Manual

TF5110 - TF5113 TC3 KinematicTransformation

TwinCAT 3

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BECKHOFF

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1 Foreword

1.1 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.

Disclaimer

The documentation has been prepared with care. The products described are, however, constantly under development.
We reserve the right to revise and change the documentation at any time and without prior announcement.
No claims for the modification of products that have already been supplied may be made on the basis of the data, diagrams and descriptions in this documentation.

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1.2 Safety instructions

Safety regulations

Please note the following safety instructions and explanations!
Product-specific safety instructions can be found on following pages or in the areas mounting, wiring, commissioning etc.

Exclusion of liability

All the components are supplied in particular hardware and software configurations appropriate for the application. Modifications to hardware or software configurations other than those described in the documentation are not permitted, and nullify the liability of Beckhoff Automation GmbH & Co. KG.

Personnel qualification

This description is only intended for trained specialists in control, automation and drive engineering who are familiar with the applicable national standards.

Description of symbols

In this documentation the following symbols are used with an accompanying safety instruction or note. The safety instructions must be read carefully and followed without fail!

⚠ DANGER

Serious risk of injury!

Failure to follow the safety instructions associated with this symbol directly endangers the life and health of persons.

⚠ WARNING

Risk of injury!

Failure to follow the safety instructions associated with this symbol endangers the life and health of persons.

⚠ CAUTION

Personal injuries!

Failure to follow the safety instructions associated with this symbol can lead to injuries to persons.

NOTE

Damage to the environment or devices

Failure to follow the instructions associated with this symbol can lead to damage to the environment or equipment.

Tip or pointer

This symbol indicates information that contributes to better understanding.

2 Introduction

The TF5110 - TF5113 TwinCAT Kinematic Transformations software package is installed together with the TF5400 software package.

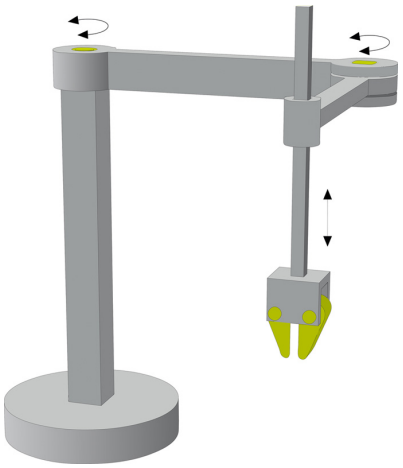
TwinCAT Kinematic Transformations

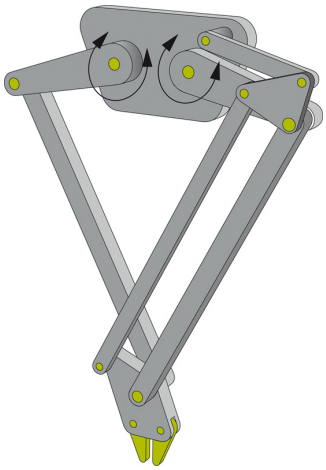
The TF5110 - TF5113 TwinCAT Kinematic Transformations is a software solution that combines robot control and conventional PLC in one system. The implementation of the entire control in one system eliminates interface losses between different CPUs for PLC, motion control and robot control. In practice, this implementation leads to a reduction of engineering costs and to reduced cycle times in the production process. In addition to the elimination of interfaces and components, the merging of PLC, robotics and motion control into one application makes the system homogeneous. Therefore, for the user there is no apparent difference in the treatment of the individual functions. Conveniently, a part on a conveyor belt operated with standard motion control can be taken and set aside by the robot quickly and handily.

Since the working area of the robot is determined by the configuration and the number of axes, it depends on a number of parameters: arm lengths, angular range, center of gravity, maximum load, etc. The configuration of the arms and joints determines the kinematic structure, which is divided in two main classes: serial kinematics and parallel kinematics.

Serial kinematics

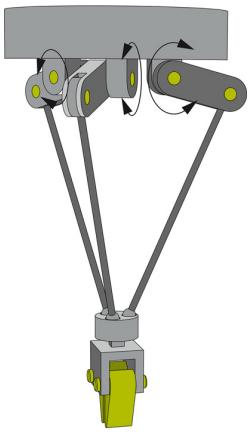
The current position of any axis always depends on the position of the preceding axis, i.e. all axes are arranged sequentially. Examples: SCARA and crane kinematics

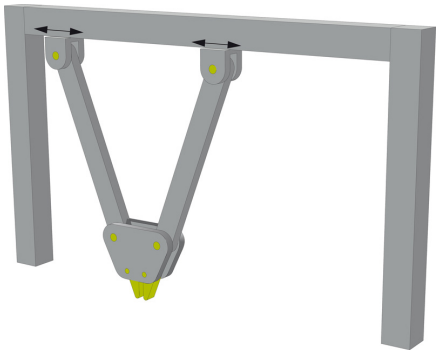




Parallel kinematics

All axes directly engage with the working platform via the kinematics. Examples: delta kinematics, shear kinematics

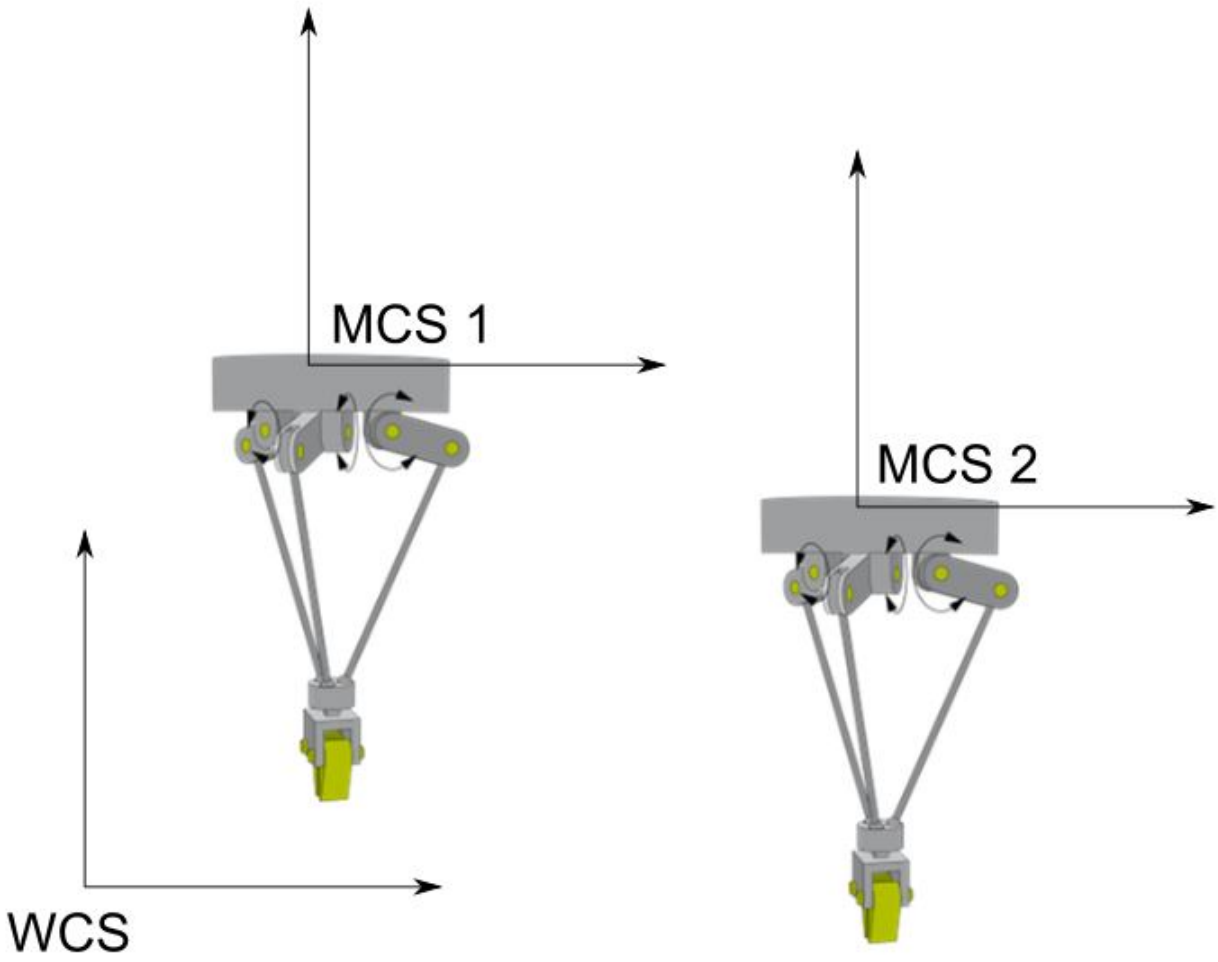




Coordinate systems

Coordinate systems are required in order to describe the positional behavior of a system. Different coordinate systems can be used as a basis for programming:

- The machine coordinate system (MCS) is a robot-based Cartesian coordinate system, which usually has its origin in the robot base.
- The world coordinate system (WCS) is a Cartesian coordinate system, which describes the whole modelled 'world'. It therefore does not refer to a specific robot, but to the whole system. The origin of a robot-based machine coordinate system (MCS) is at a particular point of the WCS. In other words, the user can specify, at which point of his “world” an industrial robot is located and how it is oriented. A WCS can contain several robots. When using a robot, world coordinates can coincide with the machine coordinates to improve transparency.
- The user can position the user coordinate system (UCS) at any position and with any orientation within the world coordinate system.
- The axis coordinate system (ACS) describes the position of the physical axes. It is generally not a Cartesian coordinate system. Many robot joint axes perform rotary movements. Using the ACS makes it easier to take into account the limit values for angle, velocity and acceleration. If a robot axis performs rotary movements, it is often difficult for the user to predict and control the path. The axis coordinate system is usually used for referencing/homing.



Kinematic transformation

In many cases, robots are programmed in the MCS. Due to the way humans think, movements are usually programmed in Cartesian coordinate systems. To execute such movements, it is therefore necessary to convert between the axis coordinate system and the Cartesian space.

Transformation describes, in the context of the kinematics, the calculation necessary in order to change from one coordinate system to another. There are basically two problems in considering the kinematics of robots.

- The conversion from the axis coordinate system (ACS) to a Cartesian coordinate system is referred to as forward transformation. The Cartesian position of the tool center point (TCP) is calculated from the axis-specific joint coordinates of the robot.
- The conversion from Cartesian coordinates of the TCP to axis coordinates, which is required in order to move the actual robot axes, is referred to as backward transformation.

Realization in TwinCAT

TwinCAT Kinematic Transformation can be used to realize robotics applications. All PLC and NC features can be combined on a common hardware and software platform. TwinCAT Kinematic Transformation realizes several robot kinematics (e.g. H-Bot, delta robot, 6-axis robot) on the PC. The axes are controlled directly from the TwinCAT motion control system.

The user can program robot movements directly in the Cartesian coordinate system. The software calculates the transformation to the axis coordinate system of the robot in each cycle. To minimize vibrations and to increase the positioning accuracy, for many kinematics a current pre-control can be activated, if the drive amplifier and the fieldbus are fast enough and interfaces for an additional current pre-control are available. EtherCAT and the Beckhoff servo drives of type AX5000 meet these requirements.

The TwinCAT function seamlessly integrates in the motion control world of Beckhoff. TwinCAT NC I enables programming both via G-Code (DIN 66025) and directly from the PLC (PlcInterpolation library). The functions TF5055 TC3 MC Flying Saw and TF5050 TC3 MC Camming enable synchronization with conveyor belts for picking and placing of workpieces, for example. In addition, standard PTP functions from the familiar Beckhoff PTP motion libraries can be used.

The configuration of the robot takes place entirely in the TwinCAT 3 Engineering environment (XAE).

3 TF511x TC3 Kinematic Transformations - Overview New Features

TF511x TC3 Kinematic Transformations

Since V3.1.6.3:

- The TF511x TC3 Kinematic Transformations become a part of the TF5400 installation package.

4 Installation

By adding a kinematic channel, the TF5110 - TF5113 | TwinCAT Kinematic Transformation becomes part of the TwinCAT 3 Motion range.

Note Take care to install the Kinematic package as well on the engineering system as on the target system.

Installation Requirements

The function TF5110 - TF5113 | TwinCAT Kinematic Transformation requires TwinCAT 3.

Target System
Windows XP or Windows 7/8/10.

Installation Level

The TF5110 - TF5113 | TwinCAT Kinematic Transformation is subdivided into four different levels, depending on the number of transformation axes. A higher level includes all sublevels.

Level 1: Supports the static transformation. This includes a translation and rotation of the coordinate system.

Level 2: Supports Level 1 and simple (mainly 2D) kinematic transformations such as H-Bot and 2D parallel kinematics.

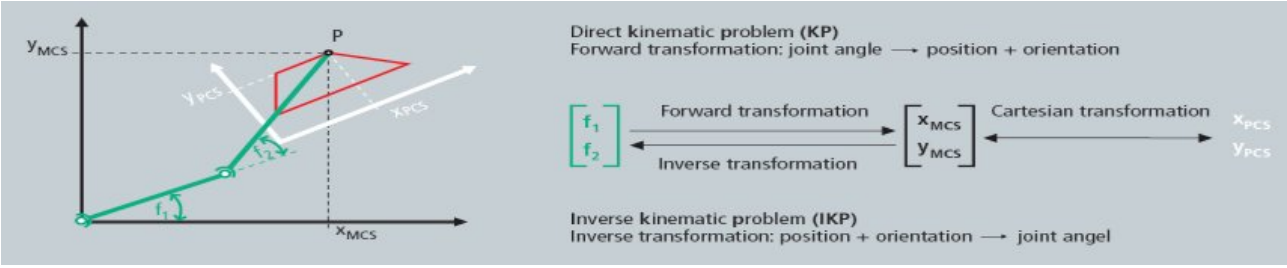
Level 3: Supports Level 2 and more complex (3D, 4D) kinematic transformations such as delta robots.

Level 4: Supports Level 3 and complex kinematic transformations (up to 6D).

5 Configuration

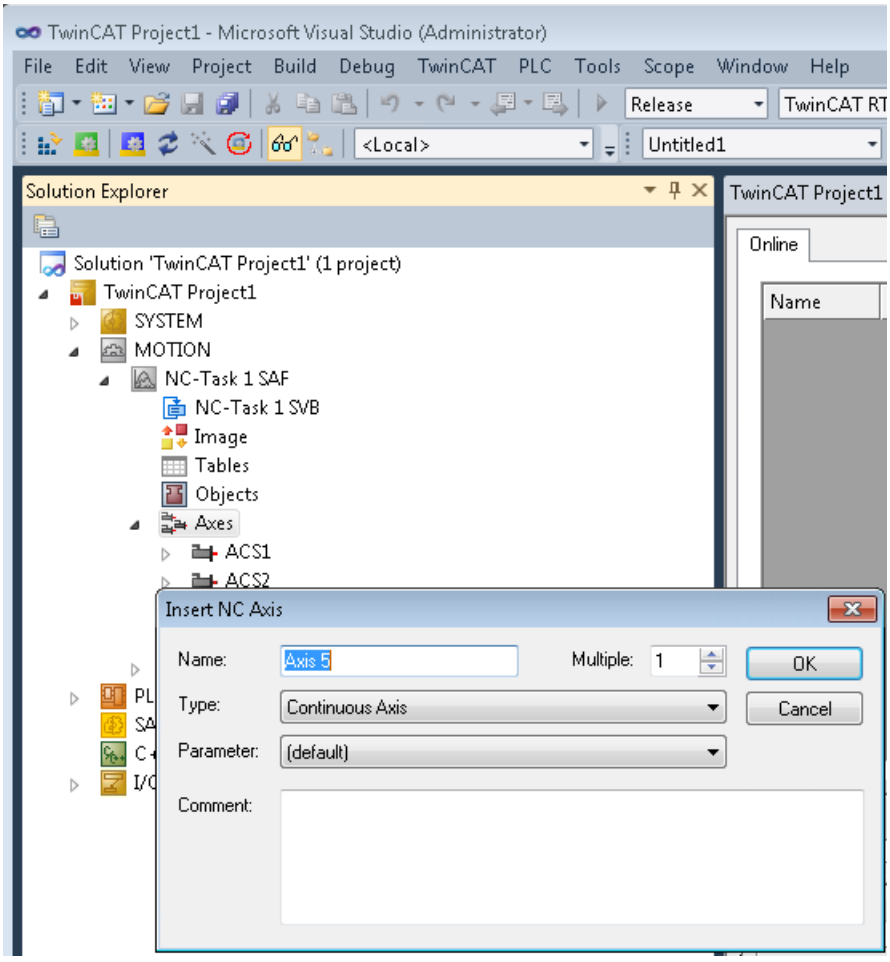
Based on PLCopen, we distinguish between two main (Introduction [▶ 8]):

- Axis coordinate system (ACS)
- Machine coordinate system (MCS)

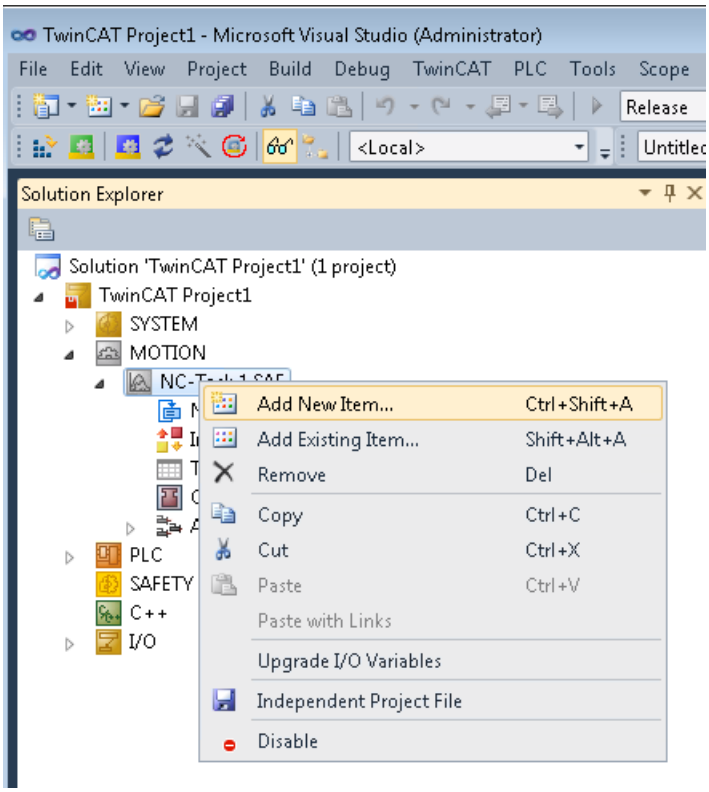


Configuring the kinematic transformation channel

1. Add all axes (ACS and MCS) to the NC configuration in the XAE, just like PTP axes. The axes of the ACS are hardware axes and are linked with drives. The axes of the MCS are pure software axes of the simulation encoder type. All ACS and MCS axes that are used in a kinematic transformation channel must be created in the XAE. A delta robot [▶ 26], for example, has three ACS axes (M1...M3) and three MCS axes (X, Y, Z).
2. Right-click on “Axes” and select “Add new item”.
3. Then create the axes in the “Insert NC Axis” window, according to the kinematics.

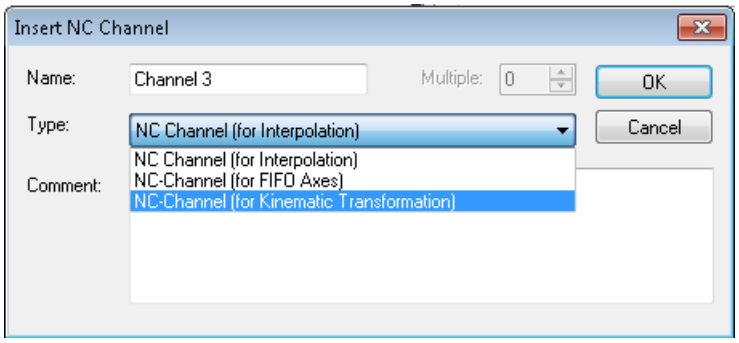


4. Add a kinematic channel to the XAE configuration.

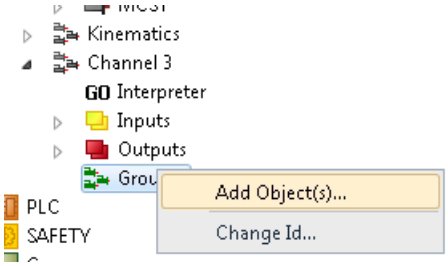


⇨ The addition of a channel creates an instance of a kinematic group.

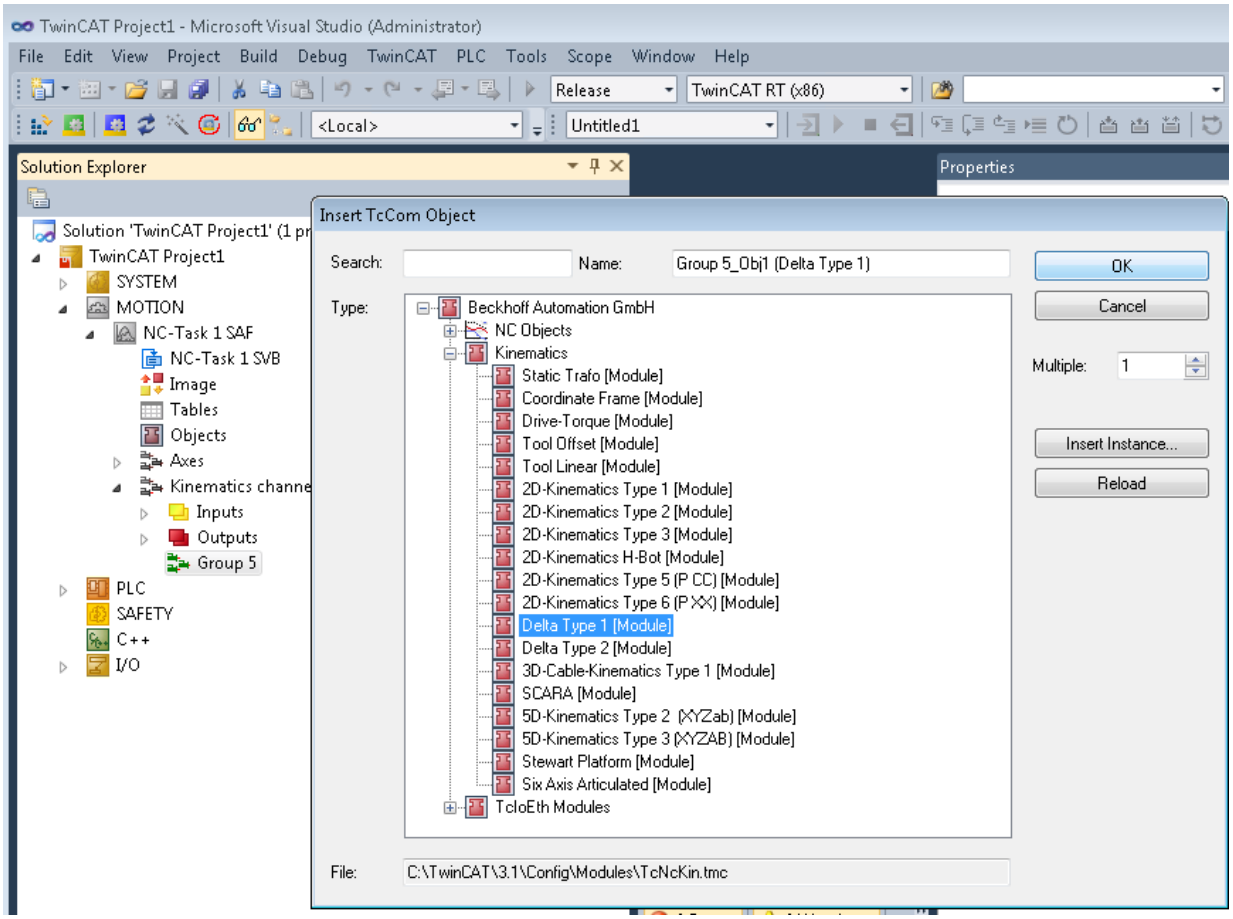
5. Select the channel type: **NC channel (for kinematic transformation)** for performing a kinematic transformation.



