TF5xxx | TwinCAT 3 Motion Control

TC3 NC PTP 10 Axes implements Motion Control for point-to-point movements in software. The axes are represented by axis objects and provide a cyclic interface, e.g. for the PLC. This axis object is then linked to a corresponding physical axis. In this way, the most diverse axis types with the most diverse fieldbus interfaces can be connected abstractly with the axis objects, which always offer an identical configuration interface. The control of the axes can be configured in various conformations (position or velocity interface) and various controllers. The axes are configured in TwinCAT Engineering.

- up to 10 axes on a maximum of 255 axes included developable
- supports electrical and hydraulic servo drives, frequency converter drives, stepper motor drives, DC drives, switched drives (fast/slow axes), simulation axes and encoder axes
- supports various encoders such as incremental encoder, absolute encoder, digital interface to the drives such as EtherCAT, SERCOS, SSI, Lightbus, PROFINET DP/MC, pulse train
- standard axis functions such as start/stop/reset/reference, velocity override, master/slave couplings, electronic gearbox, online distance compensation
- programming is carried out via PLCopen-compliant IEC 61131-3 function blocks
- convenient axis commissioning options
- online monitoring of all axis state variables such as actual/setpoint values, releases, control values, online axis tuning
- forcing of axis variables
- configuration of all axis parameters, such as measuring system, drive parameters and position controller
- configurable controller structures: P control, PID control, PID with velocity pre-control, PID with velocity and acceleration pre-control
- online master/slave and slave/master conversion
- flying saw (diagonal saw)
- cam plates (support by TC3 Cam Design Editor [optional])
- FIFO axes (optional)
- external set point value generators
- multi-master coupling

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Required
TC1200 TC1200 TC1200
Target system
Windows XP, Windows 7/8, Windows CE
Windows XP, Windows 7/8, Windows CE
Windows XP, Windows 7/8, Windows CE
Further information

We reserve the right to make technical changes.
## TwinCAT 3 Function | Motion Control

### TF5xxx | TwinCAT 3 Motion Control

<table>
<thead>
<tr>
<th>TC3 NC Camming</th>
<th>TC3 NC Flying Saw</th>
</tr>
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</table>

#### Technical data

<table>
<thead>
<tr>
<th>TF5050-00pp</th>
<th>TF5055-00pp</th>
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</table>

- TwinCAT NC Camming (cam plate) is a non-linear relationship between a master and a slave axis. The camming package offers various options for the storage of cam plates. Convenient PLC blocks enable the loading, coupling and uncoupling of cam plates. It is possible to load new cam plates or to modify cam plates during operation. The TwinCAT CAM Design Editor offers support for the creation of the cam plates.
  - position tables with master interpolation points and corresponding slave positions; interpolation between the points is done linearly or by splines
  - motion function table describing a cam plate via motion laws according to VDI guideline 2143
  - cyclic or linear processing
  - cam plate with offset and scale, can be modified on the master or slave side
  - high flexibility through online change of the motion functions

- TwinCAT NC Flying Saw implements the coupling of a slave axis to a master axis in a certain synchronous position (flying saw). PLC function blocks enable coupling and uncoupling as well as parameterisation.
  - The master axis can be a real axis, a virtual axis, or some other external source of actual values.
  - synchronisation of the slave axis from any motion situation (stop, forward or reverse travel) with the master in motion
  - simple synchronisation with the master velocity
  - precise position synchronisation with the master axis (velocity and position)
  - synchronous velocity can be set via a coupling factor
  - optional return prevention as additional safety function
  - superimposed section compensation during the synchronous phase for dynamic position correction

#### Performance class (pp)

<table>
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<tr>
<th>Performance class</th>
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<td>Further information</td>
<td><a href="http://www.beckhoff.com/TF5050">www.beckhoff.com/TF5050</a></td>
<td><a href="http://www.beckhoff.com/TF5055">www.beckhoff.com/TF5055</a></td>
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</table>
Using TwinCAT NC FIFO Axes, externally generated set position values can be output to the axes in the form of a velocity pre-control. The set value generation is designed in such a way that both the set position and the set velocity are determined as the FIFO inputs are worked through in sequence. It is also possible, if necessary, to interpolate between two neighbouring FIFO inputs.

