
<thead>
<tr>
<th>prog</th>
</tr>
</thead>
<tbody>
<tr>
<td>N00 _</td>
</tr>
<tr>
<td>G1 G91 X100 ;interrupt and delete distance to go</td>
</tr>
<tr>
<td>N20 G91 Y100</td>
</tr>
<tr>
<td>N30 G91 X-10 Y10</td>
</tr>
<tr>
<td>M30</td>
</tr>
</tbody>
</table>

Figure 14: Delete distance to go with active relative programming (G91)

There is no contour offset if the next block (N20) is programmed relative (G91).
2.6 Combination with backward motion

Backward motion on the path during delete distance to go

The short cut motion is calculated online by the PLC signal and not saved in the ISO program. For this reason, the short cut path can not move backwards.

If the user (PLC) requests backward motion while travelling on a short cut (N20'), the motion is interrupted (same as for FEEDHOLD) and a warning is output. As soon as the backward motion signal is reset, motion on the short cut is resumed.

If the backward signal is set after reaching the target position of the short cut, the backward motion is executed on the original contour (N20) which was programmed in the ISO program and not on the short cut.

The short cut executed with "delete distance to go" in not considered for backward motion. The original contour from the ISO program is always considered for backward motion.
Delete distance to go during backward motion

If the motion is already in a backward direction, the request for "delete distance to go" is only executed in the backward direction.

Figure 16: Delete distance to go during backward motion

It is not possible to reverse the motion direction on a short cut with "delete distance to go". FEED-HOLD is set and the warning is output.

The short cut must continue in the same path direction.
3 Interface

3.1 PLC interface (control unit on HLI)

<table>
<thead>
<tr>
<th>Delete distance to go, command</th>
</tr>
</thead>
</table>
| **Description** | Request "delete distance to go" by the PLC.
The signal "delete distance to go" refers only to motion blocks. At every rising edge of the signal "delete distance to go", the CNC channel decelerates to feed rate = 0 and then executes a straight line motion to the target position of the next block (short cut).
The control unit state is set to high when the CNC detects the command. |

| CNC Build | < V2.11.2800 | >= V2.11.2800 |
| Data type | MCControlBoolUnit | MC_CONTROL_BOOL_UNIT |
| Access | PLC read request + state and write command + clearance |
| ST path | pMC[idx].addr.MCControlBahn_Data.DeleteDistanceToGo | gpCh[idx].bahn_mc_control.delete_distance_to_go |

Commanded, requested and return values

| ST element | .X_Command | .command_w |
| ST element | .X_Request | .request_r |
| ST element | .X_State | .state_r |

| Data type | BOOL |
| Requirements | Parameter P-STUP-00033 must be configured for the channel. |
| Value range | [TRUE, FALSE] |
| Redirection | |

| ST element | .X_Enable | .enable_w |
3.2  Extension: Activate the end marker on the PLC interface (control unit on the HLI)

<table>
<thead>
<tr>
<th>Delete distance to go, end marker</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description</strong></td>
</tr>
<tr>
<td>Example:</td>
</tr>
<tr>
<td>CNC Build</td>
</tr>
<tr>
<td>Data type</td>
</tr>
<tr>
<td>Access</td>
</tr>
<tr>
<td>ST path</td>
</tr>
<tr>
<td>Data type</td>
</tr>
<tr>
<td>Commanded, requested and return value</td>
</tr>
<tr>
<td>ST element</td>
</tr>
<tr>
<td>Value range</td>
</tr>
<tr>
<td>Redirection</td>
</tr>
</tbody>
</table>

3.3  State of the PLC interface (display)

3.3.1  State of “delete distance to go”

<table>
<thead>
<tr>
<th>Delete distance to go, state</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description</strong></td>
</tr>
<tr>
<td>CNC Build</td>
</tr>
<tr>
<td>Information flow</td>
</tr>
<tr>
<td>ST path</td>
</tr>
<tr>
<td>Data type</td>
</tr>
<tr>
<td>Access</td>
</tr>
</tbody>
</table>

3.3.2  Additional status information of currently executed block

<p>| Line counter, NC program |</p>
<table>
<thead>
<tr>
<th>Description</th>
<th>The value displayed is the NC program line which is processed by the interpolator. The value is deduced from the count of lines which the decoder has read since the NC program started. All lines which the decoder has read are counted (including repeated read lines), empty and comment lines. All commands which result from decoding an NC program line for the interpolator are assigned to the specific number of the program line.</th>
</tr>
</thead>
<tbody>
<tr>
<td>CNC build</td>
<td>(&lt;\text{V2.11.2800}) (\geq\text{V2.11.2800})</td>
</tr>
<tr>
<td>Information flow</td>
<td>CNC → SPS</td>
</tr>
<tr>
<td>ST path</td>
<td>(\text{pMC[dx]})^.addr^.StateBahn_Data. (\text{D_BlockCount}) (\text{gpCh[dx]})^.bahn_state.block_count_r</td>
</tr>
<tr>
<td>Data type</td>
<td>UDINT</td>
</tr>
<tr>
<td>Access</td>
<td>PLC reading</td>
</tr>
</tbody>
</table>