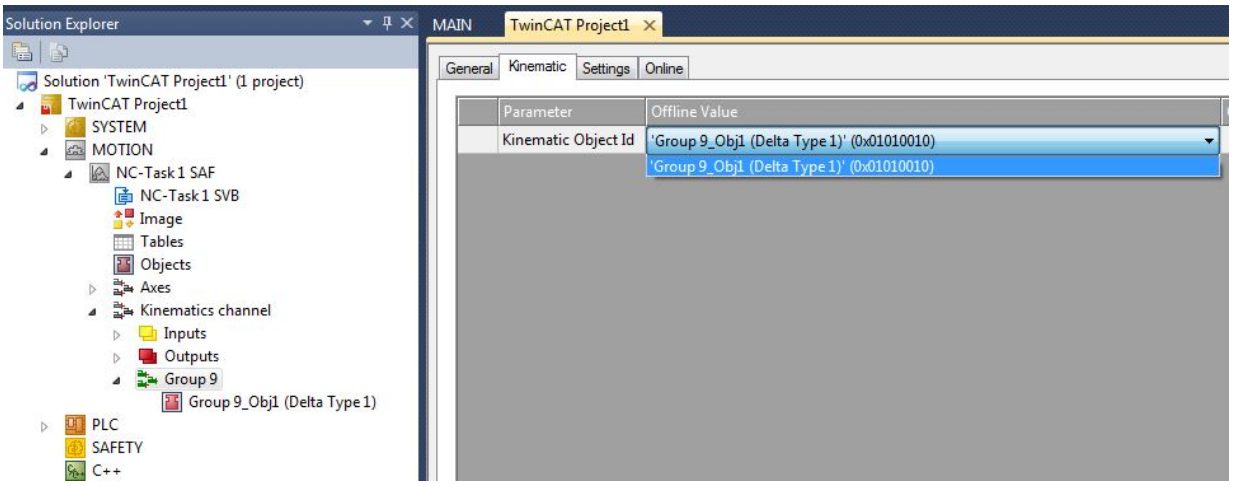
6. Add the objects under the group representing the kinematic configuration of the user.



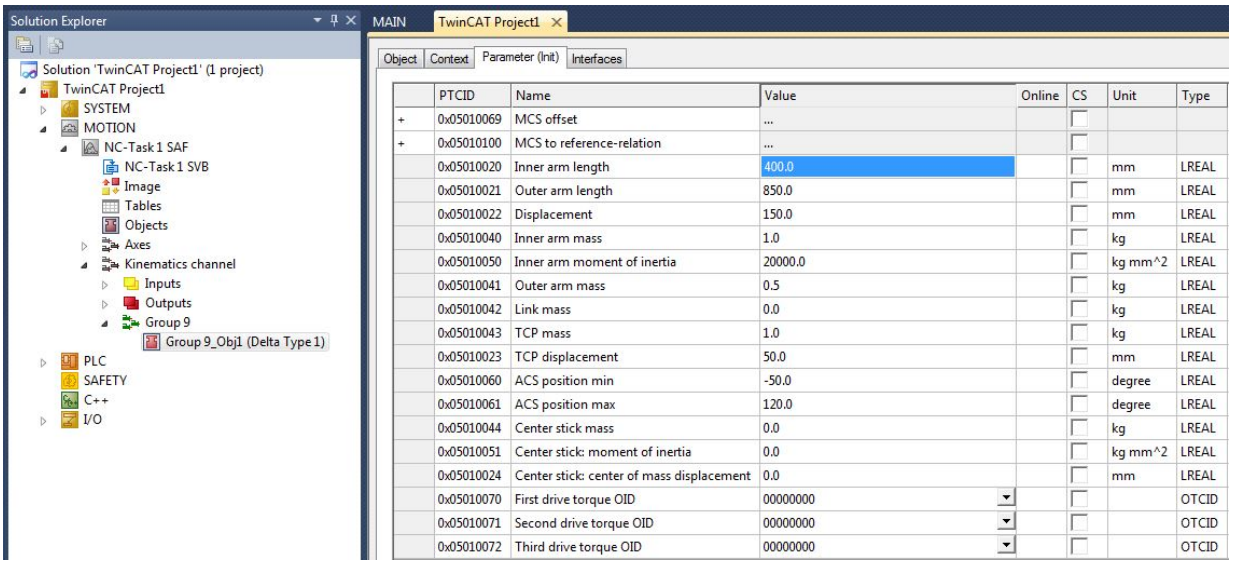
7. To start the transformation for a delta robot, select
   - Delta Type 1
   In addition, optional tools [▶ 31] and coordinate systems [▶ 34] (UCS) can be created.



8. The transformation group must know which root module is to be called. This is why the object ID of the kinematics (in this case Delta Type 1) must be selected. The kinematic object defines the number of ACS and MCS axes to be used in the PLC (see ST_KinAxes [▶ 55]).



9. Parameterize the object parameters according to the kinematics used.



	PTCID	Name	Value	Online	CS	Unit	Type
+	0x05010069	MCS offset	...				
+	0x05010100	MCS to reference-relation	...				
	0x05010020	Inner arm length	400.0			mm	LREAL
	0x05010021	Outer arm length	850.0			mm	LREAL
	0x05010022	Displacement	150.0			mm	LREAL
	0x05010040	Inner arm mass	1.0			kg	LREAL
	0x05010050	Inner arm moment of inertia	20000.0			kg mm^2	LREAL
	0x05010041	Outer arm mass	0.5			kg	LREAL
	0x05010042	Link mass	0.0			kg	LREAL
	0x05010043	TCP mass	1.0			kg	LREAL
	0x05010023	TCP displacement	50.0			mm	LREAL
	0x05010060	ACS position min	-50.0			degree	LREAL
	0x05010061	ACS position max	120.0			degree	LREAL
	0x05010044	Center stick mass	0.0			kg	LREAL
	0x05010051	Center stick: moment of inertia	0.0			kg mm^2	LREAL
	0x05010024	Center stick: center of mass displacement	0.0			mm	LREAL
	0x05010070	First drive torque OID	00000000				OTCID
	0x05010071	Second drive torque OID	00000000				OTCID
	0x05010072	Third drive torque OID	00000000				OTCID

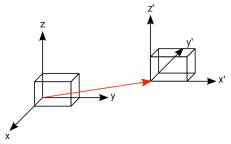
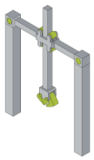
⇨ Once this is done, the XAE configuration is complete.

10. The transformation can now be activated via the PLC (see Plc Library [▶ 45]). To actuate the transformation, define a cyclic channel interface in the PLC and link it with the I/O of the kinematic channel.

```
in_stKinToPlc       AT %I*      : NCTOPLC_NCICHANNEL_REF;
out_stPlcToKin      AT %Q*      : PLCTONC_NCICHANNEL_REF;
```

6 Supported Transformations

Overview

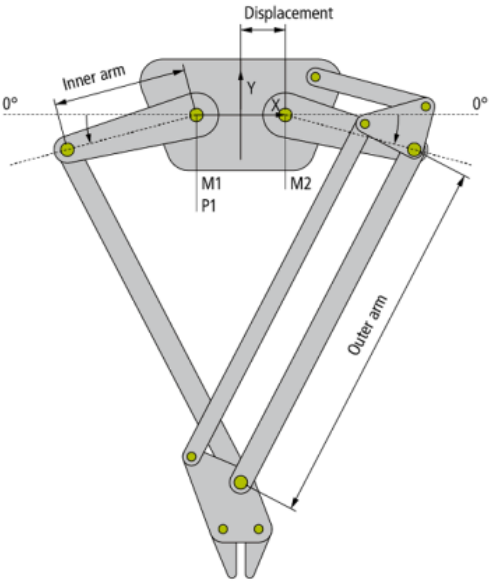
Transformation type	Scheme	Required level and version
Static Trafo		Level 1
2D-Type 1		Level 2
2D-Type 2		Level 2
2D-Type 3		Level 2
H-Bot		Level 2
2D-Type 5 (P CC)		Level 2
2D-Type 6 (P XX)		Level 2
Delta Type 1		Level 3
Delta Type 2		Level 3
3D-Cable-Kinematics Type 1		Level 3
3D-Type 4 (PCC SC)		Level 3
SCARA		Level 3
5D kinematics type 2 (XYZab)		Level 4
5D kinematics type 3 (XYZAB)		Level 4
Stewart platform		Level 4
Six Axis Articulated		Level 4

Additional objects

The following objects can be created and selected in the corresponding kinematics. A dropdown parameter list in the kinematics is used for the selection. Select the corresponding object ID (OTCID).

object type	Description	Required level and version
Tool Offset	Tool offset - describes a tool at the level of the kinematics flange.	Level 1
Tool Linear	Linear tool - describes a 1D tool mounted on the kinematics flange, which offers the option to move the TCP towards the tool.	Level 1
Drive Torque	Drive torque - represents the inertia and the efficiency of the motor and drive, to enable more precise calculation of the dynamic model.	Level 1
Coordinate Frame	Coordinate system - describes a user-defined coordinate system.	Level 1

6.1 2-D-Kinematics Type 1



The 2D kinematics type 1 is configured as shown in the diagram above.

All motor axes are scaled in degrees; 0° is defined as shown in the diagram. The arrow indicates the positive direction.

Kinematics parameters

Parameter	Description	Unit
Inner arm length	Length between pivots of the inner arm	mm
Outer arm length	Length between pivots of the outer arm	mm
Displacement	Length between the center of the base plate and the virtual rotation axes of the inner arm	mm

Parameters for the dynamic model

Parameter	Description	Unit
Inner arm mass	Total mass of the inner arm	kg

Parameter	Description	Unit
Inner arm moment of inertia	Moment of inertia of the inner arm in relation to pivot point P1, which is linked with the motor	kg mm^2
Outer arm mass	The mass of the external arms minus the mass of the joint can optionally be described as a separate parameter.	kg
First link mass	Mass of the joint linking the inner and outer arm; can be used if the mass of the joint is not already included in the outer and inner arms. The mass of the joint linking the gripper plate with the outer arm is not specified here. It can be added to TcpMass. The mass of the first joint refers to the inner arm that is linked to motor 1.	kg
Second link mass	See FirstLinkMass The mass of the second joint refers to the inner arm that is linked to motor 2.	kg
TCP mass	Mass of the tool center point, including gripper plate and gripper. The payload is usually described with a separate parameter.	kg
First drive torque OID	Object ID of the first drive torque (see here [▶ 30]) If the motors and gear units of all motors behave in a similar way, all drive torques can be represented via an OID. Both parameters therefore refer to the same object ID.	
Second drive torque OID	Object ID of the second drive torque	

General kinematics parameters

General parameters, which apply to any kinematics, are described under General kinematics parameters [▶ 19].

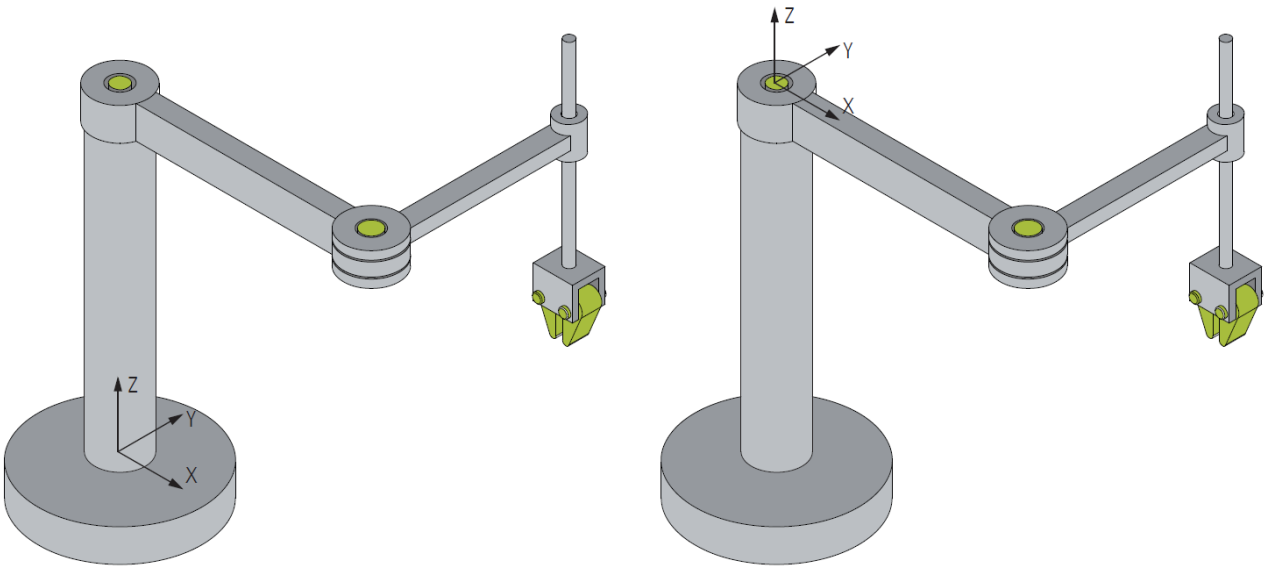
- MCS offset [▶ 19]
- MCS to reference-relation [▶ 20]
- Tool offset OID [▶ 21]

Required product level:
Level 2

6.2 General kinematics parameters

MCS offset

The MCS offset can be used to parameterize additional offset parameters before the first axis (or the basis) of the kinematics. For example, in the Scara kinematics the origin of the MCS is in the first joint (M1). The parameter z-shift of MCS offset can be used to parameterize the additional bar length, so that the origin of the MCS is at the robot base.



Parameter	Description	Unit
x-shift	Static offset in the MCS	mm
y-shift	Static offset in the MCS	mm
z-shift	Static offset in the MCS	mm

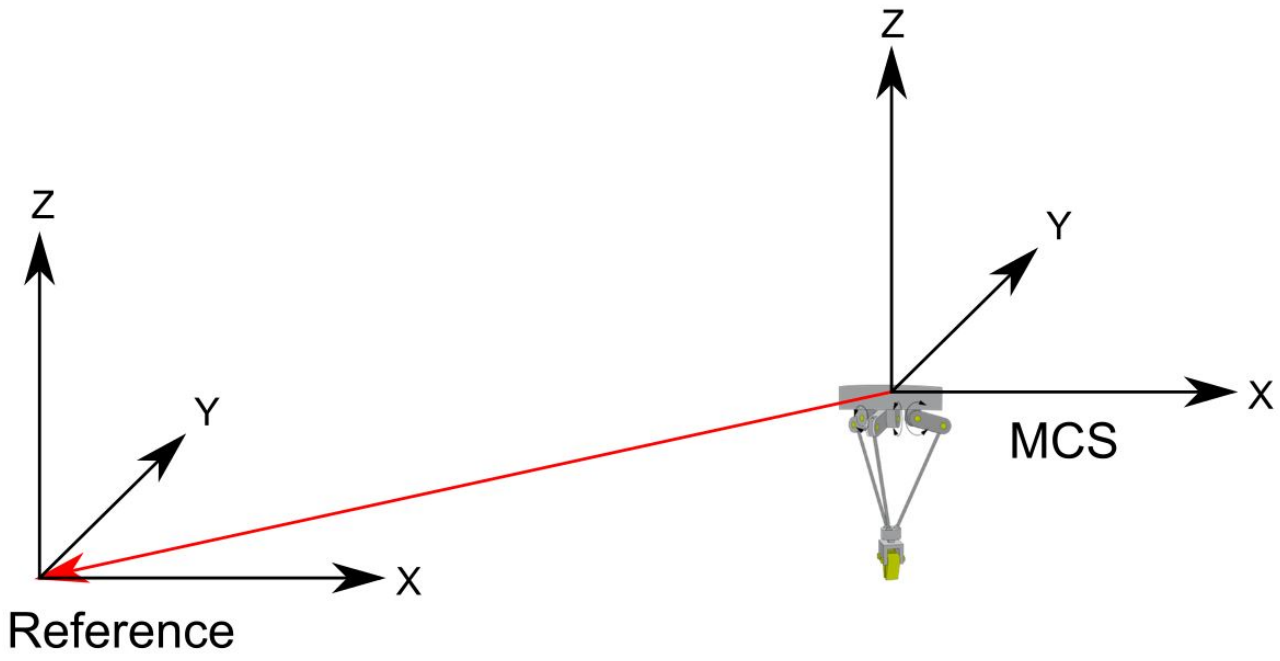
MCS to reference relation

The parameter MCS to reference relation can be used to move the MCS in a reference coordinate system. All coordinate systems are right-handed (anticlockwise).

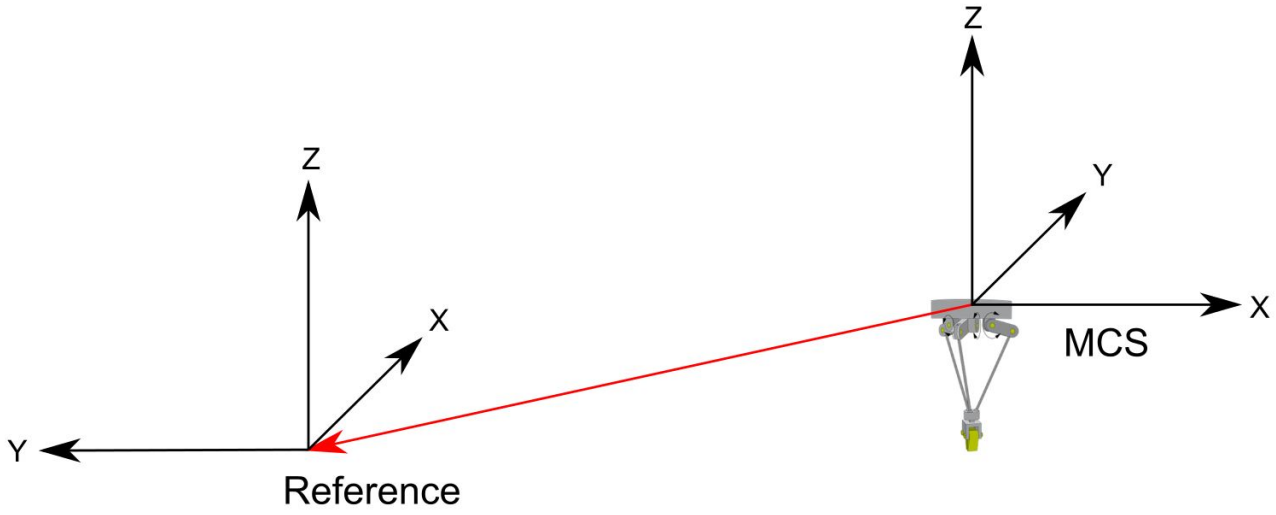
Parameter	Description	Unit
Translation X	Shift in x-direction	mm
Translation Y	Shift in y-direction	mm
Translation Z	Shift in z-direction	mm
Rotation 1	First rotation angle. The interpretation is defined by the parameter Rotation Convention.	°
Rotation 2	Second rotation angle. The interpretation is defined by the parameter Rotation Convention.	°
Rotation 3	Third rotation angle. The interpretation is defined by the parameter Rotation Convention.	°
Rotation convention	The rotation convention indicates the order of the axis rotations (parameter Rotation 1-3). The letters (X, Y, Z) from left to right indicate the order of the rotation around the corresponding axes. The number indicates the parameter (Rotation 1-3) for the value parameterization. The translatory shift is always performed before the rotation.	
Reference frame	The parameter Reference frame indicates which coordinate system is used as basis for the MCS. If the value is set to 0, the WCS is used as basis. To use another coordinate system as starting point for the shift, a Coordinate Frame [▶ 34] object can be created. The object ID of this coordinate system can be selected via the dropdown menu.	
Definition direction	Indicates the direction in which the shift is programmed (from the perspective of the reference system or the MCS). The translation is always performed first, followed by the rotation. See example below.	

Example Definition direction:

If the Definition direction MCS -> Reference is used, the shift between the original coordinate system (MCS) and the target coordinate system (reference) is specified with negative vectors.



If a positive rotation around the z-axis (here 90°) is specified in addition to the translation, the translation is performed first, followed by the rotation of target coordinate system (here +90° around the z-axis).

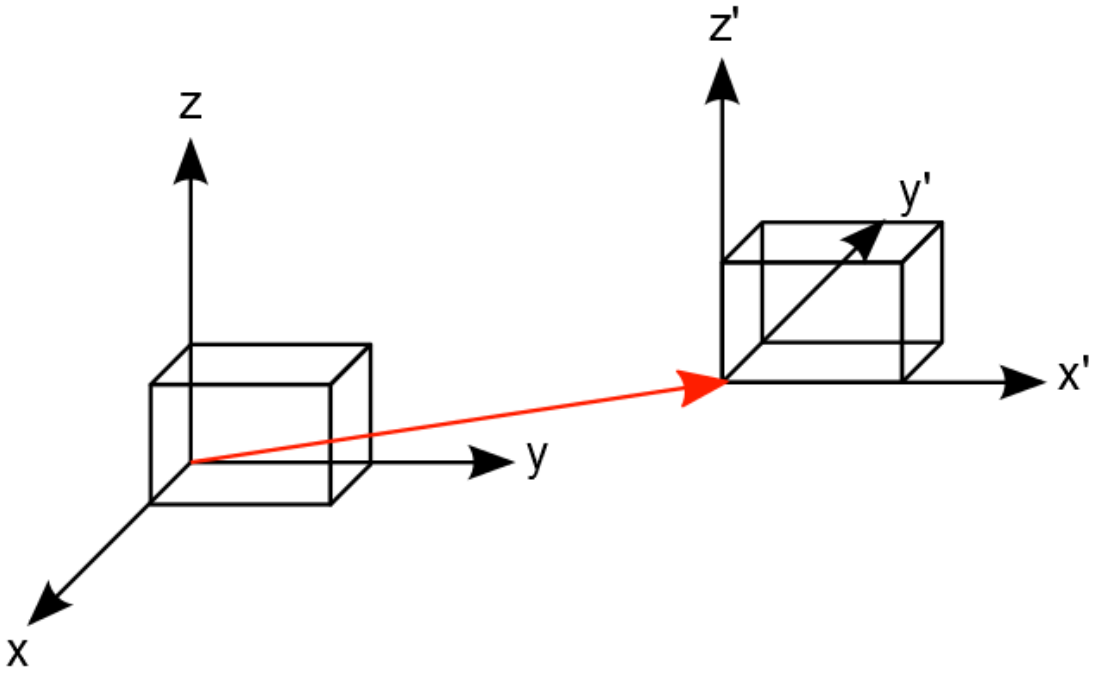


Tool offset OID

Parameter	Description	Unit
Tool offset OID	To define a tool for the kinematics, a Tool Offset [▶ 31] or Tool Linear [▶ 33] object has to be created first. The object ID of this tool can be selected via the dropdown menu.	

6.3 Static Transformation

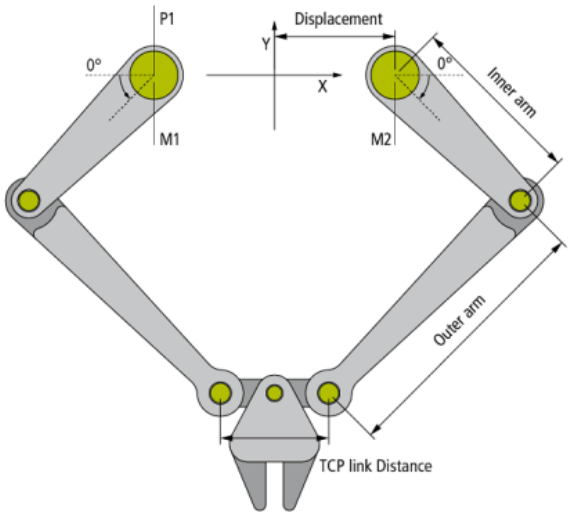
The static transformation enables creation of a Cartesian gantry. It supports translation and rotation between two Cartesian coordinate systems. The difference between a static transformation and a Coordinate system (Coordinate Frame) [▶ 34] is that it determines the number of ACS and MCS axes of the kinematic channel (parameter IO axes).



First the translation is calculated, then the rotation. The order of the rotations affects the orientation of the coordinate system. The roll/pitch/yaw rule described in DIN 9300 is used as default for the rotation sequence. The calculation sequence for the forward transformation is Z, Y', X''.

Parameter	Description	Unit
Translation X	Shift in x-direction	mm
Translation Y	Shift in y-direction	mm
Translation Z	Shift in z-direction	mm
Rotation 1	Second rotation angle. The interpretation is defined by the parameter Rotation Convention.	°
Rotation 2	Second rotation angle. The interpretation is defined by the parameter Rotation Convention.	°
Rotation 3	Third rotation angle. The interpretation is defined by the parameter Rotation Convention.	°
Rotation convention	The rotation convention indicates the order of the axis rotations (parameter Rotation 1-3). The letters (X, Y, Z) from left to right indicate the order of the rotation around the corresponding axes. The number indicates the parameter (Rotation 1-3) for the value parameterization. The translatory shift is always performed before the rotation.	
Reference frame	The parameter Reference frame indicates which coordinate system is used as basis for this coordinate system. If the value is set to 0, the WCS is used as basis. To use another coordinate system as starting point for the shift, a further Coordinate system (Coordinate Frame) [▶ 34] object can be created. The object ID of this coordinate system can be selected via the dropdown menu.	
Definition direction	Indicates the direction in which the shift is programmed (from the perspective of the reference system or this coordinate system).	
IO axes	Determines the number of axes of the Cartesian gantry.	