Using TwinCAT NC I, movements can be implemented with up to three interpolating and up to five auxiliary axes in the interpolation package. Various axis types with various fieldbus interfaces are supported. The movement is usually programmed in DIN 66025, but it can also alternatively be carried out via PLC function blocks.

- max. 3 path axes and up to 5 auxiliary axes per group
- 1 group per channel, max. 31 channels
- supports electric servo axes, stepper motor drives
- interpreter functions such as subroutine and jump technology, programmable loops, zero point shifts, tool corrections, M and H functions
- geometry functions: straight lines and circles in 3-D space, circles at all main levels, helices with base circles at all main levels, linear, circular and helical interpolation at the main levels and freely definable levels, Bezier splines, look-ahead function
- online reconfiguration of axes in groups, path override, slave coupling to path axes, auxiliary axes, axis error and sag compensation, measuring functions
- programming in DIN 66025
- access alternatively via function blocks according to IEC 61131-3
- operation of automatic mode, manual mode (jog/inch), single block mode, referencing, handwheel mode (movement/overlay)
- convenient debugging with online monitoring of current setpoint/actual position (position lag of all axes), NC program line currently being processed, NC program line currently being interpreted, channel status
Various robot types kinematics can be realised using TwinCAT Kinematic Transformation. The programming of the robot movements takes place in Cartesian coordinates using either DIN 66025 instructions or the PLCopen-compliant blocks from the PLC. An integrated dynamic pre-control ensures high precision of the movement even at high accelerations and speeds. Configuration takes place in TwinCAT Engineering.

- supports various parallel and also serial kinematics, e.g. for pick-and-place tasks
- supports the programming of interpolating movements in G-code (DIN 66025)
- alternatively, standard PTP and cam plate applications can be realised
- simple programming in the Cartesian coordinate system
- automatic calculation of the inverse kinematic for the relevant motor positions
- kinematics configured in TwinCAT 3 Engineering; in addition to the type (e.g. delta), the bar lengths and offsets must also be parameterised
- mass and mass inertia values can be specified for dynamic pre-control
- optimised for the Beckhoff Servo Drives from the AX5000 series
- basic package integrating the following kinematics: cartesian portals

Extension of the TwinCAT Kinematic Transformation L1 with additional kinematics:
- 2-D parallel kinematics
- shear kinematics
- crane and roll kinematics

Extension of the TwinCAT Kinematic Transformation L1/L2 with additional kinematics:
- 3-D Delta
- SCARA

<table>
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<tr>
<th>Technical data</th>
<th>TF5110-00pp</th>
<th>TF5111-00pp</th>
<th>TF5112-00pp</th>
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### TwinCAT Kinematic Transformation L4

**Extension of the TwinCAT Kinematic Transformation L1/L2/L3 with additional kinematics:**
- 5-D kinematics
- serial 6-axis kinematics
- Stewart platform

**TwinCAT CNC** offers the option to implement interpolation with up to 32 simultaneously interpolating axes. The number of axes and/or the number of channels can be adapted to the requirements of the application via the option packages. Various transformations can be supplemented via option packages. Programming takes place according DIN 66025. The axes and channels are configured in TwinCAT Engineering.