**Block number, NC program**

| Description | The NC block number indicates the programmed block number (N number) of the NC block just executed, e.g.:
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>CNC Build</td>
<td>(&lt;\text{V2.11.2800}) (\geq\text{V2.11.2800})</td>
</tr>
<tr>
<td>Information flow</td>
<td>CNC → PLC</td>
</tr>
<tr>
<td>ST path</td>
<td>(\text{pMC[dx]})^.addr^.StateBahn_Data. (\text{D_BlockNumber}) (\text{gpCh[dx]})^.bahn_state.block_nr_r</td>
</tr>
<tr>
<td>Data type</td>
<td>DINT</td>
</tr>
<tr>
<td>Access</td>
<td>PLC reads</td>
</tr>
</tbody>
</table>
3.4 Programming examples

3.4.1 Request at different times

Vary the "delete distance to go" HLI signal

In the test program below, the "delete distance to go" HLI signal is triggered at different times in the NC blocks N50, N80 and N100.

```nc
%delisttogo.nc
N010 G90 G165 G162
N020 G00 X0 Y0 Z0 F1000
N030 G01 X10 Y10
N040 $FOR P1 = 1,4,1
N050 G01 Y110 (1st "delete distance to go" signal)
N060 G01 Z30
N070 G01 X50
N080 G01 Y60 (2nd "delete distance to go" signal)
N090 G01 X100
N100 G02 X150 Y10 J-50 (3rd "delete distance to go" signal)
N110 G01 Y10
N120 G00 X10 Y10
N130 $ENDFOR
N140 M30
```

Figure 17: Delete distance to go at different times
3.4.2 Delete multiple distances to go with rapid motion G00

Delete multiple distances to go with rapid traverse
Simulated HLI signal "delete distance to go" before end of the first "delete distance to go" is reached

```
%deldisttogo4
N010 X0 Y0 Z0
N020 X100 F1000
N025 G1 Z30
N029 G02 Y200 J100
N032 G00 Y220
N033 X111
N034 Y50
N035 X80
N040 X0 Y0
M30
```

Figure 18: Delete distance to go with rapid traverse G00
3.4.3 Delete single distance to go applied multiple times, G01 motion

Delete single distance to go applied multiple times with G01
Simulated HLI signal "delete distance to go" before end of the first "delete distance to go" is reached

%deldisttogo5
N010 X0 Y0 Z0
N020 X100 F1000
N025 G1 Z30
N029 G02 Y200 J100
N032 G01 Y220
N033 X111
N034 Y50
N035 X80
N040 X0 Y0
M30

Figure 19: Delete distance to go with linear motion G01
3.4.4 Delete distance to go with intermediate signal reset

Multiple signal reset, only the last short cut is executed.

```
%deldisttogo6
N010 X0 Y0 Z0
N020 X100 F1000
N025 G1 Z30
N029 G02 Y200 J100
N032 G01 Y220
N033 X111
N034 Y50
N035 X80
N040 X0 Y0
M30
```

Figure 20: Delete distance to go with signal reset
3.4.5 Delete distance to go with command within deleted contour

Intermediate NC commands within the deleted contour are executed before the short cut.

```
%deldisttogo8
N005 X0 Y0 Z0 F1000
N010 X100 ;interrupt and delete distance to go
N015 M48
N016 P1=1
N017 #TIME 10
N020 Y100
N030 X90 Y110
N040 M30
```
3.4.6 Delete distance to go with backward motion

Delete distance to go with backward motion
Delete distance to go in block N34 and short cut after block N35. Backward motion is not possible on the short cut. It is not possible to execute backward motion before block N35. The CNC stops with FEEDHOLD until the ‘backward motion’ command is reset. Warning P-ERR-50729 is output.

%deldisttogo9
N010 X0 Y0 Z0
N020 X100 F1000
N025 G1 Z30
N029 G02 Y200 J100
N032 G00 Y220
N033 X111
N034 Y50 ; interrupt and delete distance to go
N035 X80 ; target DIST2GO
N040 X0 Y0
N050 M30

Extract from diagnostic data:

Error 800123 00000002 DELDTG raised
800149 00000004 FBC-resume : N34 dist=764000, forward=1, simu=0, del_dist=1
800149 00000001 DELDTG stopped in N34: (1110000,1436000,300000)
800149 00000001 DELDTG short cut to N35: (800000,500000,300000)
800243 00000002 DELDTG cleared
800334 00000004 BACKWARD raised
800359 00000002 DELDTG fwd=0/bwd=1 impossible in block N35
811354 00000004 BACKWARD rollback
811465 00000001 DELDTG finished N35

Figure 21: Reset Delete distance to go signal
### 3.4.7 Delete distance to go for backward motion

Delete distance to go for backward motion. Switch to short cut in forward motion.

Warning output. P-ERR-50729

If “Delete distance to go” is set during backward motion and a reversal is made back to forward motion on the short cut, FEEDHOLD is set and the warning P-ERR-50729 is output.

The short cut must continue in backward direction to the end. It is not possible to switch the motion direction on the short cut.

In the example, motion in N34 is backward.

```plaintext
%deldisttogo10
N010 X0 Y0 Z0
N020 X100 F1000
N025 G1 Z30
N029 G02 Y200 J100
N032 G00 Y220
N033 X111
N034 Y50
N035 X80
N040 X0 Y0
N050 M30
```

![Diagram](image)

Figure 22: Repeated forward motion in case of a backward short cut
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