6.4 2-D-Kinematics Type 2



The 2D kinematics type 2 is configured as shown in the diagram above.

All motor axes are scaled in degrees; 0° is defined as shown in the diagram. The arrow indicates the positive direction.

Kinematics parameters

Parameter	Description	Unit
Inner arm length	Length between pivots of the inner arm	mm
Outer arm length	Length between pivots of the outer arm	mm
Displacement	Length between the center of the base plate and the virtual rotation axes of the inner arm	mm
TCP link distance	Distance between pivots of the outer arm	mm

Parameters for the dynamic model

Parameter	Description	Unit
Inner arm mass	Total mass of the inner arm	kg
Inner arm moment of inertia	Moment of inertia of the inner arm in relation to pivot point P1, which is linked with the motor.	kg mm^2
Outer arm mass	The mass of the external arms minus the mass of the joint can optionally be described as a separate parameter.	kg
First link mass	Mass of the joint linking the inner and outer arm. Can be used if the mass of the joint is not already included in the outer and inner arms. The mass of the joint linking the gripper plate with the outer arm is not specified here. It can be added to the TCP mass. The mass of the first joint refers to the inner arm that is linked to motor 1.	kg
Second link mass	see First link mass The mass of the second joint refers to the inner arm that is linked to motor 2.	kg
TCP mass	Mass of the TCP, including gripper plate and gripper. The payload is usually described with a separate parameter.	kg
First drive torque OID	Object ID of the first drive torque (see here [▶ 30]) If the motors and gear units of all motors behave in a similar way, all drive torques can be represented via an OID. Both parameters therefore refer to the same object ID.	

Parameter	Description	Unit
Second drive torque OID	Object ID of the second drive torque	

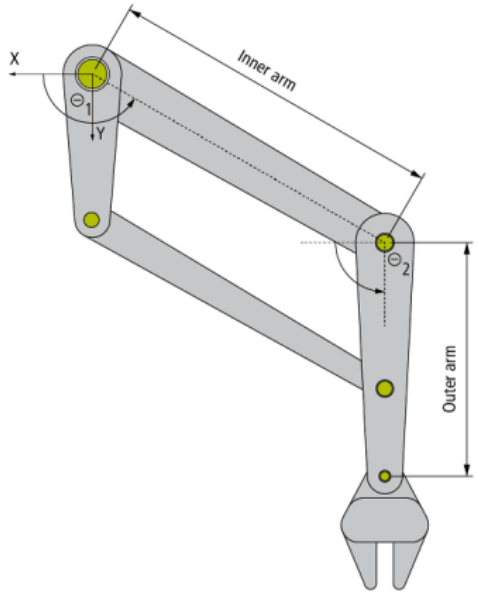
General kinematics parameters

General parameters, which apply to any kinematics, are described under General kinematics parameters [▶ 19].

- MCS offset [▶ 19]
- MCS to reference-relation [▶ 20]
- Tool offset OID [▶ 21]

Required product level:
Level 2

6.5 2-D-Kinematics Type 3



The 2D kinematics type 3 is configured as shown in the diagram above.

All motor axes are scaled in degrees; 0° is defined as shown in the diagram. The arrow indicates the positive direction.

This kinematics type is implemented as a left-handed system. The shafts of motor 1 and 2 are located at the origin of the coordinate system.

Kinematics parameters

Parameter	Description	Unit
Inner arm length	Length between the motor shaft and the pivot point of the external arm	mm
Outer arm length	Length between the pivot point and the tool center point of the outer arm	mm
Theta1 min	Minimum permitted angle of the first motor axis.	°
Theta2 min	Minimum permitted angle of the second motor axis	°

Parameters for the dynamic model

Parameter	Description	Unit
Inner arm mass	Total mass of the inner arm	kg

Parameter	Description	Unit
Outer arm mass	Mass of the outer arm.	kg
TCP mass	Mass of the TCP, including gripper plate and gripper. The payload is usually described with a separate parameter.	kg
First drive torque OID	Object ID of the first drive torque (see here [▶ 30]). If the motors and gear units of all motors behave in a similar way, all drive torques can be represented via an OID. Both parameters therefore refer to the same object ID.	
Second drive torque OID	Object ID of the second drive torque	

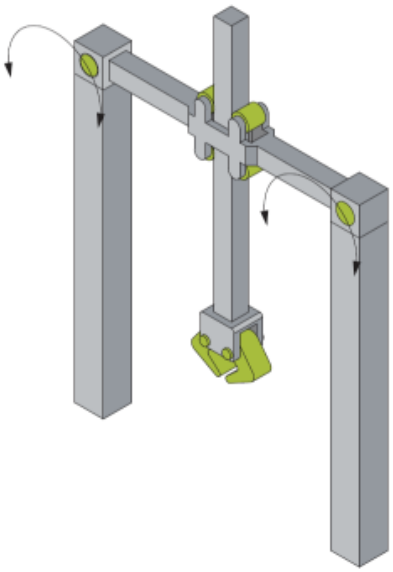
General kinematics parameters

General parameters, which apply to any kinematics, are described under General kinematics parameters [▶ 19].

- MCS offset [▶ 19]
- MCS to reference-relation [▶ 20]
- Tool offset OID [▶ 21]

Required product level:
Level 2

6.6 2D kinematics H-Bot



The H-Bot is configured as shown in the diagram above.

The motor axes must be scaled in mm, corresponding to the belt length at each side of the TCP. The relative belt lengths suffice for calculating the transformation. The absolute belt lengths are not required.

The point of origin of the machine coordinate system MCS is defined by the point for which the positions of the two motors are zero.

Parameters for the dynamic model

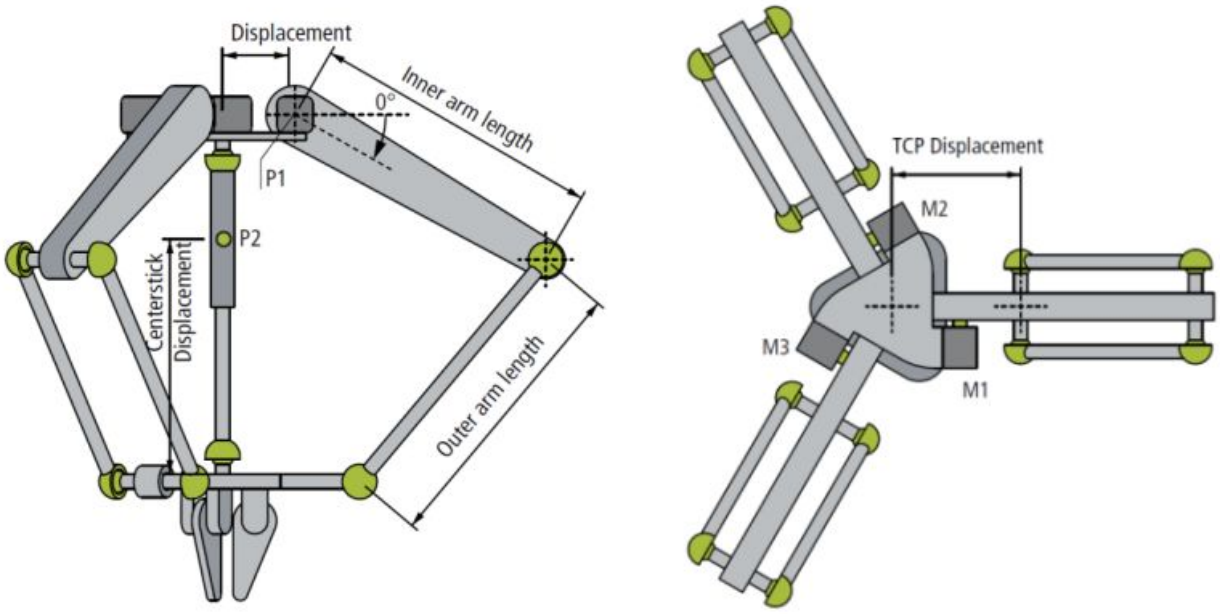
Parameter	Description	Unit
FirstDriveTorqueOID	Object ID of the first drive torque (see here [▶ 30]). If the motors and gear units of all motors behave in a similar way, all drive torques can be represented via an OID. Both parameters therefore refer to the same object ID.	
SecondDriveTorqueOID	Object ID of the second drive torque	

General kinematics parameters

General parameters, which apply to any kinematics, are described under General kinematics parameters [▶ 19].

- MCS offset [▶ 19]
- MCS to reference-relation [▶ 20]
- Tool offset OID [▶ 21]

6.7 Delta Type 1



The delta kinematics type 1 is configured as shown in the diagram above. The Kinematic Transformation expects ball joints (or elements with the same behavior) in the link between the arms and the lower plate.

Parameterization of the center stick for aligning the gripper is optional.

All motor axes are scaled in degrees; 0° is defined as shown in the diagram. The arrow indicates the positive direction. This applies for all three motors.

Kinematics parameters

Parameter	Description	Unit
Inner arm length	Length between the pivot points of the inner arm; this is the arm that is directly linked with the motor.	mm
Outer arm length	Length between pivots of the outer arm	mm
Displacement	Length between the center of the base plate and the virtual rotation axes of the inner arm	mm
TCP displacement	Length between the center of the gripper plate and the virtual rotation axes of the outer arm	mm

Parameter	Description	Unit
ACS position min	Minimum permitted angle for the ACS axes	°
ACS position max	Maximum permitted angle for the ACS axes	°

Parameters for the dynamic model

Parameter	Description	Unit
Inner arm mass	Total mass of the inner arm	kg
Inner arm moment of inertia	Moment of inertia of the inner arm in relation to pivot point P1, which is linked with the motor	kg mm^2
Outer arm mass	Mass of the outer arm. If two bars are used, the total mass is required. The mass of the joint can optionally be described as a separate parameter.	kg
Link mass	Mass of the joint linking the inner and outer arm. Can be used if the mass of the joint is not already included in the outer and inner arms. The mass of the joint linking the gripper plate with the outer arm is not specified here. It can be added to TcpMass.	kg
TCP mass	Mass of the TCP, including gripper plate and gripper. The payload is usually described with a separate parameter.	kg
Center stick mass	Total mass of the center stick	kg
Center stick: moment of inertia	Moment of inertia of the center stick in relation to the center of gravity (P2)	kg mm^2
Center stick: center of mass displacement	Length between the gripper plate and the center of gravity of the bar	mm
First drive torque OID	Object ID of the first drive torque (see here [▶ 30]) If the motors and gear units of all motors behave in a similar way, all drive torques can be represented via an OID. All three parameters refer to the same object ID.	
Second drive torque OID	Object ID of the second drive torque	
Third drive torqueOID	Object ID of the third drive torque	

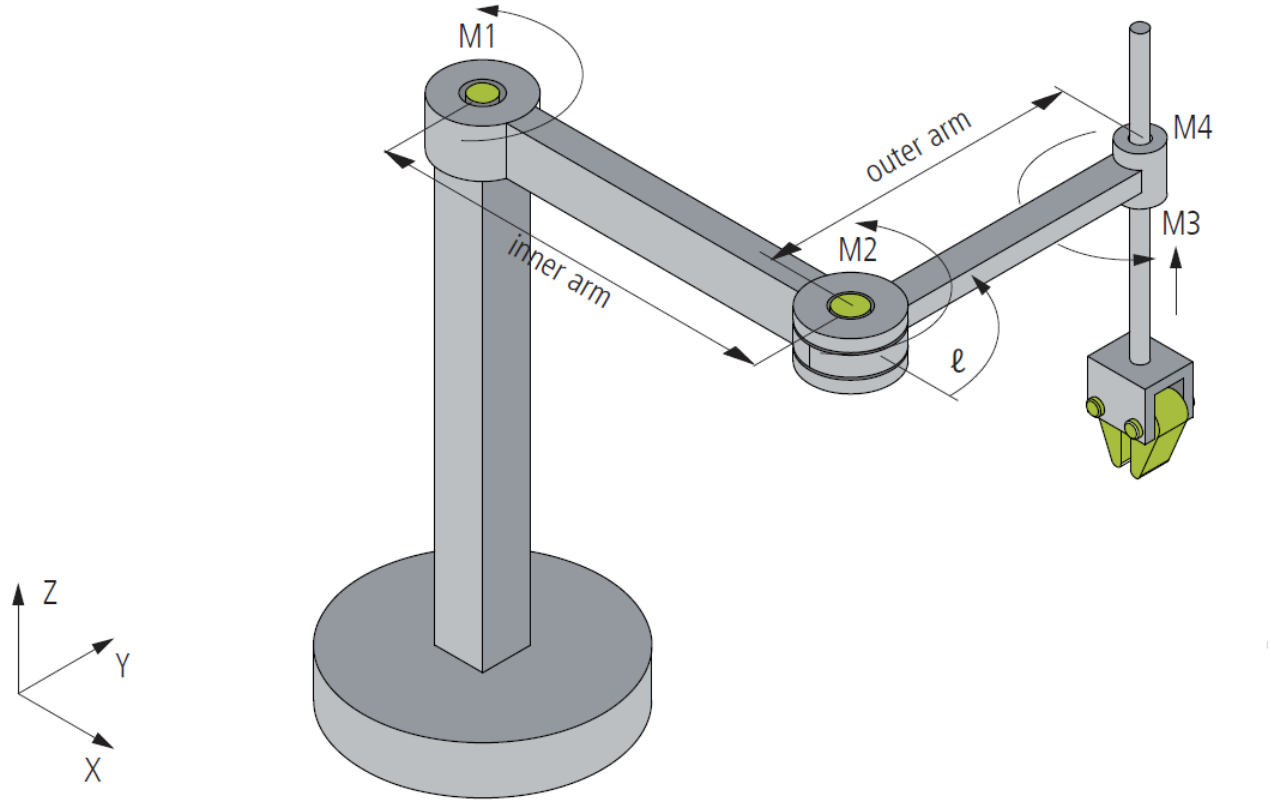
General kinematics parameters

General parameters, which apply to any kinematics, are described under General kinematics parameters [▶ 19].

- MCS offset [▶ 19]
- MCS to reference-relation [▶ 20]
- Tool offset OID [▶ 21]

Required product level:
Level 3

6.8 SCARA



The SCARA kinematics (“Selective Compliance Assembly Robot Arm”) is configured as shown in the diagram above.

Motor axes 1, 2 and 4 are in scaled in degrees; the arrow indicates the positive direction of rotation. The third motor axis is scaled in mm.

The origin of the MCS is in the first joint (M1). The x-axis is determined by the SCARA arm, when all rotary motor axes are at 0°.

Kinematics parameters

Parameter	Description	Unit
Inner arm length	Length between the pivot points of the inner arm; this is the arm on the origin side.	mm
Outer arm length	Length between the pivot points of the outer arm; this is the arm on the TCP side.	mm
Tool offset OID	Object ID of a tool mounted on the kinematics flange. The flange coordinate system is rotated 180° around the x-axis, so that its z-axis points downwards.	

General kinematics parameters

General parameters, which apply to any kinematics, are described under General kinematics parameters [▶ 19].

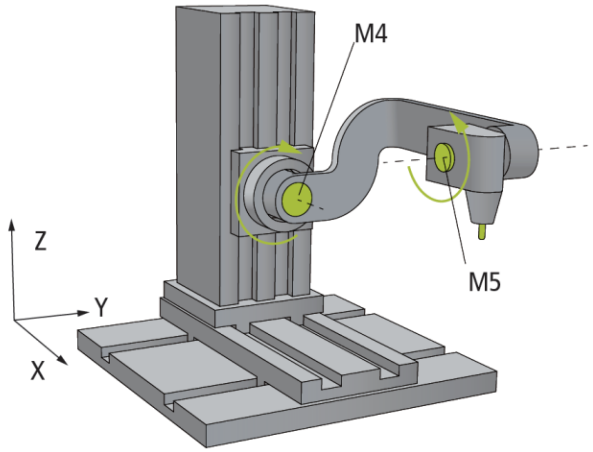
- MCS offset
- MCS to reference-relation
- Tool offset OID

Required product level:
Level 3

Also see about this

- General kinematics parameters [▶ 21]

6.9 5D-Kinematics Type 2 (XYZab)

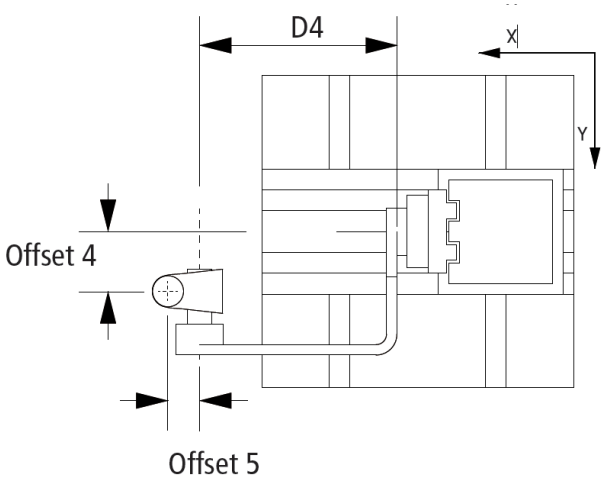


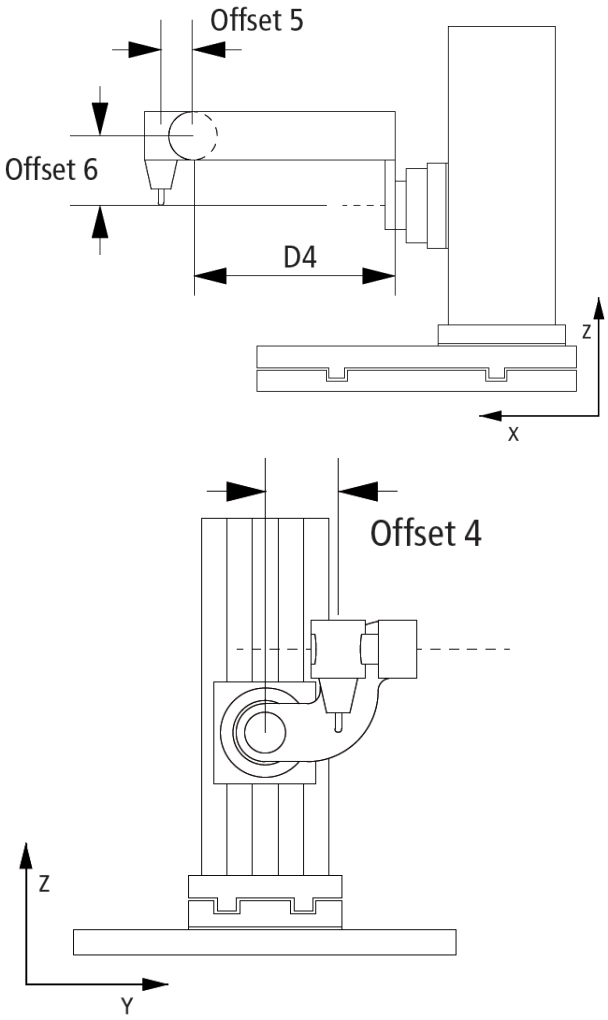
The 5D kinematics type 2 is configured as shown in the diagram above.

Motors 1 to 3 (X, Y, Z) are scaled in mm. Motors 4 and 5 are scaled in degrees. 0° is axis position shown in the drawing; the arrow indicates the positive direction of rotation.

Kinematics parameters

Parameter	Description	Unit
D4	Arm length in x-direction between motor axis 4 and motor axis 5, as shown in the diagram	mm
Offset 4	Offset in y-direction between motor axis 4 and TCP	mm
Offset 5	Offset in x-direction between motor axis 5 and TCP	mm
Offset 6	Offset in z-direction between motor axis 4 and motor axis 5	mm
Tool offset OID	Object ID of a tool mounted on the kinematics flange. The flange coordinate system is rotated 180° around the x-axis, so that its z-axis points downwards.	





General kinematics parameters

General parameters, which apply to any kinematics, are described under General kinematics parameters [▶ 19].

- MCS offset [▶ 19]
- MCS to reference-relation [▶ 20]
- Tool offset OID [▶ 21]

Required product level:
Level 4

6.10 Drive Torque

The drive torque represents the inertia and the efficiency of the motor and gear unit. It is used for the precise computation of the dynamic model.

A parameter in the kinematics can be used to assign an object drive torque to a kinematics.

Parameter for drive

Parameter	Description	Unit
Drive moment of inertia	Rotor Moment of inertia of the motor	kg mm^2

Gear unit parameters

Parameter	Description	Unit
Ratio	Gear ratio	
Gearbox moment of inertia	Moment of inertia of the gear unit in relation to the drive	kg mm^2
Coulomb friction	Represents the kinetic friction coefficient	Nm
Stokes friction	Represents the friction ratio that increases proportionally to the speed	Nms

Required product level:
Level 1

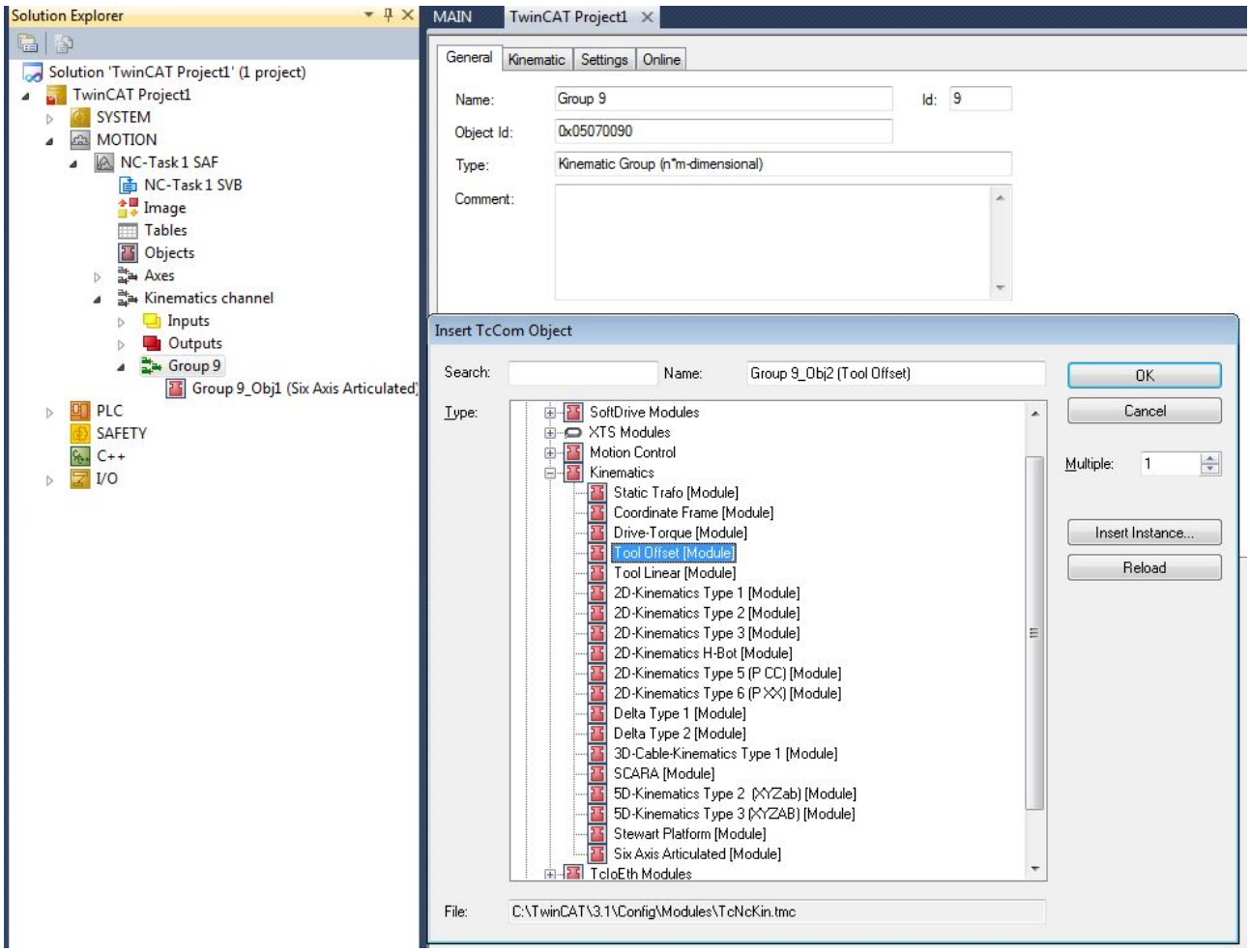
6.11 Tool Offset

The user can use the tool offset to link a tool with the flange of the kinematics. Unless specified otherwise in the kinematics, the flange coordinate system is defined such that the orientation of the flange coordinate system matches that of the machine coordinate system MCS, if all axes are at 0.