- 8 path axes/controlled spindles, max. 64 axes/controlled spindles (optional), max. 12 channels (optional)
- supports electric servo axes, stepper motor drives
- subroutine and jump technology, programmable loops, zero point shifts, tool corrections, M and H functions, mathematical functions, programming of parameters/variables, user macros, spindle and auxiliary functions, tool functions
- geometry functions linear, circular and helical interpolation at the main levels and freely definable levels, max. 32 interpolating path axes per channel (optional), look-ahead function
- axis functions, coupling and gantry axis function, override, axis error and sag compensation, measuring functions
- programming in DIN 66025 with high-level language extension
- access via function blocks from TwinCAT PLC according to IEC 61131-3
- operation with automatic mode, manual mode (jog/inch), single block mode, referencing, block advance, handwheel mode (movement/overlay)
- convenient debugging with online monitoring of all states

### TwinCAT CNC E

**TwinCAT CNC in the export version (E-version)** offers the option to implement an interpolation with up to four simultaneously interpolating axes. The number of axes and/or the number of channels can be adapted to the requirements of the application via the option packages. Various transformations can be supplemented via option packages. Programming takes place according DIN 66025. The axes and channels are configured in TwinCAT Engineering.

- maximum 8 path axes/controlled spindles, max. 64 axes/controlled spindles (optional), max. 12 channels
- maximum 4 interpolating path axes
- supports electric servo axes, stepper motor drives
- subroutine and jump technology, programmable loops, zero point shifts, tool corrections, M and H functions, mathematical functions, programming of parameters/variables, user macros, spindle and auxiliary functions, tool functions
- geometry functions linear, circular and helical interpolation at the main levels and freely definable levels, max. 64 path axes per channel, look-ahead function
- axis functions, coupling and gantry axis function, override, axis error and sag compensation, measuring functions
- programming in DIN 66025 with high-level language extension
- access via function blocks from TwinCAT PLC according to IEC 61131-3
- operation with automatic mode, manual mode (jog/inch), single block mode, referencing, block advance, handwheel mode (movement/overlay)
- convenient debugging with online monitoring of all states

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<th>TC3 Kinematic Transformation L4</th>
<th>TC3 CNC</th>
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**Windows XP, Windows 7/8, Windows CE**

- Windows XP, Windows 7/8
- www.beckhoff.com/TF5113

**TC3660**

- Windows XP, Windows 7/8
- www.beckhoff.com/TF5200

**TC1260**

- Windows XP, Windows 7/8
- www.beckhoff.com/TF5210

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We reserve the right to make technical changes.
Using the TwinCAT CNC Axes Pack, extension is possible up to a total of 64 axes/controlled spindles, of which a maximum of 32 can be path axes and a maximum of 12 can be controlled spindles.

Using TwinCAT CNC Channel Pack, a further CNC channel can be extended to a maximum of 12 channels.

TwinCAT CNC Transformation is an optional function for the TwinCAT CNC.

- transformation functionality
- kinematics selection from the kinematics library
- RTCP function
- TLC function
- definition of different coordinate systems, linking/transition of coordinate systems

<table>
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<th>TC3 CNC Channel Pack</th>
<th>TC3 CNC Transformation</th>
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TwinCAT CNC HSC Pack is an optional high-speed cutting solution for the TwinCAT CNC:
- cross-block velocity and acceleration control for optimum utilisation of the axis dynamics and thus higher path speeds
- high surface quality through smoothed dynamics and associated reduction of vibrational excitation of the machine
- effective control of specified contour tolerances
- path programming via splines with programmable spline type (Akima-spline, B-spline) for reduction of NC blocks for free-form surfaces

TwinCAT CNC Spline Interpolation is an optional package for the TwinCAT CNC for path programming via splines with programmable spline type, Akima-spline, B-spline.

TwinCAT CNC Virtual NCK Basis is a virtual TwinCAT CNC for simulation in a Windows environment as an option for the TwinCAT CNC.

TwinCAT CNC Virtual NCK Options is a virtual TwinCAT CNC for simulation in a Windows environment as a further option package for the TwinCAT CNC and TwinCAT CNC Virtual NCK Basis.

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<th>TC3 CNC Virtual NCK Basis</th>
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TC1270
Windows XP, Windows 7/8
www.beckhoff.com/TF5250

TC1270
Windows XP, Windows 7/8
www.beckhoff.com/TF5260

TC1000
Windows XP, Windows 7/8
www.beckhoff.com/TF5270

TFS270
Windows XP, Windows 7/8
www.beckhoff.com/TF5271