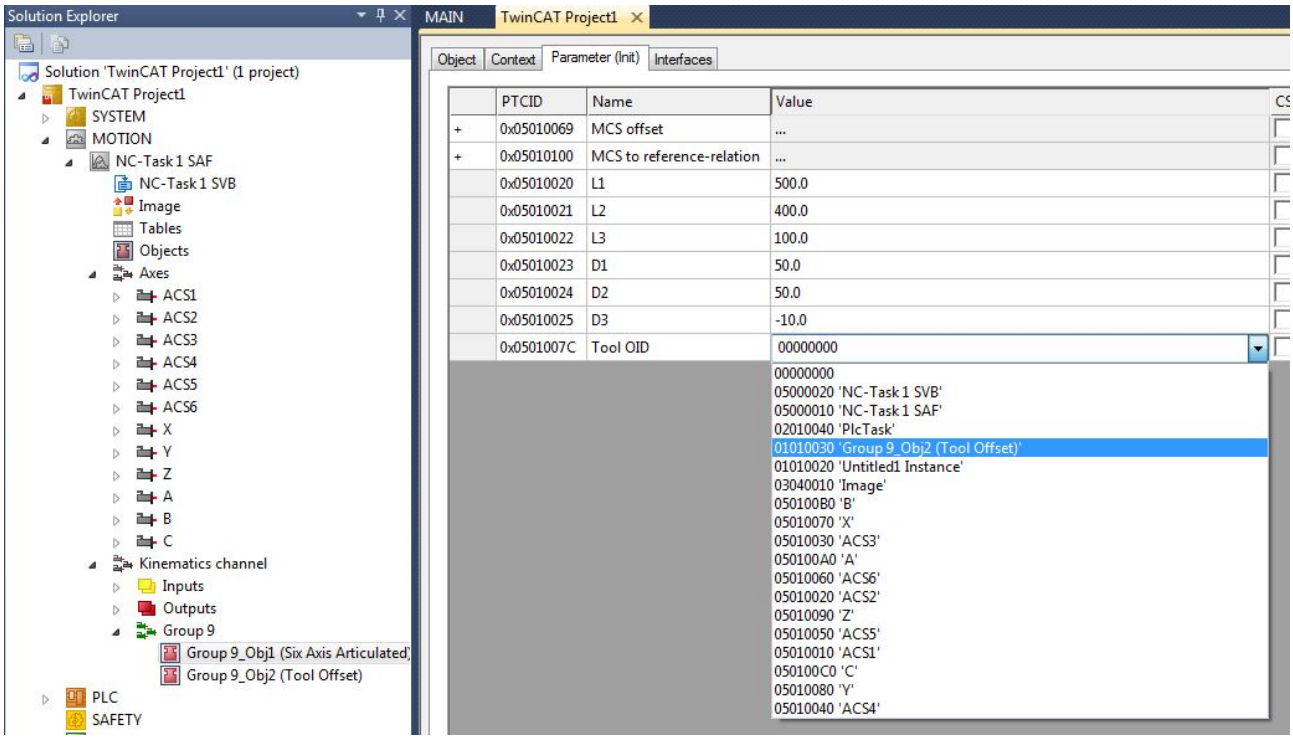
Parameter	Description	Unit
Extension X	X-offset of the static tool, which is mounted at the coordinate system of the flange of the higher-level transformation	mm
Extension Y	Y-offset of the static tool, which is mounted at the coordinate system of the flange of the higher-level transformation	mm
Extension Z	Z-offset of the static tool, which is mounted at the coordinate system of the flange of the higher-level transformation	mm

Creating a tool

1. First, a tool has to be created under the group of the kinematics.



2. The created tool object can be allocated to the kinematics in the parameters via its tool OID.



3. The tool can now be configured via its object parameters.

6.12 Tool Linear

The Tool Linear describes a 1D tool, which is mounted at the flange of the kinematics. An additional simulation axis can be used for movement in tool direction. The 1D tool can be used to move the TCP at a certain distance from a workpiece.

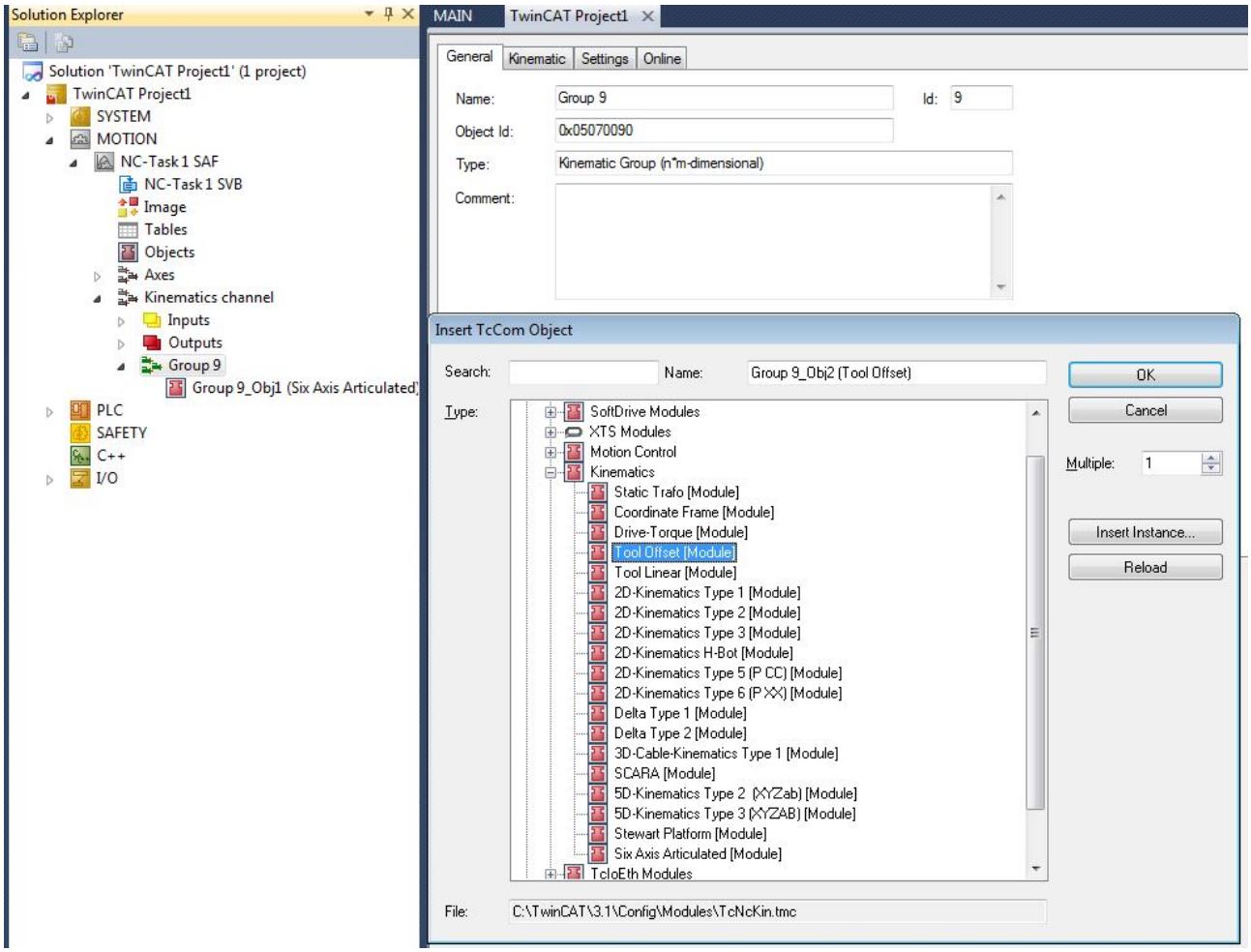
Unless specified otherwise in the kinematics, the flange coordinate system is defined such that the orientation of the flange coordinate system matches that of the machine coordinate system, if all axes are at 0.

If the axis position of the additional simulation axes is 0, the TCP is at the position of the tool offset (parameter L_init).

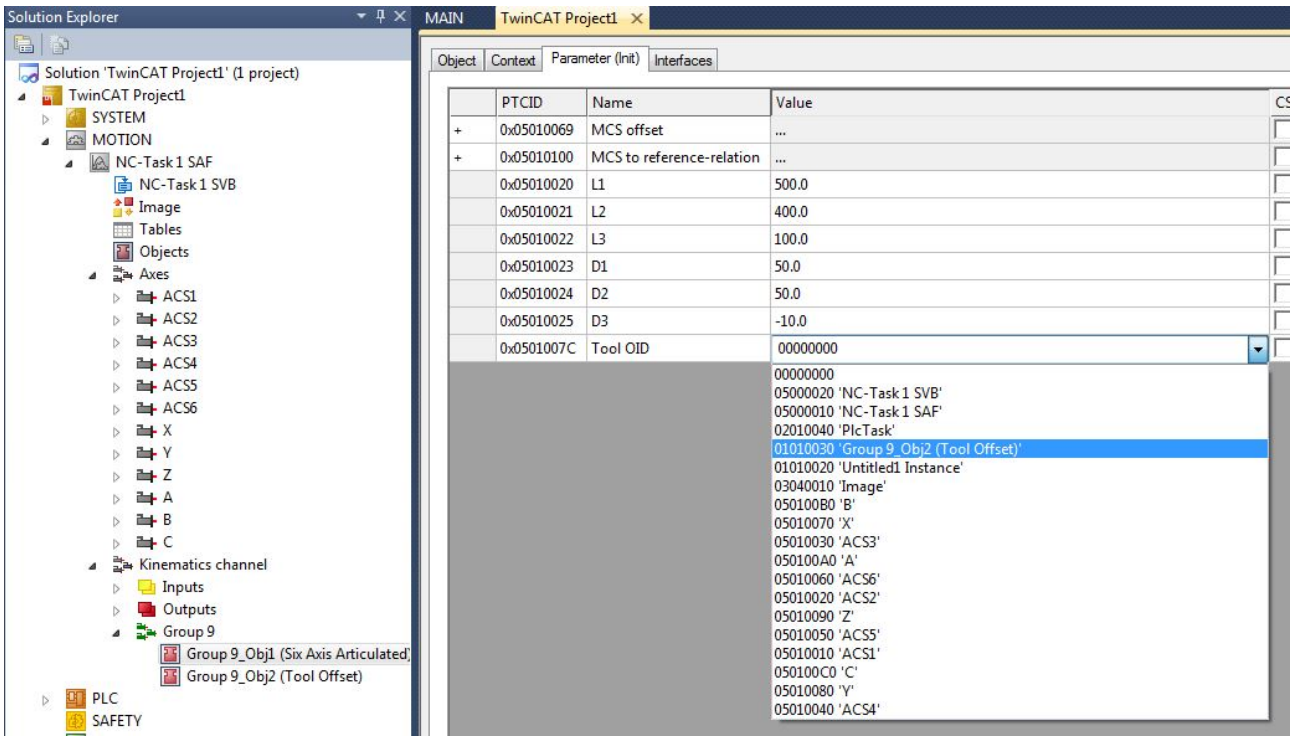
Parameter	Description	Unit
L_init	Tool length	mm
Axis ID length	Axis ID of the simulation axis; when this axis is moved, the TCP moves in the direction of the linear tool.	

Creating a tool

1. First, a tool has to be created under the group of the kinematics.



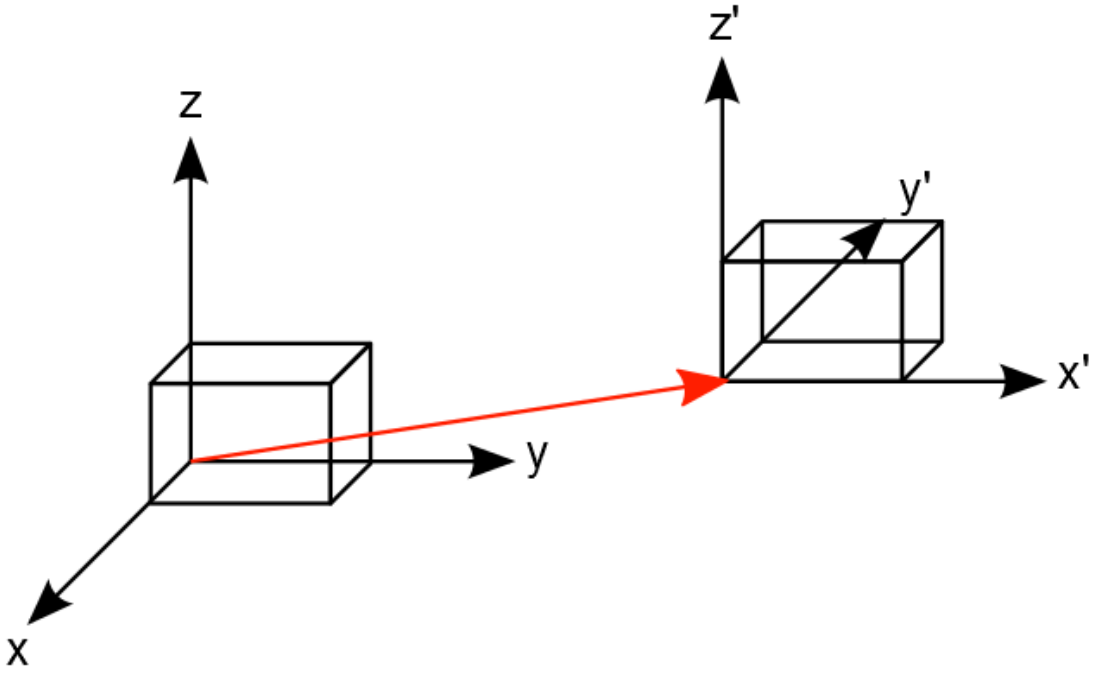
2. The created tool object can be allocated to the kinematics in the parameters via its tool OID.



3. The tool can now be configured via its object parameters.

6.13 Coordinate system (Coordinate Frame)

The coordinate system supports a translation and a rotation. This transformation can be used to define a user coordinate system (UCS). A general introduction to coordinate systems can be found here [▶ 8].



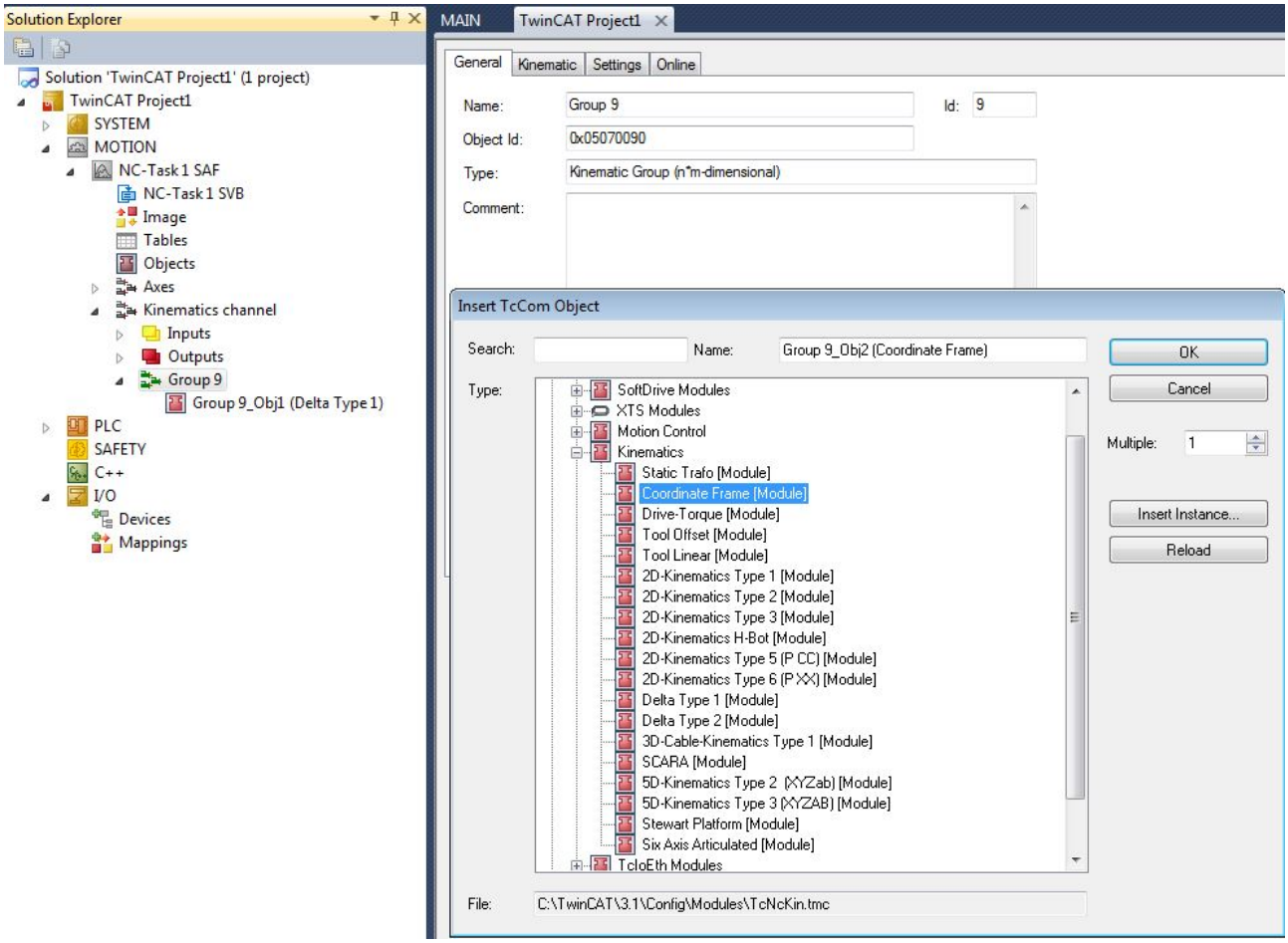
First the translation is calculated, then the rotation. The order of the rotations affects the orientation of the coordinate system. The roll/pitch/yaw rule described in DIN 9300 is used as default for the rotation sequence. The calculation sequence for the forward transformation is Z, Y', X''.

Parameter	Description	Unit
Translation X	Shift in x-direction	mm
Translation Y	Shift in y-direction	mm

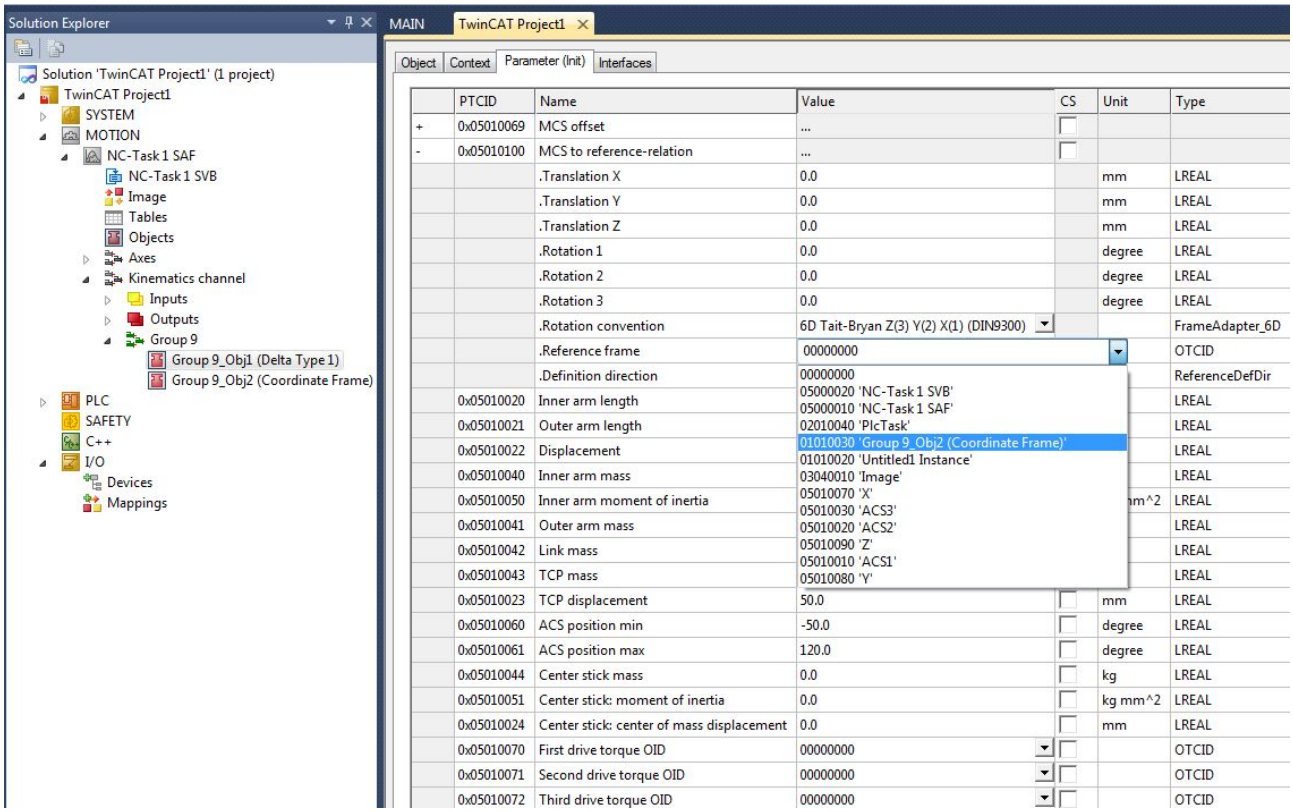
Parameter	Description	Unit
Translation Z	Shift in z-direction	mm
Rotation 1	First rotation angle. The interpretation is defined by the parameter Rotation Convention.	°
Rotation 2	Second rotation angle. The interpretation is defined by the parameter Rotation Convention.	°
Rotation 3	Third rotation angle. The interpretation is defined by the parameter Rotation Convention.	°
Rotation convention	The rotation convention indicates the order of the axis rotations (parameter Rotation 1-3). The letters (X, Y, Z) from left to right indicate the order of the rotation around the corresponding axes. The number indicates the parameter (Rotation 1-3) for the value parameterization. The translatory shift is always performed before the rotation.	
Reference frame	The parameter Reference frame indicates which coordinate system is used as basis for this coordinate system. If the value is set to 0, the WCS is used as basis. To use another coordinate system as starting point for the shift, a further coordinate system object can be created. The object ID of this coordinate system can be selected via the dropdown menu.	
Definition direction	Indicates the direction in which the shift is programmed (from the perspective of the reference system or this coordinate system).	

Creating a coordinate system

1. First create the coordinate system under the kinematic group.



2. The created coordinate system object can be defined in the kinematics via the parameter Reference frame as origin of the MCS of the kinematics.



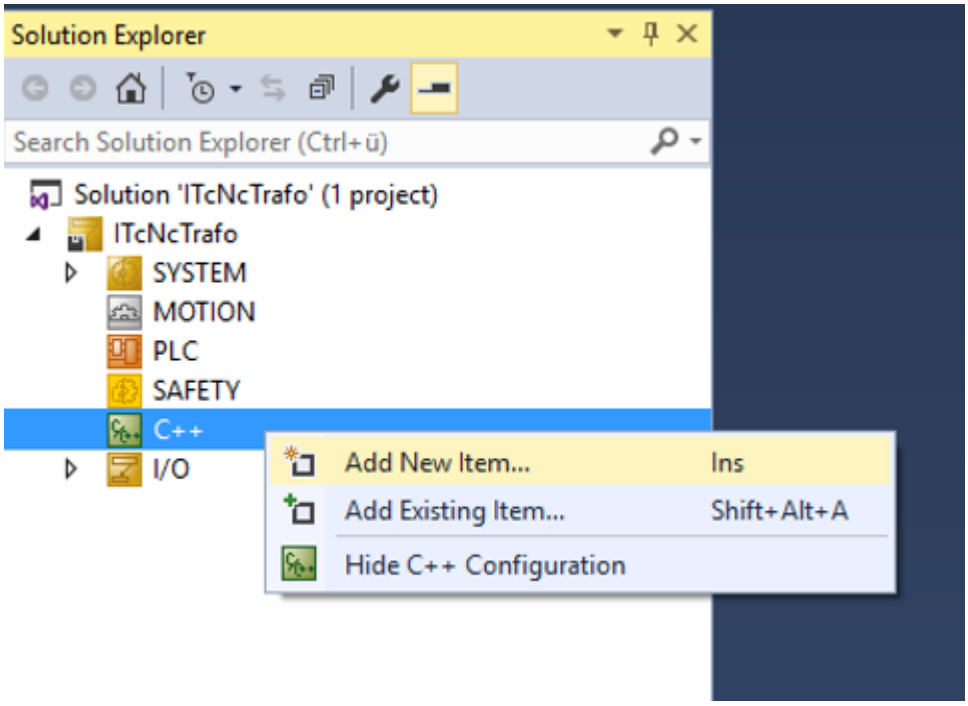
3. The coordinate system can now be configured via its object parameters.

7 User Specific Transformations - How to...

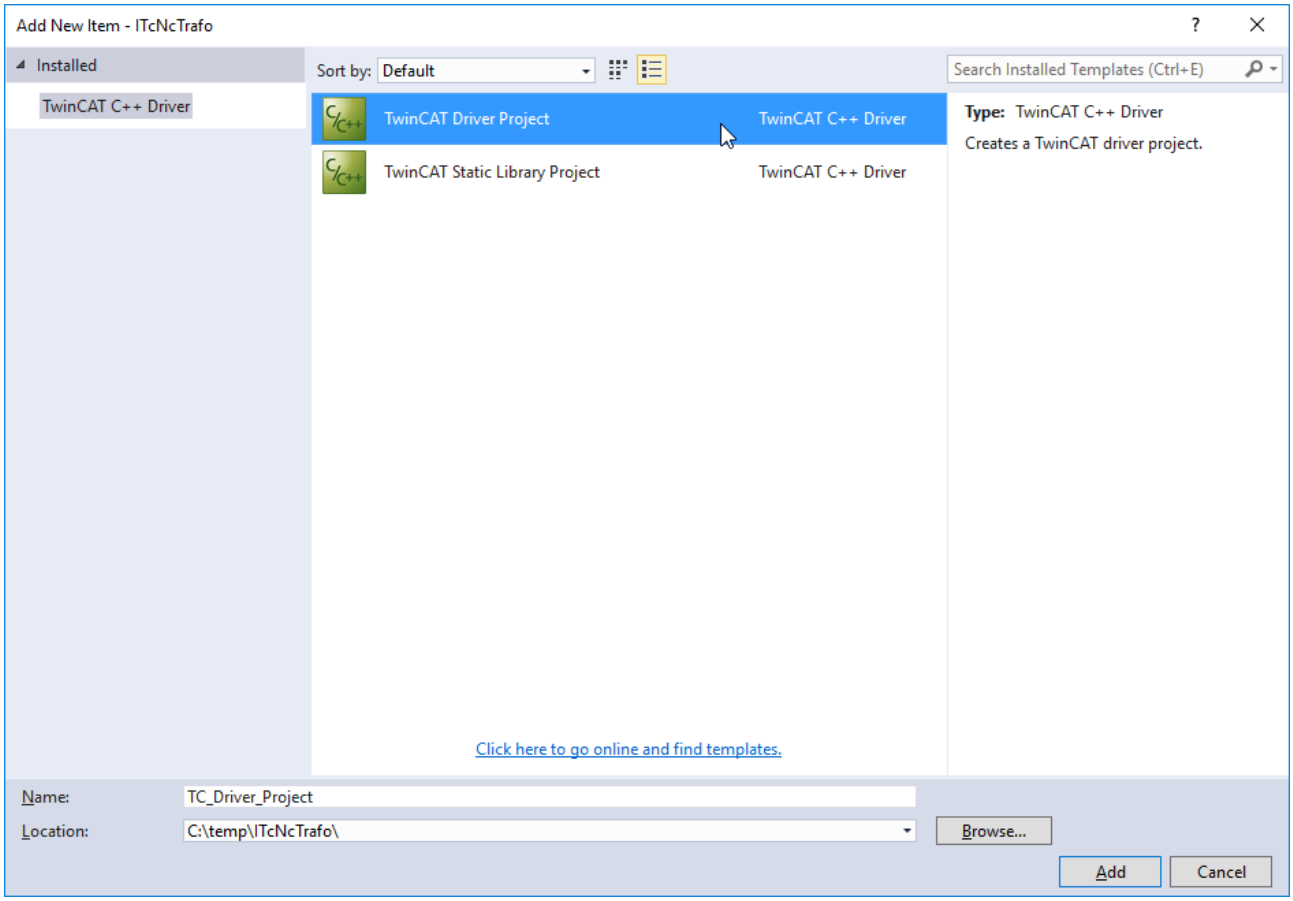
ITcNcTrafo

Step by Step Manual for how to Integrate own Kinematics with TF511x

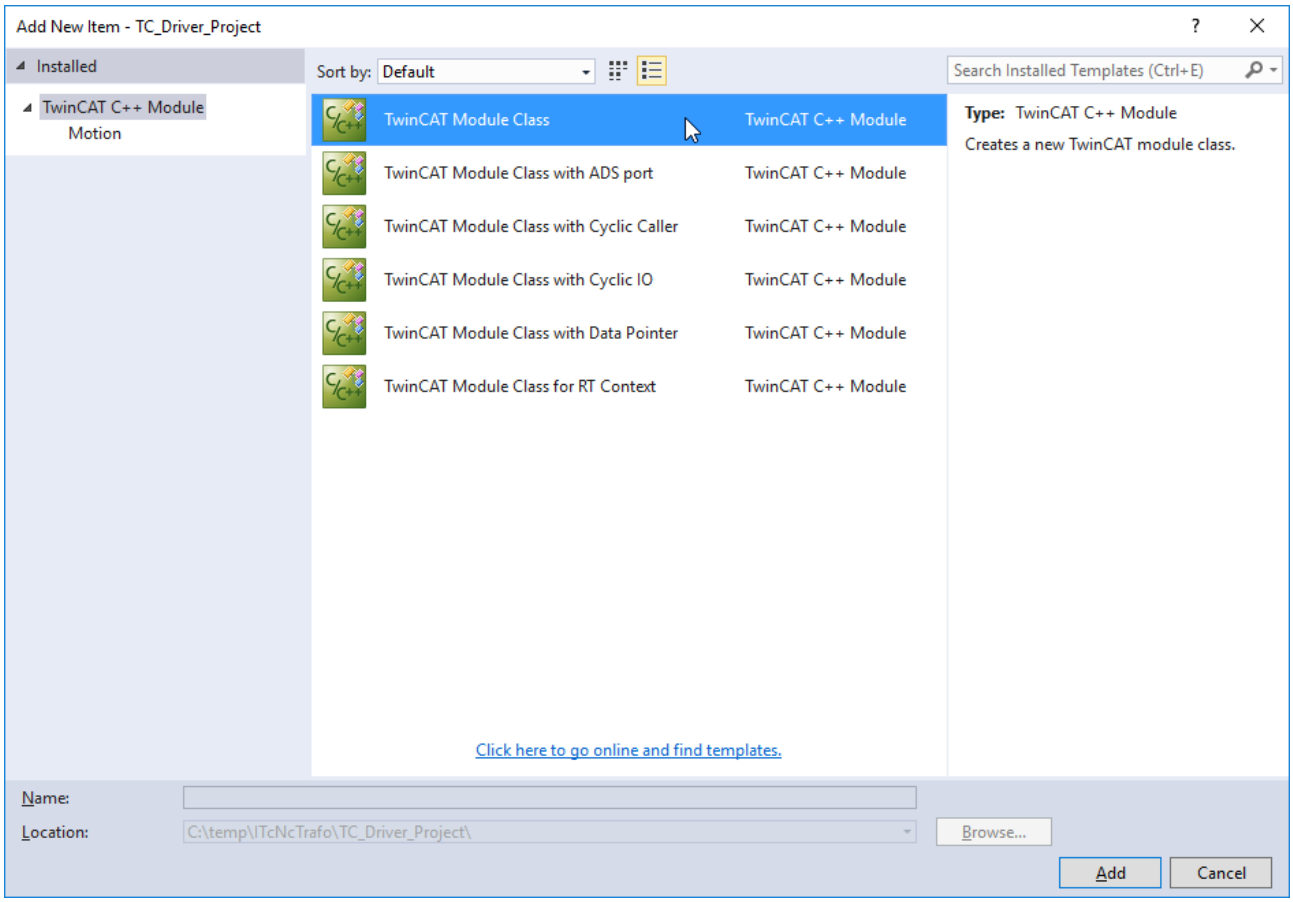
- Start with an empty TwinCAT Project.
- Add a C++ Object.

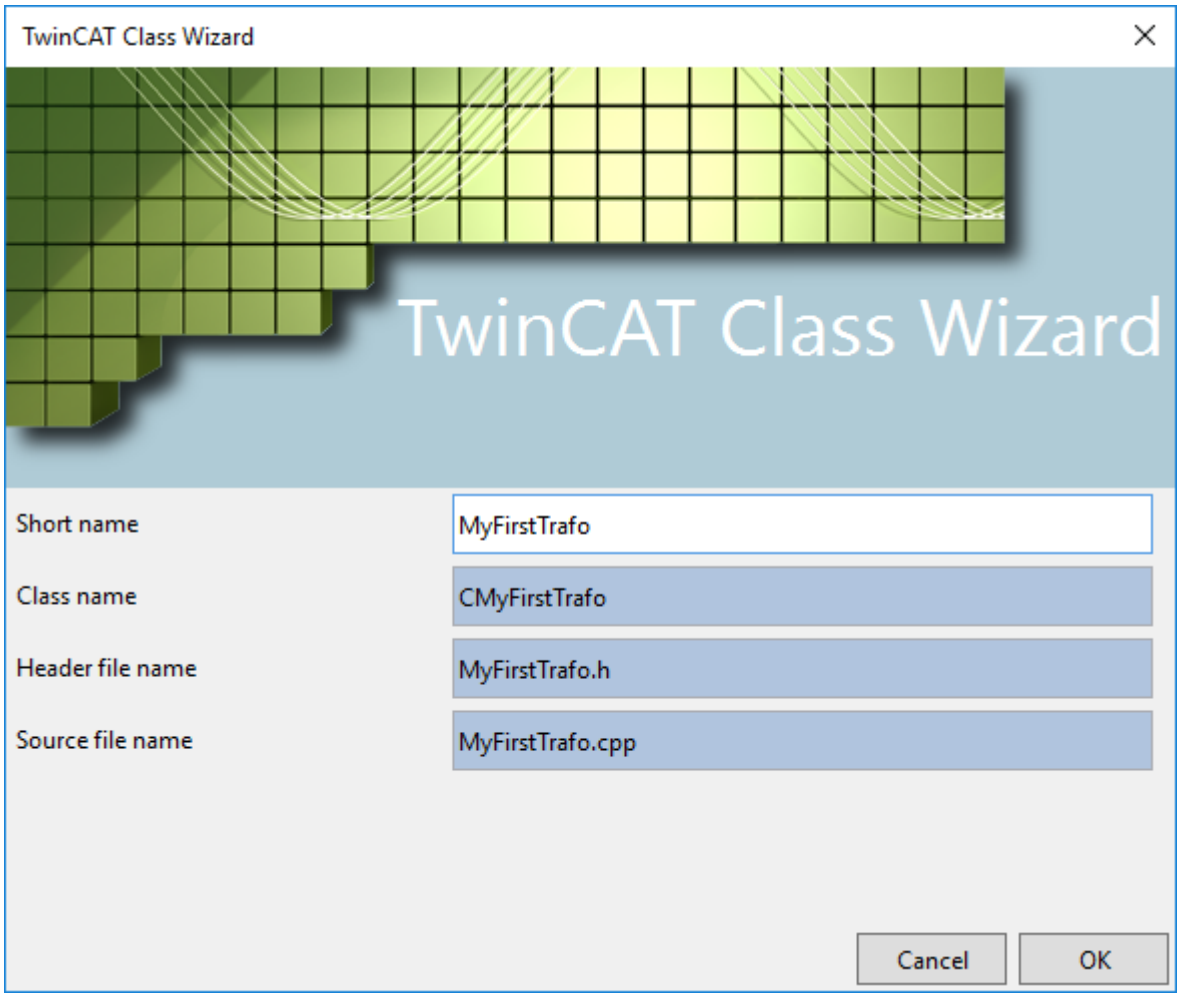


- Select a TwinCAT Driver Project.

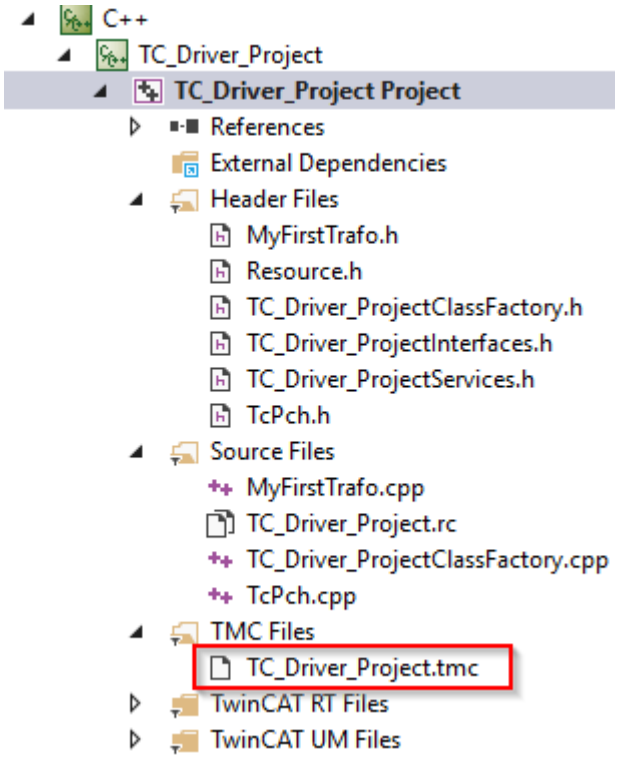


- Select a TwinCAT Module Class.

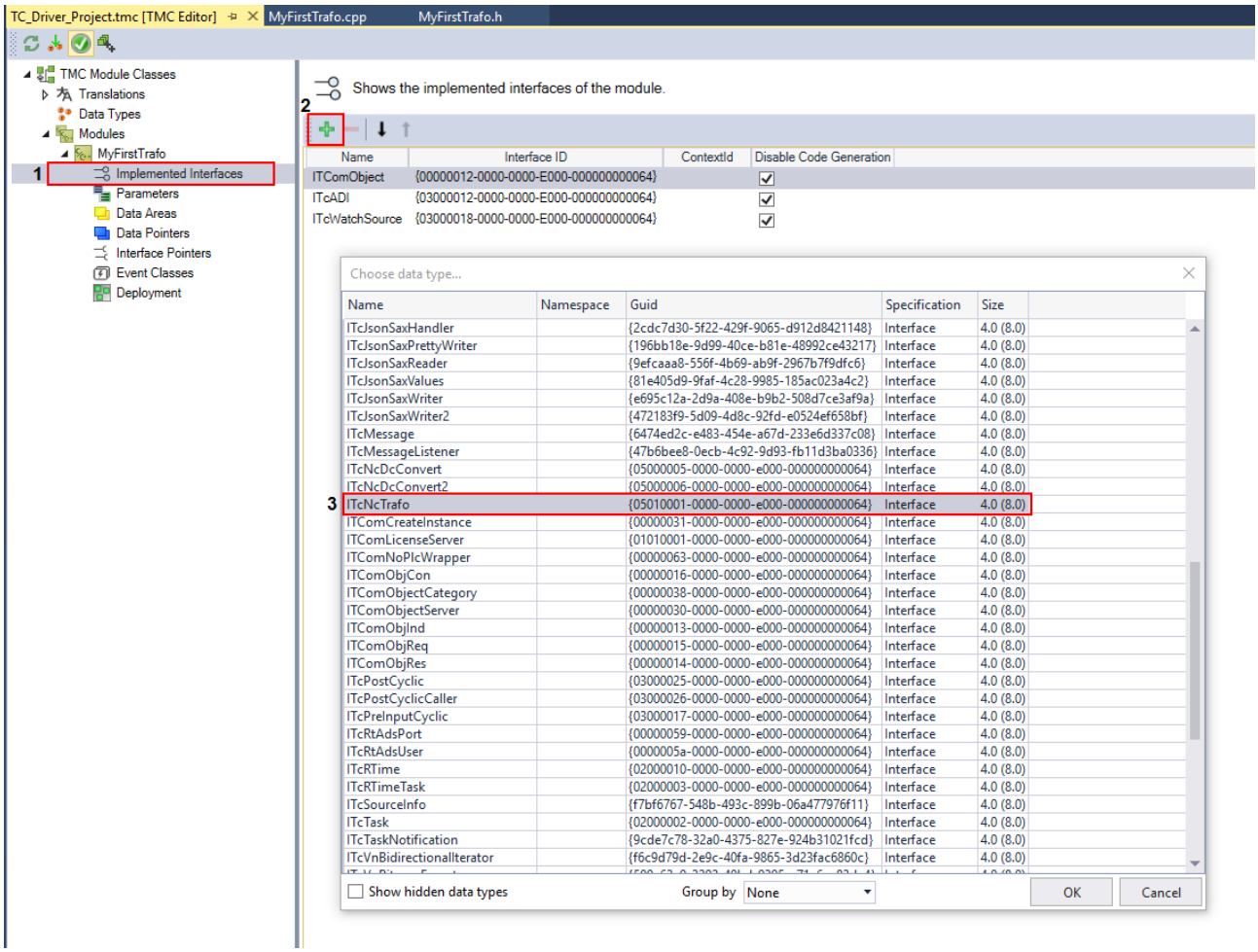




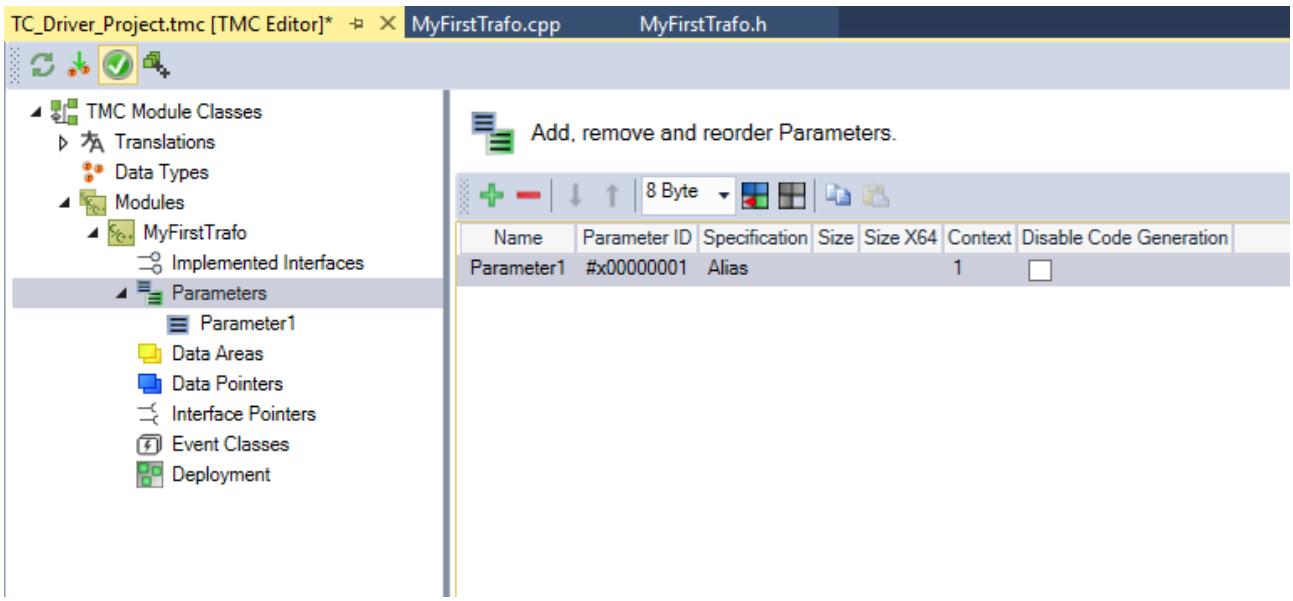
- Select the `TMC` Editor.

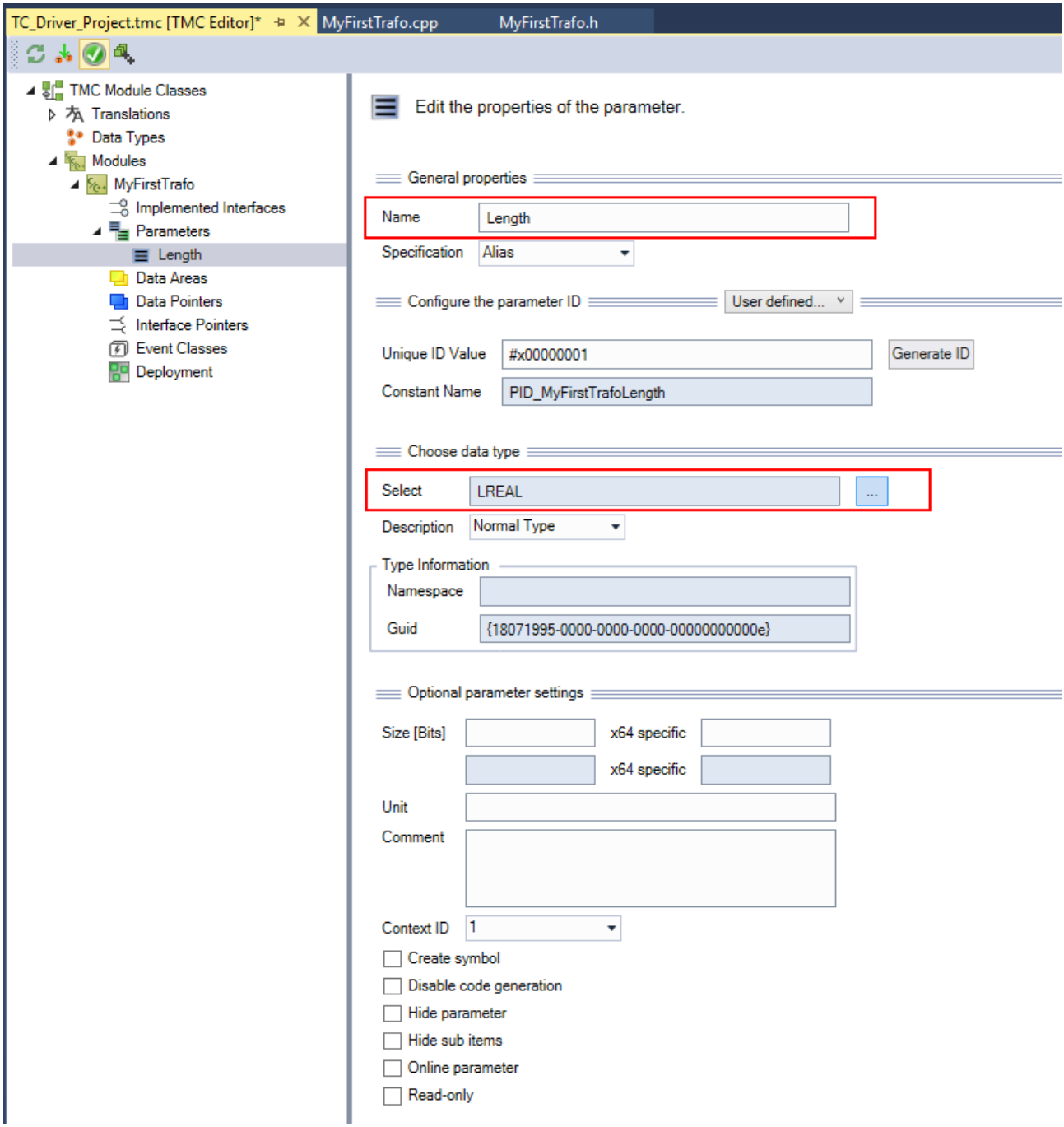


- Add the `ITcNcTrafo` interface.

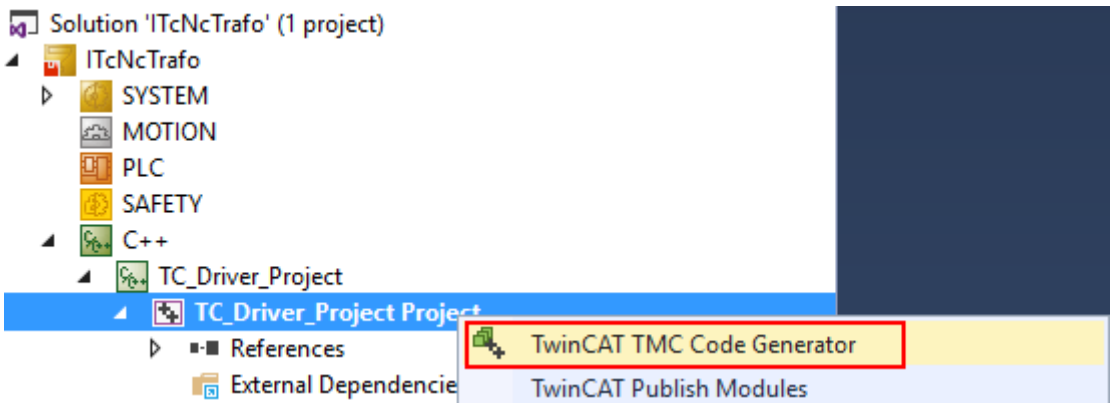


- Add kinematic specific parameters (arm length, displacements, etc.).

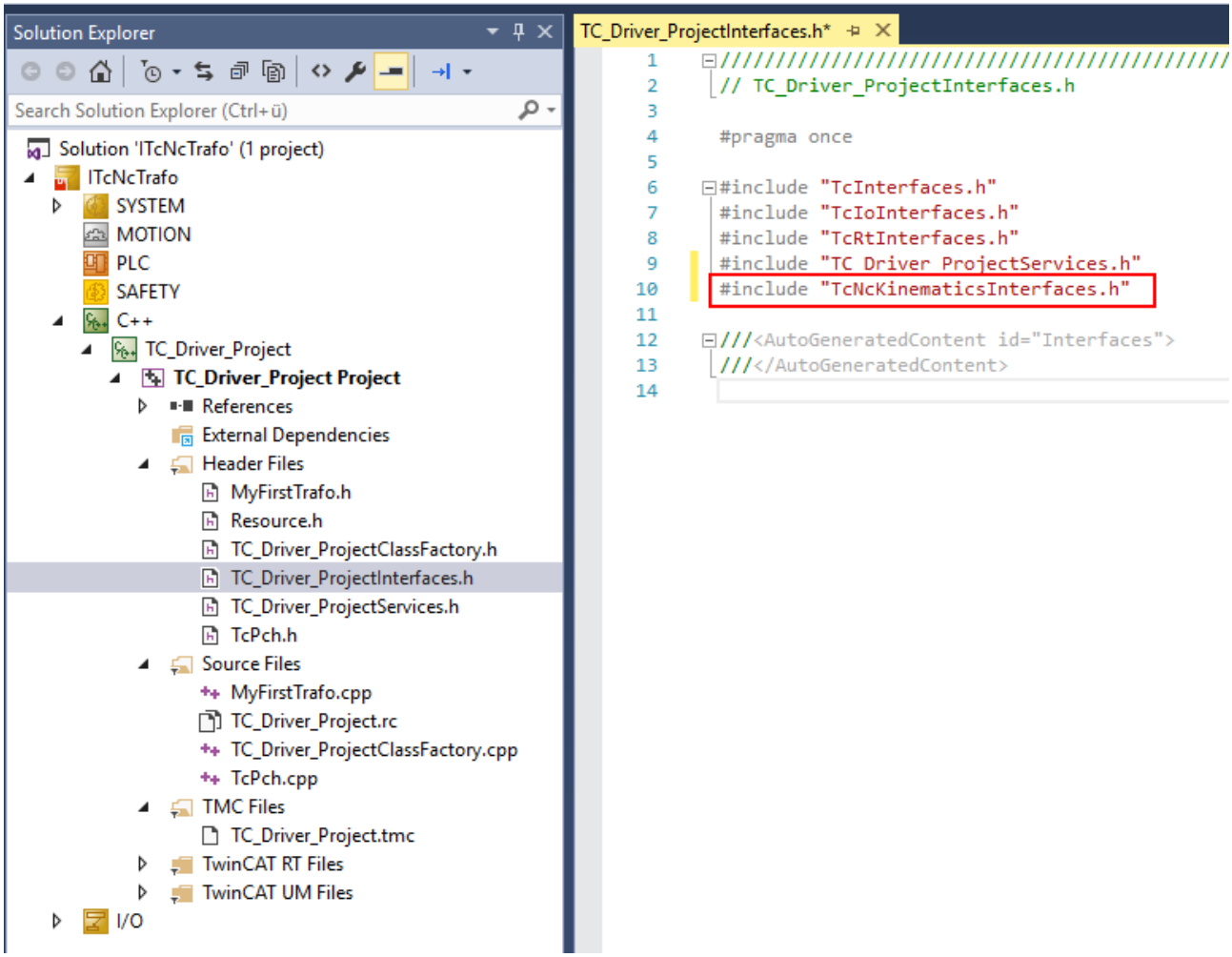

TC_Driver_Project.tmc [TMC Editor]*
MyFirstTrafo.cpp
MyFirstTrafo.h
TMC Module Classes
Translations
Data Types
Modules
MyFirstTrafo
Implemented Interfaces
Parameters
Parameter1
Data Areas
Data Pointers
Interface Pointers
Event Classes
Deployment
Add, remove and reorder Parameters.
8 Byte
Name
Parameter ID
Specification
Size
Size X64
Context
Disable Code Generation
Parameter1
#x00000001
Alias
1



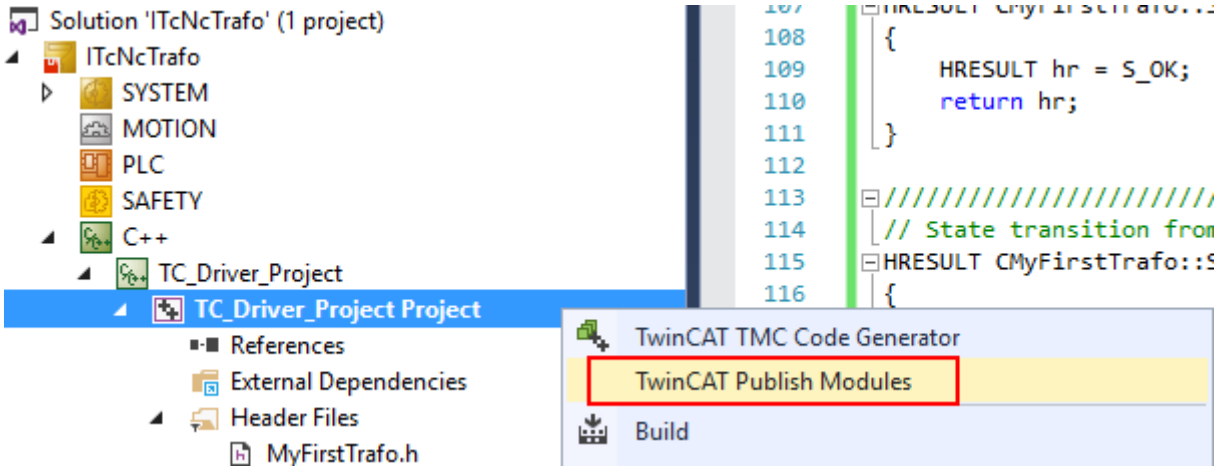
- Run the `TMC` Code Generator.



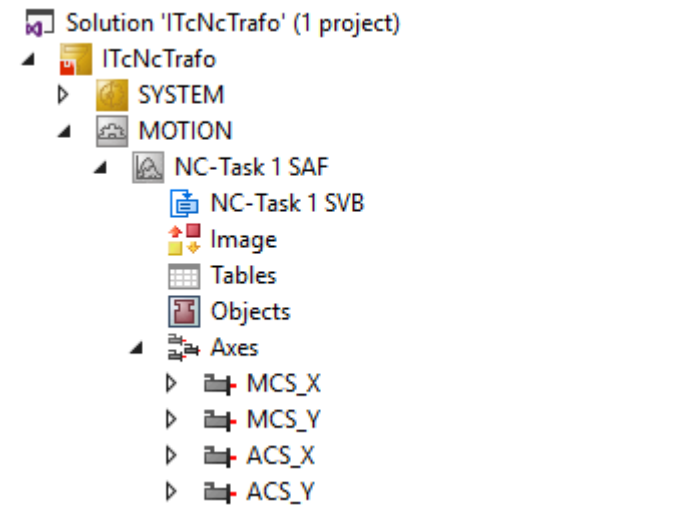
- Add a header. `<ProjectName>Interfaces.h` requires an include statement, additionally. Also add `TcNcKinematicsInterfaces.h`.



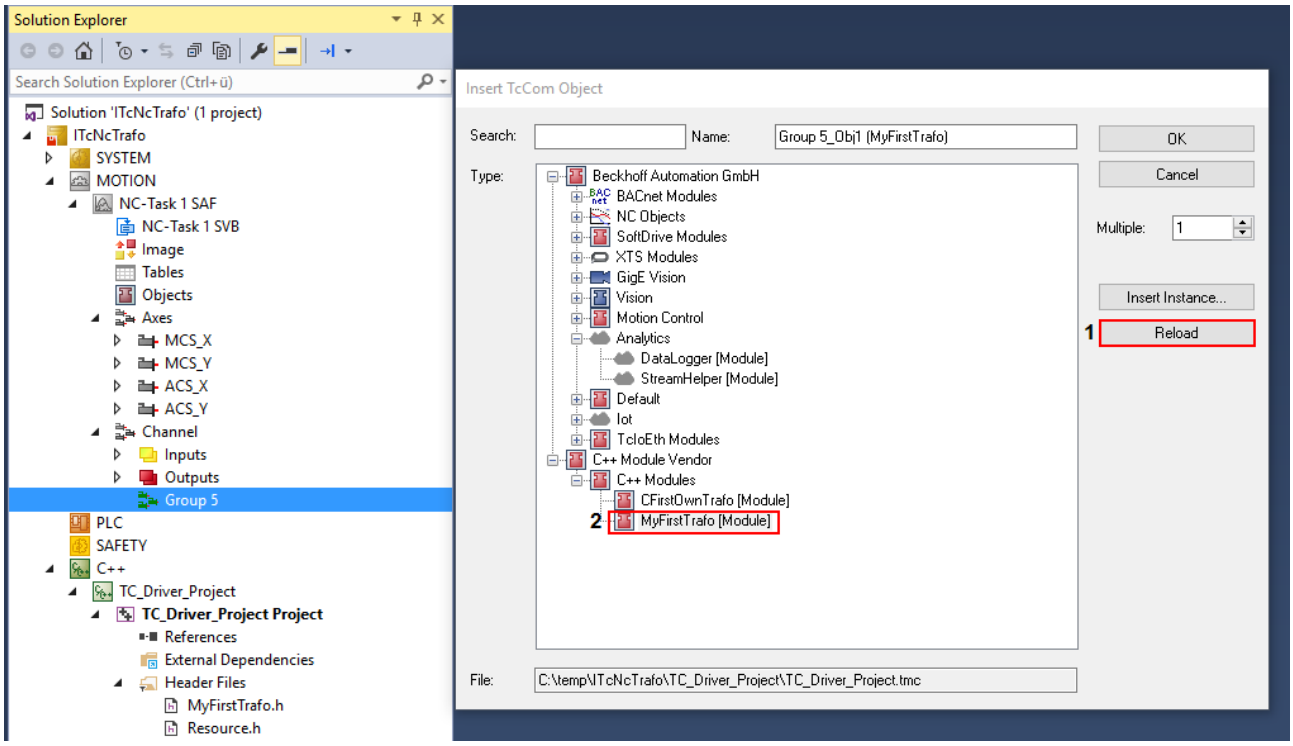
- Implement the methods `Forward`, `Backward`, `TrafoSupported` and `GetDimensions`. These methods have to have a valid implementation and are automatically placed at `Source Files\<TrafoName>.cpp`.
- Build and publish the modules.



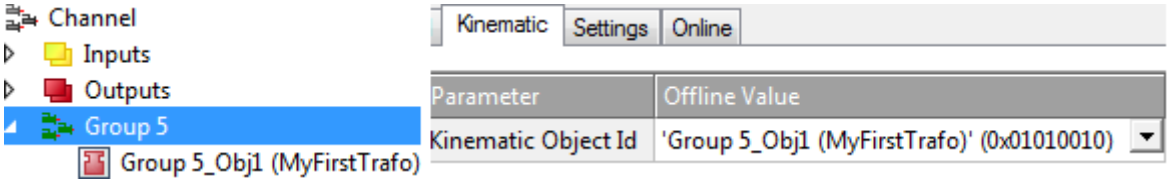
- Configure axes in the `MOTION` subtree and add PTP axes.



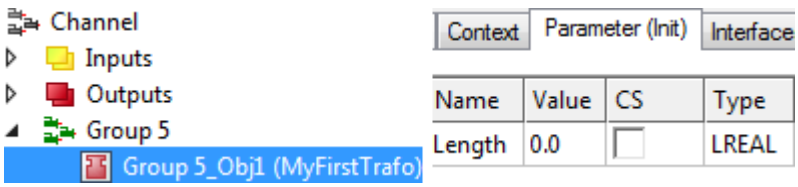
- Add user specific modules (Channel).
- Reload the `TcCom` objects by pressing the `Reload` button.
- Select your transformation object and confirm your choice by pressing the `OK` button.



- The transformation group has to know which root module is to be called. This is why the object ID of the kinematics (in this case `MyFirstTrafo`) has to be selected. The kinematic object defines the number of ACS axes and MCS axes to be used in the PLC (see ST_KinAxes [▶ 55]).



- Parameterize the object parameters according to the kinematics used. Once this is done, the XAE configuration is complete.



- The transformation can now be activated via the PLC (see PLC Library). To actuate the transformation define a cyclic channel interface in the PLC and link it with the IO of the kinematic channel.

```
in_stKinToPlc      AT %I*     : NCTOPLC_NCICHANNEL_REF;
out_stPlcToKin     AT %Q*     : PLCTONC_NCICHANNEL_REF;
```

Customer Specific Kinematic

The function block `FB_KinCalcTrafo` cannot be employed for transformations that have been set up on one's own.

8 Plc Library

Function Block	Description
Kinematic Tranformation	
FB_KinConfigGroup [▶ 45]	Configures ACS and MCS axes according to the kinematic transformation group and enables Cartesian mode or joint mode (ACS)
FB_KinResetGroup [▶ 47]	Resets the kinematic transformation group
F_KinGetChnOperationState [▶ 54]	Reads the status of the kinematic transformation group cyclically
F_KinGetAcsMcsAxisIds [▶ 54]	Reads the active ACS and MCS axes of the kinematic group
Transformation calculation	
FB_KinCalcTrafo [▶ 49]	Calculates the Kinematic Transformation without link to the axes
FB_CalcMultiTrafo	Calculates the Kinematic Transformation for several positions
Edit parameters and coordinate systems online	
FB_LockTrafoParam [▶ 53]	Locks the parameters of the kinematic transformation group, denies write access
FB_UnlockTrafoParam [▶ 51]	Unlocks the parameters of the kinematic transformation group, enables write access

Structures and enumerations

Name	Description
ST_KinAxes [▶ 55]	Structure of the ACS and MCS axes, which form the kinematics
E_KINSTATUS [▶ 55]	Status of the kinematic group (enum)

Development environment	Target system	PLC libraries to include
TwinCAT 3	PC or CX (x86, x64)	Tc2_NcKinematicTransformation

Function blocks for compatibility with existing programs

Function blocks for compatibility

The purpose of the function blocks listed is to ensure compatibility with existing projects. It is not advisable to use these blocks for new projects. Instead, the equivalent blocks shown in the table above should be used.

Function Block	Description
FB_KinCheckActualStatus [▶ 56]	Reads the status of the kinematic transformation group acyclically

8.1 Function Blocks

8.1.1 FB_KinConfigGroup

The function block FB_KinConfigGroup configures axes according to the kinematic transformation. These are axes for the ACS (joint) and the MCS (Cartesian). The function block takes the ACS and MCS axes defined in the **stAxesList** and configures them in the kinematic group of **stKinRefIn**.

VAR_INPUT

```
VAR_INPUT
    bExecute              : BOOL;
    bCartesianMode        : BOOL;
END_VAR
```

bExecute: The command is triggered by a rising edge at this input.

bCartesianMode: If FALSE, the ACS axes (joint) can be moved directly. If TRUE, the movement described in the MCS axes (Cartesian) is transformed into a movement of the ACS axes (joint). The ACS axes cannot be moved directly.

VAR_IN_OUT

```
VAR_IN_OUT
    stAxesList            : ST_KinAxes;
    stKinRefIn            : NCTOPLC_NCICHANNEL_REF;
END_VAR
```

stAxesList: Determines the ACS and MCS axes included in the configuration. See ST_KinAxes.

stKinRefIn: Determines the kinematic group of the configuration.

VAR_OUTPUT

```
VAR_OUTPUT
    bBusy                 : BOOL;
    bDone                 : BOOL;
    bError                : BOOL;
    nErrorId              : UDINT;
END_VAR
```

bBusy: The output becomes TRUE when the command is started with *bExecute* and remains TRUE as long as the function block executes the command. While *bBusy* is TRUE, no new command is accepted at the inputs. If *bBusy* becomes FALSE again, the function block is ready for a new command. At the same time one of the outputs *bDone* or *bError* is set.

bDone: The output becomes TRUE when the command was executed successfully.

bError: The output *bError* is set to TRUE, if an error occurred during the command execution.

nErrorId: contains the command-specific error code of the most recently executed command. Details of the error code can be found in the ADS error documentation [▶ 59] or in the NC error documentation [▶ 61] (error codes from 0x4000).

Sample

```
VAR
    io_X                  : AXIS_REF;
    io_Y                  : AXIS_REF;
    io_Z                  : AXIS_REF;
    io_M1                 : AXIS_REF;
    io_M2                 : AXIS_REF;
    io_M3                 : AXIS_REF;
    in_stKinToPlc AT %I*  : NCTOPLC_NCICHANNEL_REF;
    fbConfigKinGroup      : FB_KinConfigGroup;
    stAxesConfig          : ST_KinAxes;
    bAllAxesReady         : BOOL;
    bExecuteConfigKinGroup: BOOL;
    bUserConfigKinGroup   : BOOL;
    bUserCartesianMode    : BOOL := TRUE;
    (*true: cartesian mode - false: direct mode (without transformation) *)
END_VAR
```

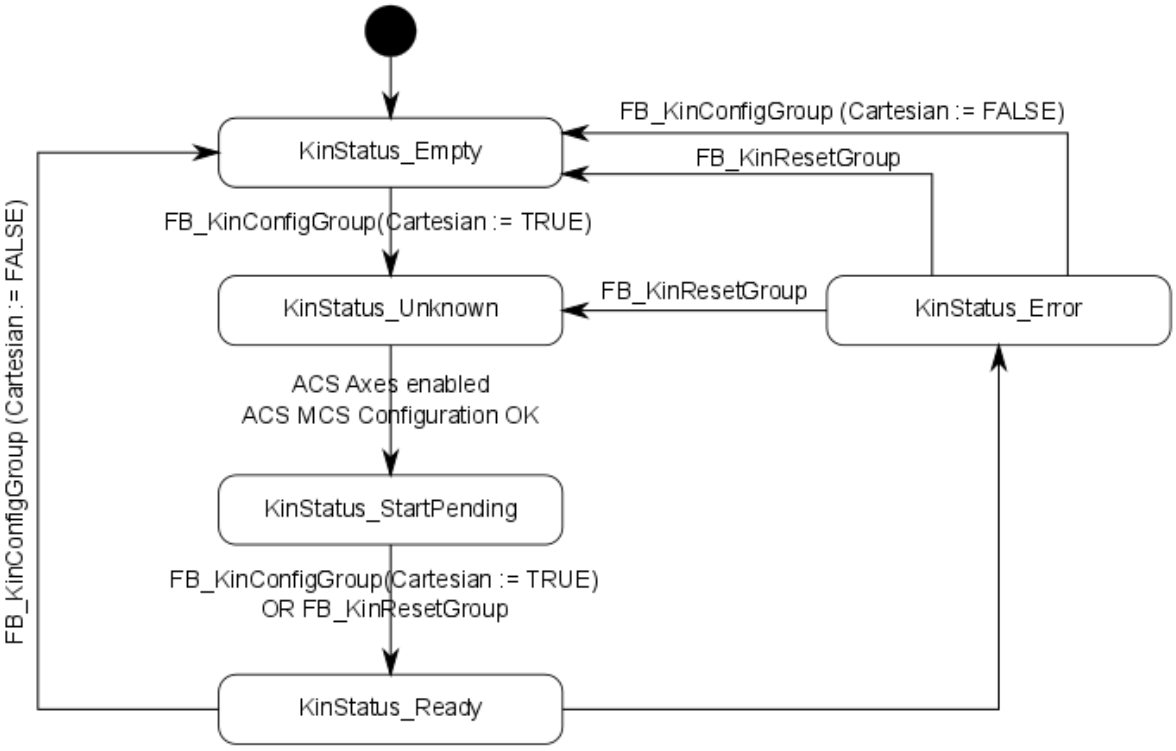
```
(* read the IDs from the cyclic axis interface so the axes can mapped later to the kinematic group
*)
stAxesConfig.nAxisIdsAcs[1] := io_M1.NcToPlc.AxisId;
stAxesConfig.nAxisIdsAcs[2] := io_M2.NcToPlc.AxisId;
stAxesConfig.nAxisIdsAcs[3] := io_M3.NcToPlc.AxisId;
```

```
stAxesConfig.nAxisIdsMcs[1] := io_X.NcToPlc.AxisId;
stAxesConfig.nAxisIdsMcs[2] := io_Y.NcToPlc.AxisId;
stAxesConfig.nAxisIdsMcs[3] := io_Z.NcToPlc.AxisId;

IF bAllAxesReady AND bUserConfigKinGroup THEN
    bExecuteConfigKinGroup := TRUE;
ELSE
    bExecuteConfigKinGroup := FALSE;
END_IF

fbConfigKinGroup(
    bExecute       := bExecuteConfigKinGroup ,
    bCartesianMode := bUserCartesianMode ,
    stAxesList     := stAxesConfig,
    stKinRefIn     := in_stKinToPlc );
```

State of the kinematic group



Enable configuration

The ACS axes must be enabled through MC_Power, to ensure that the state can reach the value **KinStatus_Ready**. If the ACS axes are not enabled, enable the axes and then call up FB_KinConfigGroup or FB_KinResetGroup.

8.1.2 FB_KinResetGroup

The function block FB_KinResetGroup resets the kinematic group. All ACS and MCS axes are reset. In addition, the input *nItpChannelId* can be used for specifying the corresponding interpolation channel. The channel is reset, if the nItpChannelId is not 0.

When all axes are enabled and the group was in Cartesian mode, the group returns to state KinStatus_Ready. If the group was not in Cartesian mode, the group returns to state KinStatus_Empty. If the axes are not enabled, the group remains in state KinStatus_Empty.

VAR_INPUT

```
VAR_INPUT
    bExecute      : BOOL;
    nItpChannelId : UDINT;
END_VAR
```

bExecute: The command is triggered by a rising edge at this input.

nItpChannelId: ID of the corresponding interpolation channel. If the input us not 0, the corresponding interpolation channel is reset.

VAR_IN_OUT

```
VAR_IN_OUT
    stAxesList            : ST_KinAxes;
    stKinRefIn            : NCTOPLC_NCICHANNEL_REF;
END_VAR
```

stAxesList: Determines the ACS and MCS axes included in the configuration. See ST_KinAxes.

stKinRefIn: Determines the kinematic group of the configuration.

VAR_OUTPUT

```
VAR_OUTPUT
    bBusy                 : BOOL;
    bDone                 : BOOL;
    bError                : BOOL;
    nErrorId              : UDINT;
END_VAR
```

bBusy: The output becomes TRUE when the command is started with *bExecute* and remains TRUE as long as the function block executes the command. While *bBusy* is TRUE, no new command is accepted at the inputs. If *bBusy* becomes FALSE again, the function block is ready for a new command. At the same time one of the outputs *bDone* or *bError* is set.

bDone: The output becomes TRUE when the command was executed successfully.

bError: The output *bError* is set to TRUE, if an error occurred during the command execution.

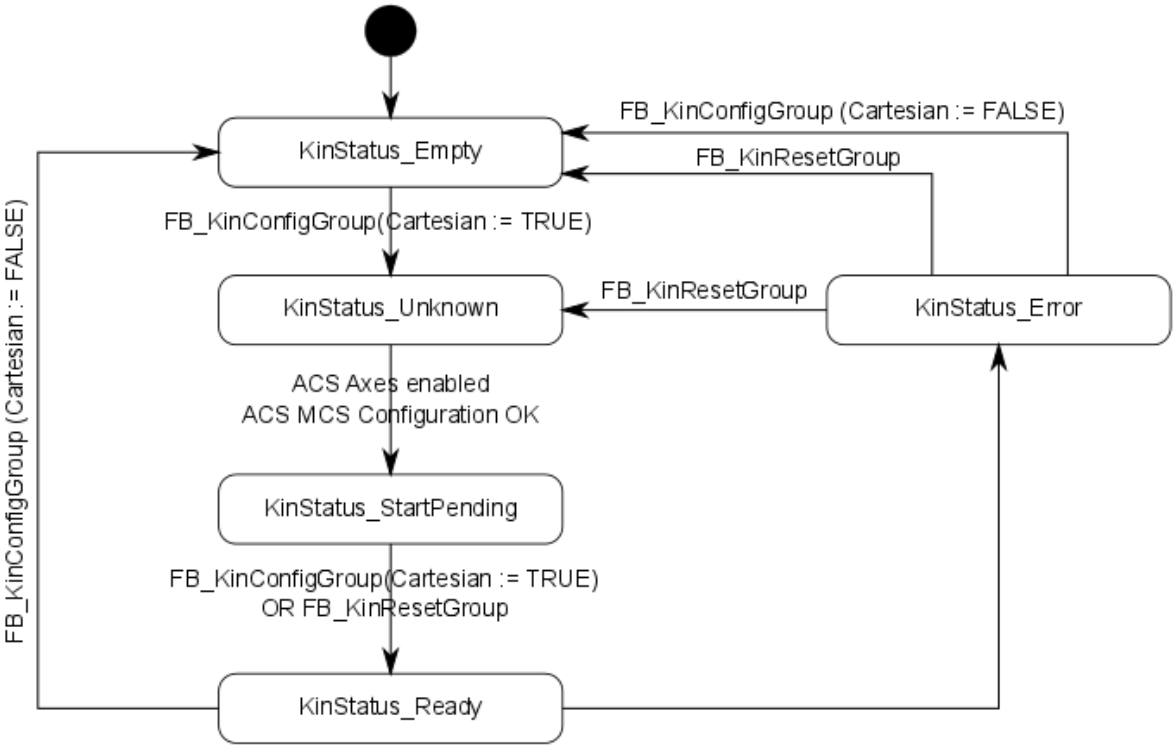
nErrorId: contains the command-specific error code of the most recently executed command. Details of the error code can be found in the ADS error documentation [▶ 59] or in the NC error documentation [▶ 61] (error codes from 0x4000).

Sample

```
VAR
    fbFB_ResetKinGroup   : FB_KinResetGroup;
    stAxesConfig         : stAxesConfig;
    in_stKinToPlc AT %I* : NCTOPLC_NCICHANNEL_REF;
END_VAR
```

```
fbFB_ResetKinGroup(
    bExecute := TRUE,
    nItpChannelId := 3,
    stKinRefIn := in_stKinToPlc,
    stAxesList := stAxesConfig,
    bBusy=> ,
    bDone=> ,
    bError=> ,
    nErrorId=> );
```

State of the kinematic group



8.1.3 FB_KinCalcTrafo

The function block FB_KinCalcTrafo calculates the forward or backward transformation, even if no kinematic group was created with FB_KinConfigGroup [▶ 45].

VAR_INPUT

```
VAR_INPUT
    bExecute              : BOOL;
    bForward              : BOOL;
    oidTrafo              : UDINT;
END_VAR
```

bExecute: The command is triggered by a rising edge at this input.

bForward: Determines whether the forward or backward transformation is calculated.

oidTrafo: Object-ID of the kinematic transformation object to be calculated. See example [▶ 50] below.

VAR_IN_OUT

```
VAR_IN_OUT
    stAxesPosIn           : ARRAY[1..8] OF LREAL;
    stAxesPosOut          : ARRAY[1..8] OF LREAL;
    uMetaInfoIn           : U_KinMetaInfo;
    uMetaInfoOut          : U_KinMetaInfo;
END_VAR
```

stAxesPosIn: Array containing the input positions of the transformation. For the calculation of a forward transformation they represent the joint positions. For the calculation of a backward transformation they represent the Cartesian axis positions.

stAxesPosOut: Array containing the result positions of the transformation. For the calculation of a forward transformation they represent the Cartesian axis positions. For the calculation of a backward transformation they represent the joint positions.

uMetaInfoIn: In cases where different robot configurations lead to a solution, the preferred solution can be selected (see sample [▶ 50]). For kinematics in which this parameter is not required, a dummy variable can be assigned to this input.

uMetaInfoOut: If different solutions are possible for a transformation, the solution that was found is specified. For kinematics in which this parameter is not required, a dummy variable can be assigned to this input.

VAR_OUTPUT

```
VAR_OUTPUT
    bBusy                : BOOL;
    bDone                : BOOL;
    bError               : BOOL;
    nErrorId             : UDINT;
END_VAR
```

bBusy: The output becomes TRUE when the command is started with *bExecute* and remains TRUE as long as the function block executes the command. While *bBusy* is TRUE, no new command is accepted at the inputs. If *bBusy* becomes FALSE again, the function block is ready for a new command. At the same time one of the outputs *bDone* or *bError* is set.

bDone: The output becomes TRUE when the command was executed successfully.

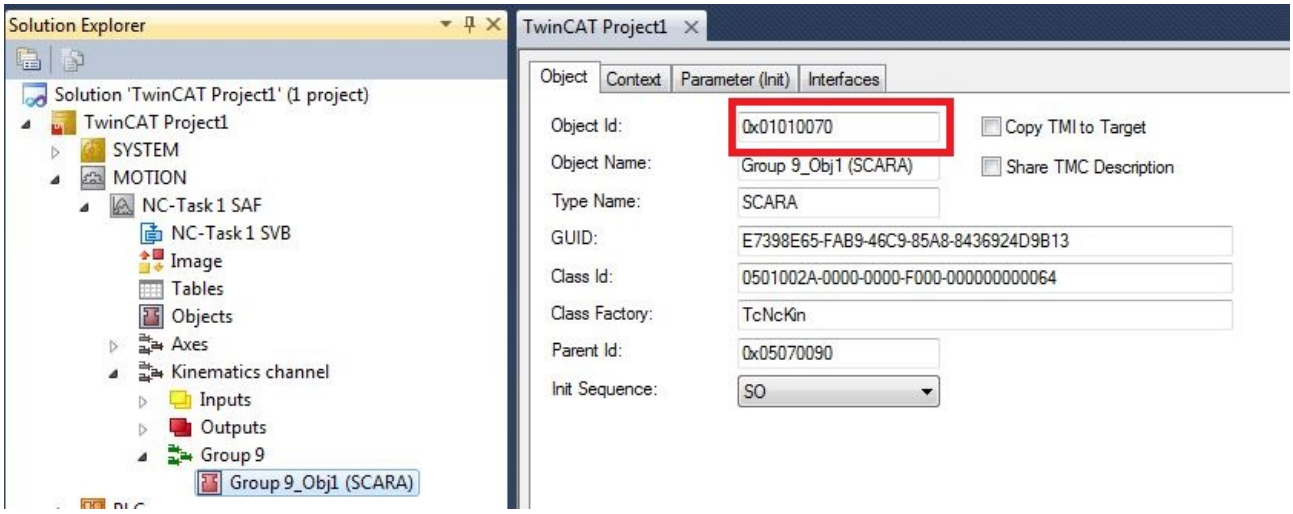
bError: The output *bError* is set to TRUE, if an error occurred during the command execution.

nErrorId: contains the command-specific error code of the most recently executed command. Details of the error code can be found in the ADS error documentation [▶ 59] or in the NC error documentation [▶ 61] (error codes from 0x4000).

Sample

The object ID of the transformation is shown in the transformation object under the kinematic channel.

SCARA transformation [▶ 28] - sample object ID




```
VAR
    fbFB_CalcTrafo     : FB_KinCalcTrafo;
    stAxesPosIn        : ARRAY[1..8] OF LREAL;
    stAxesPosOut       : ARRAY[1..8] OF LREAL;
    bUserExecute       : BOOL;
    bUserCalcFwdTrafo  : BOOL;
```

```
    uScaraMetaInfoIn : U_KinMetaInfo;
    uScaraMetaInfoOut : U_KinMetaInfo;
END_VAR
```

```
uScaraMetaInfoIn.eScara := E_KinMetaInfoScara.scaraLeftArm;

fbKinCalcTrafo(
bExecute := bUserExecute,
bForward := bUserCalcFwdTrafo,
oidTrafo := 16#01010070,
stAxesPosIn := stAxesPosIn,
stAxesPosOut := stAxesPosOut,
uMetaInfoIn:= uScaraMetaInfoIn ,
uMetaInfoOut:= uScaraMetaInfoOut,
bBusy=> ,
bDone=> ,
bError=> ,
nErrorId=> );
```

8.1.4 FB_KinUnlockTrafoParam

The function block FB_KinUnlockTrafoParam unlocks the transformation parameters for write access.

Once the kinematics parameters have been unlocked, the PLC has write access via ADSWRITE. The required index group is the object ID, the index offset is the parameter ID. The written parameters are not persistent.

⚠ CAUTION	
	Changing the parameters can lead to discontinuities. Please note that utmost caution is required. Redefinition of kinematic parameters can lead to position setpoint step changes in the kinematic chain.

VAR_INPUT

```
VAR_INPUT
    bExecute              : BOOL;
    oidTrafo              : UDINT;
END_VAR
```

bExecute: The command is triggered by a rising edge at this input.

oidTrafo: Object ID of the kinematic transformation object. See the example [▶ 52] below.

VAR_OUTPUT

```
VAR_OUTPUT
    bBusy                 : BOOL;
    bDone                 : BOOL;
    bError                : BOOL;
    nErrorId              : UDINT;
END_VAR
```

bBusy: The output becomes TRUE when the command is started with *bExecute* and remains TRUE as long as the function block executes the command. While *bBusy* is TRUE, no new command is accepted at the inputs. If *bBusy* becomes FALSE again, the function block is ready for a new command. At the same time one of the outputs *bDone* or *bError* is set.

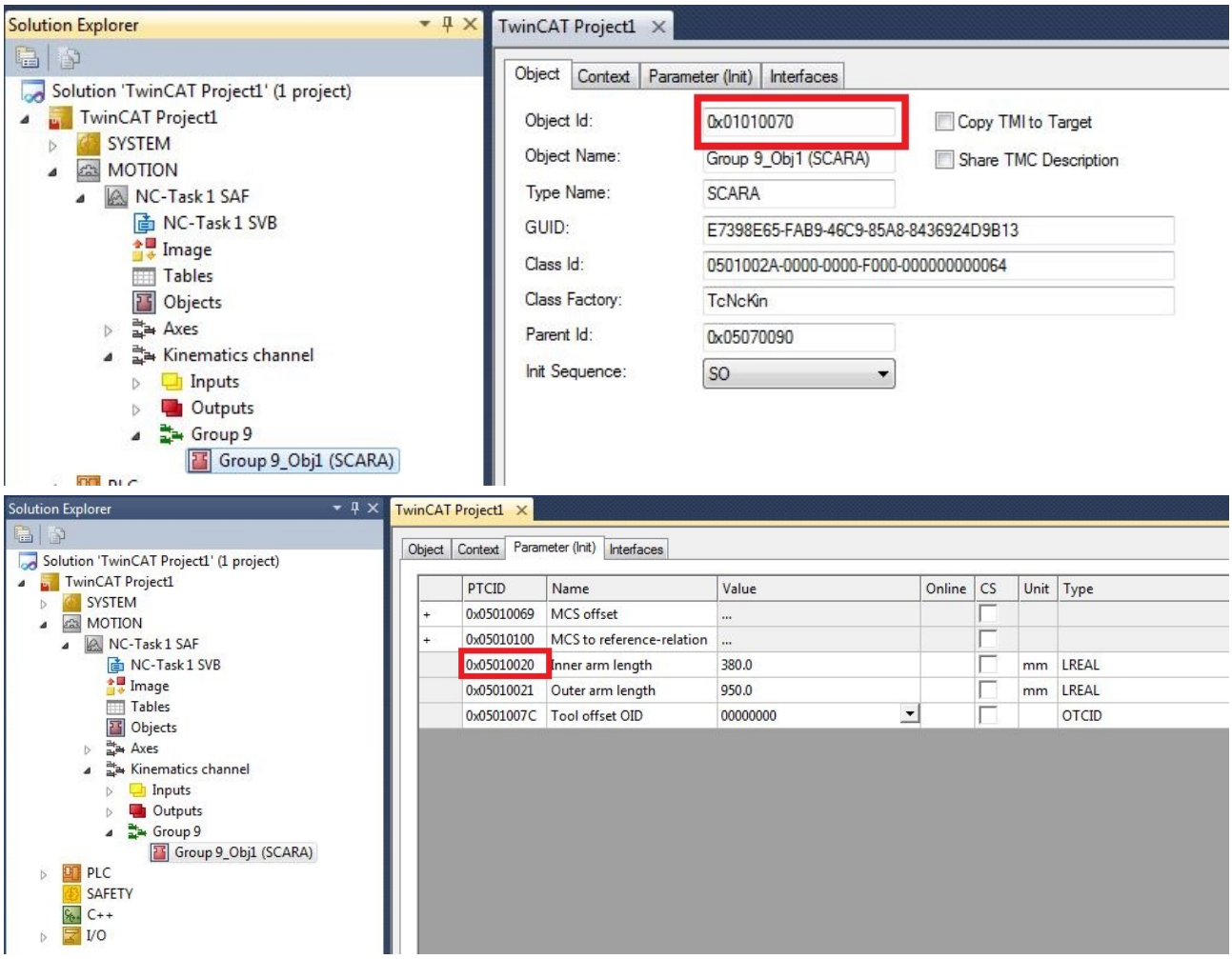
bDone: The output becomes TRUE when the command was executed successfully.

bError: The output *bError* is set to TRUE, if an error occurred during the command execution.

nErrorId: contains the command-specific error code of the most recently executed command. Details of the error code can be found in the ADS error documentation [▶ 59] or in the NC error documentation [▶ 61] (error codes from 0x4000).

Sample

The object ID and parameter ID required for enabling a transformation parameter and for writing a corresponding new value can be read from the transformation object in the XAE.




```
VAR
    bUserExecuteUnlock     : BOOL;
    fbFB_UnlockTrafoParam  : FB_KinUnlockTrafoParam;
    bUserExecuteWriteParam : BOOL;
    fbADSWRITE             : ADSWRITE;
    oidTrafo               : UDINT := 16#01010170; (*Trafo object id*)
    pidTrafo               : UDINT := 16#05010020; (*parameter id*)
    fParamValue            : LREAL;
END_VAR
```

```
fbFB_UnlockTrafoParam(
    bExecute := bUserExecuteUnlock,
    oidTrafo := oidTrafo,
    bBusy=>,
    bDone=>,
    bError=>,
    nErrorId=> );

(*After unlocking new parameter value can be written*)
fbADSWRITE(
    NETID:='' ,
    PORT:= AMSPORT_R0_NCSAF,
    IDXGRP:=oidTrafo ,
    IDXOFFS:= pidTrafo,
    LEN:=SIZEOF(fParamValue) ,
    SRCADDR:= ADR(fParamValue),
    WRITE:=bUserExecuteWriteParam ,
    TMOUT:= ,
    BUSY=> ,
    ERR=> ,
    ERRID=> );
```

8.1.5 FB_KinLockTrafoParam

Once the transformation parameters have been modified with the aid of FB_KinUnlockTrafoParam [▶ 51], the function block FB_KinLockTrafoParam locks the transformation parameters again, so that write access is no longer possible.

VAR_INPUT

```
VAR_INPUT
    bExecute            : BOOL;
    oidTrafo            : UDINT;
END_VAR
```

bExecute: The command is triggered by a rising edge at this input.

oidTrafo: Object-ID of the kinematic transformation object. See example [▶ 53] below.

VAR_OUTPUT

```
VAR_OUTPUT
    bBusy               : BOOL;
    bDone               : BOOL;
    bError              : BOOL;
    nErrorId            : UDINT;
END_VAR
```

bBusy: The output becomes TRUE when the command is started with *bExecute* and remains TRUE as long as the function block executes the command. While *bBusy* is TRUE, no new command is accepted at the inputs. If *bBusy* becomes FALSE again, the function block is ready for a new command. At the same time one of the outputs *bDone* or *bError* is set.

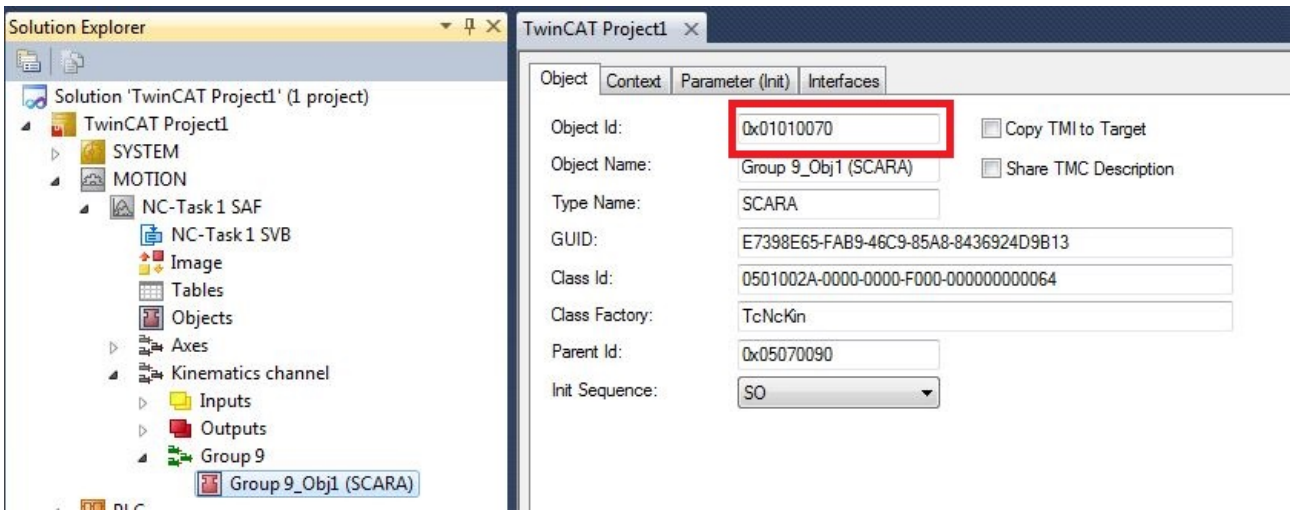
bDone: The output becomes TRUE when the command was executed successfully.

bError: The output *bError* is set to TRUE, if an error occurred during the command execution.

nErrorId: contains the command-specific error code of the most recently executed command. Details of the error code can be found in the ADS error documentation [▶ 59] or in the NC error documentation [▶ 61] (error codes from 0x4000).

Sample

SCARA transformation - sample object ID

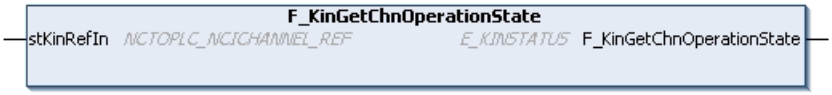


```
VAR
    bUserExecute         : BOOL;
    fbFB_LockTrafoParam  : FB_KinLockTrafoParam;
    oidTrafo             : UDINT := 16#01010070; (*Trafo object id*)
END_VAR
```

```
fbFB_LockTrafoParam(
    bExecute := bUserExecute,
    oidTrafo := oidTrafo,
    bBusy=>,
    bDone=>,
    bError=>,
    nErrorId=> );
```

8.2 Functions

8.2.1 F_KinGetChnOperationState



This function returns the operating state of the kinematic channel.

Function F_KinGetChnOperationState : E_KINSTATUS

```
VAR_IN_OUT
    stKinRefIn : NCTOPLC_NCICHANNEL_REF
END_VAR
```

stKinRefIn: Determines the kinematic group of the configuration.

Return value

E_KINSTATUS [▶ 55]: State of the kinematic channel (see below). If an invalid version of the cyclic interface is used, *KinStatus_InvalidItfVersion* is returned.

Sample

```
VAR
    stKinRefIn AT %I*      : NCTOPLC_NCICHANNEL_REF;
    nErrId                 : UDINT;
    eKinOperationState     : E_KINSTATUS;
END_VAR
```

```
IF F_KinGetChnOperationState (stKinRefIn)<> KinStatus_InvalidItfVersion THEN
    eKinOperationState := F_KinGetChnOperationState (stKinRefIn);
ELSE
    nErrId := F_KinGetChnOperationState (stKinRefIn);
END_IF
```

8.2.2 F_KinGetAcsMcsAxisIds

This function reads the configured ACS and MCS axes of the cyclic interface. The IDs are written to stAxesList.

FUNCTION F_KinGetAcsMcsAxisIds : UDINT

```
VAR_IN_OUT
    stAxesList : ST_KinAxes;
    stKinRefIn : NCTOPLC_NCICHANNEL_REF;
END_VAR
```

stAxesList: List of axis IDs for the axis coordinate system (ACS) and the machine coordinate system (MCS).

stKinRefIn: The structure of the cyclic channel interface between the kinematic channel and the PLC. This structure is only accessed for reading.

Return value

UDINT: Error code

Sample

```
VAR
    stAxesList          : ST_KinAxes;
    stKinRefIn AT %I*   : NCTOPLC_NCICHANNEL_REF;
    nErrId              : UDINT;
END_VAR
```

```
nErrId := F_KinGetAcsMcsAxisIds (stAxesList, stKinRefIn);
IF nErrId=0 THEN
    ;(*Axes List is valid*)
END_IF
```

8.3 Datatypes

8.3.1 ST_KinAxes

This structure defines the axes, which form a kinematic system.

```
TYPE ST_KinAxes :
STRUCT
    nAxisIdsMcs: ARRAY[1..8] OF DWORD;
    nAxisIdsAcs: ARRAY[1..8] OF DWORD;
END_STRUCT
END_TYPE
```

nAxisIdsMcs: List of axis IDs of the axes that form the MCS. Usually, the first three array elements specify the Cartesian axes (X,Y,Z), the subsequent array elements specify the rotational axes.

nAxisIdsAcs: List of axis IDs of the axes that form the ACS.

Sample

```
VAR
    stAxesConfig          : ST_KinAxes;
    io_X                  : AXIS_REF;
    io_Y                  : AXIS_REF;
    io_Z                  : AXIS_REF;
    io_M1                 : AXIS_REF;
    io_M2                 : AXIS_REF;
    io_M3                 : AXIS_REF;
END_VAR
```

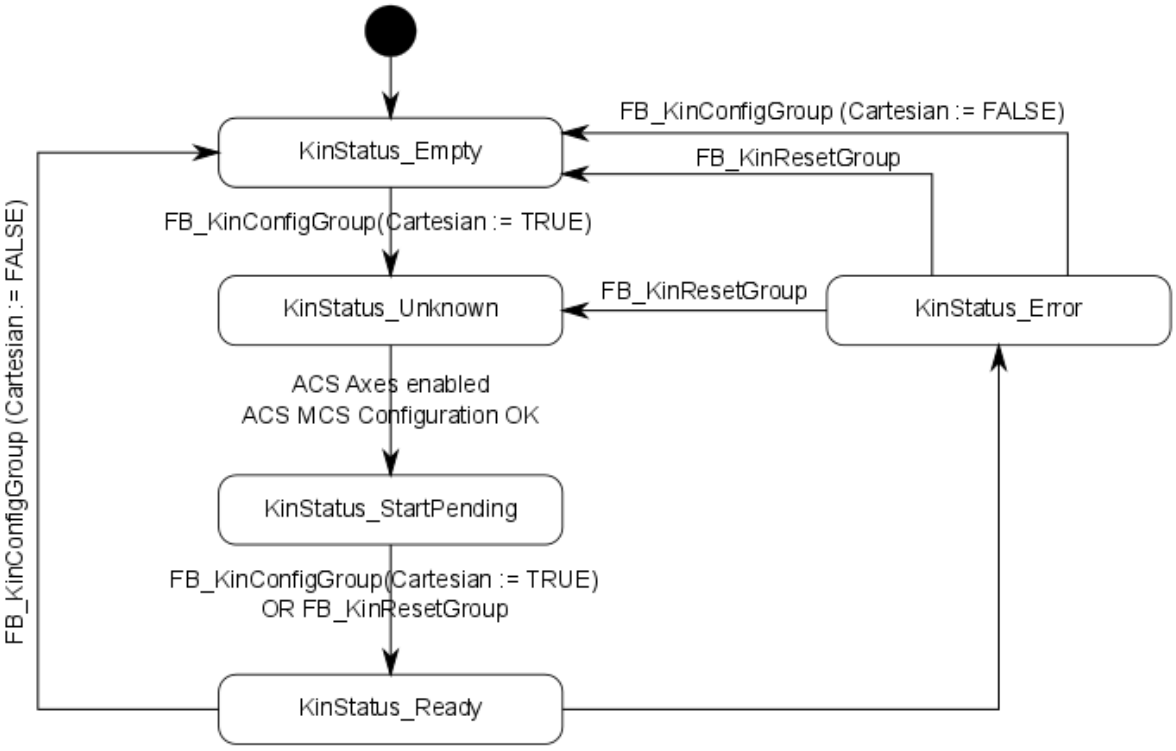
```
(* read the IDs from the cyclic axis interface so the axes can mapped later to the kinematic group
*)
stAxesConfig.nAxisIdsAcs[1] := io_M1.NcToPlc.AxisId;
stAxesConfig.nAxisIdsAcs[2] := io_M2.NcToPlc.AxisId;
stAxesConfig.nAxisIdsAcs[3] := io_M3.NcToPlc.AxisId;
stAxesConfig.nAxisIdsMcs[1] := io_X.NcToPlc.AxisId;
stAxesConfig.nAxisIdsMcs[2] := io_Y.NcToPlc.AxisId;
stAxesConfig.nAxisIdsMcs[3] := io_Z.NcToPlc.AxisId;
```

8.3.2 E_KinStatus

This enumeration defines the state of the kinematic group.

```
TYPE E_KinStatus :
(
    KinStatus_Error,
    KinStatus_Empty,
    KinStatus_Unknown,
```

```
    KinStatus_StartPending,
    KinStatus_Ready,
    KinStatus_InvalidItfVersion := 16#4000
);
END_TYPE
```



KinStatus_Empty: ACS axes can be moved. No transformation enabled.

KinStatus_Ready: MCS axes can be moved. Transformation active.

KinStatus_InvalidItfVersion: A function or function block is not supported by this version of the cyclic channel interface. An update is required in order to be able to use the function.

Enable configuration

The ACS axes must be enabled through MC_Power, to ensure that the state can reach the value **KinStatus_Ready**.

8.4 Legacy

8.4.1 FB_KinCheckActualStatus

Outdated version

The sole purpose of the function block is to ensure compatibility with existing projects. For new projects please use F_KinGetChnOperationState [▶ 54]. This function block needs more than one PLC cycle to read the status of the kinematic channel. To obtain the status for each cycle please use F_KinGetChnOperationState [▶ 54].

The function block FB_KinCheckActualStatus returns the status of the kinematic channel.

VAR_INPUT

```
VAR_INPUT
    bExecute              : BOOL;
END_VAR
```

bExecute: The command is triggered by a rising edge at this input.

VAR_IN_OUT

```
VAR_IN_OUT
    stAxesList            : ST_KinAxes;
    stKinRefIn            : NCTOPLC_NCICHANNEL_REF;
END_VAR
```

stAxesList: Determines the ACS and MCS axes included in the configuration. See ST_KinAxes.

stKinRefIn: Determines the kinematic group of the configuration.

VAR_OUTPUT

```
VAR_OUTPUT
    eKinStatus            : E_KINSTATUS;
    bBusy                 : BOOL;
    bDone                 : BOOL;
    bError                : BOOL;
    nErrorId              : UDINT;
END_VAR
```

eKinStatus: Returns the status of the kinematic channel. See E_KINSTATUS [▶ 55].

bBusy: The output becomes TRUE when the command is started with *bExecute* and remains TRUE as long as the function block executes the command. While *bBusy* is TRUE, no new command is accepted at the inputs. If *bBusy* becomes FALSE again, the function block is ready for a new command. At the same time one of the outputs *bDone* or *bError* is set.

bDone: The output becomes TRUE when the command was executed successfully.

bError: The output *bError* is set to TRUE, if an error occurred during the command execution.

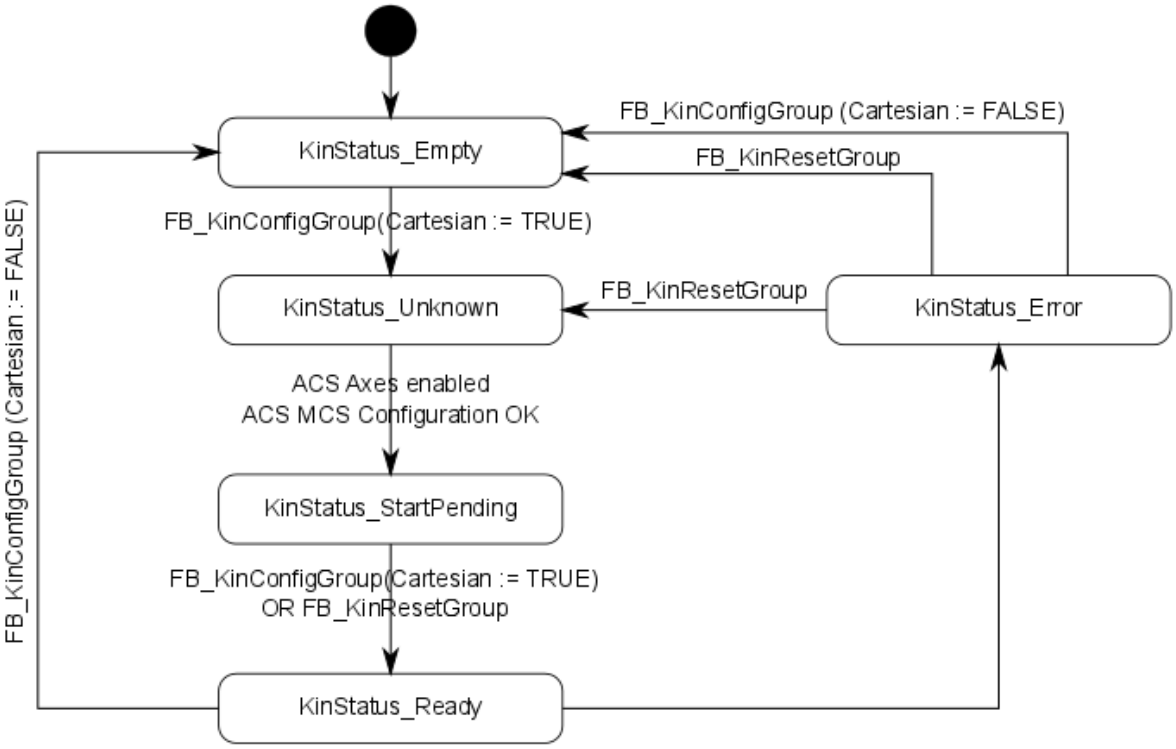
nErrorId: contains the command-specific error code of the most recently executed command. Details of the error code can be found in the ADS error documentation [▶ 59] or in the NC error documentation [▶ 61] (error codes from 0x4000).

Sample

```
VAR
    fbFB_KinCheckActualStatus  : FB_KinCheckActualStatus;
    in_stKinToPlc AT %I*       : NCTOPLC_NCICHANNEL_REF;
    stAxesConfig               : ST_KinAxes;
    eKinStatus                 : E_KINSTATUS;
END_VAR
```

```
fbFB_KinCheckActualStatus(
    bExecute            := TRUE,
    stAxesListReference := stAxesConfig,
    stKinRefIn          := in_stKinToPlc,
    eKinStatus          => eKinStatus      );
```

State of the kinematic group



9 Error Codes

9.1 ADS Return Codes

Error codes: 0x000 [▶ 59]..., 0x500 [▶ 59]..., 0x700 [▶ 60]..., 0x1000 [▶ 61]...

HRESULT

When output in HRESULT format, the ADS return codes are preceded by the high word 16#9811. The error 'Destination port not found' is then output as 16#9811_0006, for example.

Global Error Codes

Hex	Dec	Description
0x0	0	no error
0x1	1	Internal error
0x2	2	No Rtime
0x3	3	Allocation locked memory error
0x4	4	Insert mailbox error
0x5	5	Wrong receive HMSG
0x6	6	target port not found
0x7	7	target machine not found
0x8	8	Unknown command ID
0x9	9	Bad task ID
0xA	10	No IO
0xB	11	Unknown ADS command
0xC	12	Win 32 error
0xD	13	Port not connected
0xE	14	Invalid ADS length
0xF	15	Invalid AMS Net ID
0x10	16	Low Installation level
0x11	17	No debug available
0x12	18	Port disabled
0x13	19	Port already connected
0x14	20	ADS Sync Win32 error
0x15	21	ADS Sync Timeout
0x16	22	ADS Sync AMS error
0x17	23	ADS Sync no index map
0x18	24	Invalid ADS port
0x19	25	No memory
0x1A	26	TCP send error
0x1B	27	Host unreachable
0x1C	28	Invalid AMS fragment

Router Error Codes

Hex	Dec	Name	Description
0x500	1280	ROUTERERR_NOLOCKEDMEMORY	No locked memory can be allocated
0x501	1281	ROUTERERR_RESIZEMEMORY	The size of the router memory could not be changed
0x502	1282	ROUTERERR_MAILBOXFULL	The mailbox has reached the maximum number of possible messages. The current sent message was rejected
0x503	1283	ROUTERERR_DEBUGBOXFULL	The mailbox has reached the maximum number of possible messages. The sent message will not be displayed in the debug monitor
0x504	1284	ROUTERERR_UNKNOWNPORTTYPE	Unknown port type
0x505	1285	ROUTERERR_NOTINITIALIZED	Router is not initialized
0x506	1286	ROUTERERR_PORTALREADYINUSE	The desired port number is already assigned
0x507	1287	ROUTERERR_NOTREGISTERED	Port not registered

Hex	Dec	Name	Description
0x508	1288	ROUTERERR_NOMOREQUEUES	The maximum number of Ports reached
0x509	1289	ROUTERERR_INVALIDPORT	Invalid port
0x50A	1290	ROUTERERR_NOTACTIVATED	TwinCAT Router not active

General ADS Error Codes

Hex	Dec	Name	Description
0x700	1792	ADSERR_DEVICE_ERROR	General device error
0x701	1793	ADSERR_DEVICE_SRVNOTSUPP	Service is not supported by server
0x702	1794	ADSERR_DEVICE_INVALIDGRP	invalid index group
0x703	1795	ADSERR_DEVICE_INVALIDOFFSET	invalid index offset
0x704	1796	ADSERR_DEVICE_INVALIDACCESS	reading/writing not permitted
0x705	1797	ADSERR_DEVICE_INVALIDSIZE	parameter size not correct
0x706	1798	ADSERR_DEVICE_INVALIDDATA	invalid parameter value(s)
0x707	1799	ADSERR_DEVICE_NOTREADY	device is not in a ready state
0x708	1800	ADSERR_DEVICE_BUSY	device is busy
0x709	1801	ADSERR_DEVICE_INVALIDCONTEXT	invalid context (must be in Windows)
0x70A	1802	ADSERR_DEVICE_NOMEMORY	out of memory
0x70B	1803	ADSERR_DEVICE_INVALIDPARM	invalid parameter value(s)
0x70C	1804	ADSERR_DEVICE_NOTFOUND	not found (files, ...)
0x70D	1805	ADSERR_DEVICE_SYNTAX	syntax error in command or file
0x70E	1806	ADSERR_DEVICE_INCOMPATIBLE	objects do not match
0x70F	1807	ADSERR_DEVICE_EXISTS	object already exists
0x710	1808	ADSERR_DEVICE_SYMBOLNOTFOUND	symbol not found
0x711	1809	ADSERR_DEVICE_SYMBOLVERSIONINVAL	symbol version invalid
0x712	1810	ADSERR_DEVICE_INVALIDSTATE	server is in invalid state
0x713	1811	ADSERR_DEVICE_TRANSMODENOTSUPP	AdsTransMode not supported
0x714	1812	ADSERR_DEVICE_NOTIFYHNDINVALID	Notification handle is invalid
0x715	1813	ADSERR_DEVICE_CLIENTUNKNOWN	Notification client not registered
0x716	1814	ADSERR_DEVICE_NOMOREHDLS	no more notification handles
0x717	1815	ADSERR_DEVICE_INVALIDWATCHSIZE	size for watch too big
0x718	1816	ADSERR_DEVICE_NOTINIT	device not initialized
0x719	1817	ADSERR_DEVICE_TIMEOUT	device has a timeout
0x71A	1818	ADSERR_DEVICE_NOINTERFACE	query interface failed
0x71B	1819	ADSERR_DEVICE_INVALIDINTERFACE	wrong interface required
0x71C	1820	ADSERR_DEVICE_INVALIDCLSID	class ID is invalid
0x71D	1821	ADSERR_DEVICE_INVALIDOBJID	object ID is invalid
0x71E	1822	ADSERR_DEVICE_PENDING	request is pending
0x71F	1823	ADSERR_DEVICE_ABORTED	request is aborted
0x720	1824	ADSERR_DEVICE_WARNING	signal warning
0x721	1825	ADSERR_DEVICE_INVALIDARRAYIDX	invalid array index
0x722	1826	ADSERR_DEVICE_SYMBOLNOTACTIVE	symbol not active
0x723	1827	ADSERR_DEVICE_ACCESSDENIED	access denied
0x724	1828	ADSERR_DEVICE_LICENSENOTFOUND	missing license
0x725	1829	ADSERR_DEVICE_LICENSEEXPIRED	license expired
0x726	1830	ADSERR_DEVICE_LICENSEEXCEEDED	license exceeded
0x727	1831	ADSERR_DEVICE_LICENSEINVALID	license invalid
0x728	1832	ADSERR_DEVICE_LICENSESYSTEMID	license invalid system id
0x729	1833	ADSERR_DEVICE_LICENSENOTIMELIMIT	license not time limited
0x72A	1834	ADSERR_DEVICE_LICENSEFUTUREISSUE	license issue time in the future
0x72B	1835	ADSERR_DEVICE_LICENSETIMETOLONG	license time period to long
0x72c	1836	ADSERR_DEVICE_EXCEPTION	exception occured during system start
0x72D	1837	ADSERR_DEVICE_LICENSEDUPLICATED	License file read twice
0x72E	1838	ADSERR_DEVICE_SIGNATUREINVALID	invalid signature
0x72F	1839	ADSERR_DEVICE_CERTIFICATEINVALID	public key certificate
0x740	1856	ADSERR_CLIENT_ERROR	Error class <client error>

Hex	Dec	Name	Description
0x741	1857	ADSERR_CLIENT_INVALIDPARM	invalid parameter at service
0x742	1858	ADSERR_CLIENT_LISTEMPTY	polling list is empty
0x743	1859	ADSERR_CLIENT_VARUSED	var connection already in use
0x744	1860	ADSERR_CLIENT_DUPLINVOKEID	invoke ID in use
0x745	1861	ADSERR_CLIENT_SYNCTIMEOUT	timeout elapsed
0x746	1862	ADSERR_CLIENT_W32ERROR	error in win32 subsystem
0x747	1863	ADSERR_CLIENT_TIMEOUTINVALID	Invalid client timeout value
0x748	1864	ADSERR_CLIENT_PORTNOTOPEN	ads-port not opened
0x750	1872	ADSERR_CLIENT_NOAMSADDR	internal error in ads sync
0x751	1873	ADSERR_CLIENT_SYNCINTERNAL	hash table overflow
0x752	1874	ADSERR_CLIENT_ADDHASH	key not found in hash
0x753	1875	ADSERR_CLIENT_REMOVEHASH	no more symbols in cache
0x754	1876	ADSERR_CLIENT_NOMORESYM	invalid response received
0x755	1877	ADSERR_CLIENT_SYNCRESINVALID	sync port is locked

RTime Error Codes

Hex	Dec	Name	Description
0x1000	4096	RTERR_INTERNAL	Internal fatal error in the TwinCAT real-time system
0x1001	4097	RTERR_BADTIMERPERIODS	Timer value not vaild
0x1002	4098	RTERR_INVALIDTASKPTR	Task pointer has the invalid value ZERO
0x1003	4099	RTERR_INVALIDSTACKPTR	Task stack pointer has the invalid value ZERO
0x1004	4100	RTERR_PRIOEXISTS	The demand task priority is already assigned
0x1005	4101	RTERR_NOMORETCB	No more free TCB (Task Control Block) available. Maximum number of TCBs is 64
0x1006	4102	RTERR_NOMORESEMAS	No more free semaphores available. Maximum number of semaphores is 64
0x1007	4103	RTERR_NOMOREQUEUES	No more free queue available. Maximum number of queue is 64
0x100D	4109	RTERR_EXTIRQALREADYDEF	An external synchronization interrupt is already applied
0x100E	4110	RTERR_EXTIRQNOTDEF	No external synchronization interrupt applied
0x100F	4111	RTERR_EXTIRQINSTALLFAILED	The apply of the external synchronization interrupt failed
0x1010	4112	RTERR_IRQLNOTLESSOREQUAL	Call of a service function in the wrong context
0x1017	4119	RTERR_VMXNOTSUPPORTED	Intel VT-x extension is not supported
0x1018	4120	RTERR_VMXDISABLED	Intel VT-x extension is not enabled in system BIOS
0x1019	4121	RTERR_VMXCONTROLSMISSING	Missing function in Intel VT-x extension
0x101A	4122	RTERR_VMXENABLEFAILS	Enabling Intel VT-x fails

TCP Winsock Error Codes

Hex	Dec	Description
0x274D	10061	A connection attempt failed because the connected party did not properly respond after a period of time, or established connection failed because connected host has failed to respond.
0x2751	10065	No connection could be made because the target machine actively refused it. This error normally occurs when you try to connect to a service which is inactive on a different host - a service without a server application.
0x274C	10060	No route to a host. A socket operation was attempted to an unreachable host
		Further Winsock error codes: Win32 Error Codes

9.2 Overview of NC Errors

Error code (hex)	Description
0x4000 - 0x4FFF: NC error code range	
0x40nn	General errors [▶ 62]
0x41nn	Channel Errors [▶ 64]
0x42nn	Group Errors [▶ 67]
0x43nn	Axis Errors [▶ 86]

Error code (hex)	Description
0x44nn	Encoder Errors [▶ 93]
0x45nn	Controller Errors [▶ 98]
0x46nn	Drive Errors [▶ 103]
0x4Ann	Table Errors [▶ 109]
0x4Bnn	NC PLC errors [▶ 111]
0x4Cnn	Kinematic Transformation [▶ 117]
0x8000 … 0x8FFF: New extended NC error code range	
0x81nn - 0x811F	Bode plot (diagnosis) [▶ 117]
0x8120 - 0x8FFF	further errors [▶ 119]

9.2.1 General NC Errors

Error(Hex)	Error(Dec)	Error type	Description
4000	**16384**	internal	**"Internal error"** Internal system error in the NC on ring 0, no further details.
4001	**16385**	memory	**"Memory error"** The ring-0 memory management is not providing the required memory. This is usually a result of another error, as a result of which the controller will halt normal operation (now if not before).
4002	**16386**	internal	**"Nc retain data error (persistent data)"** Error while loading the Nc retain data. The axes concerned are no longer referenced (status flag "Homed" is set to FALSE). Possible reasons are: - Nc retain data not found - Nc retain data expired (old backup data) - Nc retain data corrupt or inconsistent
4003	**16387**	Parameter	**Parameter for Monitoring the NC Setpoint Issuing is Invalid** The parameter for activating or deactivating the function “cyclic monitoring of NC setpoint issuing on continuity and consistency” is invalid. (Special function.)
4004	**16388**	Internal	**External Error** This error code can be set by an external module (e.g. third-party module) or can be set when an external module exhibits an error.
4010	**16400**	parameter	**"Channel identifier not allowed"** Either an unacceptable value (not 1...255) has been used, or a channel that does not exist in the system has been named.
4011	**16401**	parameter	**"Group identifier not allowed"** Either an unacceptable value (not 1...255) has been used, or a group that does not exist in the system has been named.
4012	**16402**	parameter	**"Axis identifier not allowed"** Either an unacceptable value (not 1...255) has been used, or an axis that does not exist in the system has been named.
4013	**16403**	parameter	**"Encoder identifier not allowed"** Either an unacceptable value (not 1...255) has been used, or a encoder that does not exist in the system has been named.

Error(Hex)	Error(Dec)	Error type	Description
4014	**16404**	parameter	**"Controller identifier not allowed"** Either an unacceptable value (not 1...255) has been used, or a controller that does not exist in the system has been named.
4015	**16405**	parameter	**"Drive identifier not allowed"** Either an unacceptable value (not 1...255) has been used, or a drive that does not exist in the system has been named.
4016	**16406**	parameter	**"Table identifier not allowed"** Either an unacceptable value (not 1...255) has been used, or a table that does not exist in the system has been named.
4020	**16416**	internal	**"No process image"** No PLC-axis interface during creation of an axis.
4021	**16417**	internal	**"No process image"** No axis-PLC interface during creation of an axis.
4022	**16418**	internal	**"No process image"** No encoder-I/O interface during creation of an axis.
4023	**16419**	internal	**"No process image"** No I/O-encoder interface during creation of an axis.
4024	**16420**	internal	**"No process image"** No drive-I/O interface during creation of an axis.
4025	**16421**	internal	**"No process image"** No I/O-drive interface during creation of an axis.
4030	**16432**	internal	**"Coupling type not allowed"** Unacceptable master/slave coupling type.
4031	**16433**	internal	**"Axis type not allowed"** Unacceptable type specification during creation of an axis.
4032	**16434**	Parameter	**Unknown Channel Type** The `NC` channel type is unknown. Known types are e.g. an `NCI` channel, a `FIFO` channel, etc..
4040	**16448**	internal	**"Axis is incompatible"** Axis is not suitable for the intended purpose. A high speed/low speed axis, for example, cannot function as a slave in an axis coupling.
4050	**16464**	internal	**"Channel not ready for operation"** The channel is not complete, and is therefore not ready for operation. This is usually a consequence of problems at system start-up.
4051	**16465**	internal	**"Group not ready for operation"** The group is not complete, and is therefore not ready for operation. This is usually a consequence of problems at system start-up.
4052	**16466**	internal	**"Axis not ready for operation"** The axis is not complete, and is therefore not ready for operation. This is usually a consequence of problems at system start-up.
4060	**16480**	internal	**"Channel exists"** The channel that is to be created already exists.
4061	**16481**	internal	**"Group exists"** The group that is to be created already exists.
4062	**16482**	internal	**"Axis exists"** The axis that is to be created already exists.
4063	**16483**	internal	**"Table exists"** The table that is to be created already exists, resp. it is tried internally to use an already existing table id (e.g. for the universal flying saw).
4070	**16496**	internal	**"Axis index not allowed"** The location within the channel specified for an axis is not allowed.

Error(Hex)	Error(Dec)	Error type	Description
4071	**16497**	internal	**"Axis index not allowed"** The location within the group specified for an axis is not allowed.

9.2.2 Channel Errors

Error(Hex)	Error(Dec)	Error type	Description
4101	**16641**	Parameter	**"Group index not allowed"** The location within the channel specified for a group is not allowed.
4102	**16642**	Address	**"Null pointer"** The pointer to the group is invalid. This is usually a consequence of an error at system start-up.
4103	**16643**	Internal	**"No process image"** It is not possible to exchange data with the PLC. Possible causes: n the channel does not have an interface (no interpreter present) n The connection to the PLC is faulty
4104	**16644**	Parameter	**"M-function index not allowed"** Unacceptable M-function (not 0...159) detected at the execution level.
4105	**16645**	Memory	**"No memory"** No more system memory is available. This is usually the result of another error.
4106	**16646**	Function	**"Not ready"** The function is not presently available, because a similar function is already being processed. This is usually the result of access conflicts: more than one instance wants to issue commands to the channel. This can, for example, be the consequence of an incorrect PLC program.
4107	**16647**	Function	**"Function/command not supported"** A requested function or command is not supported by the channel.
4108	**16648**	Parameter	**"Invalid parameter while starting"** Parameters to start the channel (TwinCAT-Start) are invalid. Typically there is an invalid memory size or channel type requested.
4109	**16649**	Function	**"Channel function/command not executable"** A channel function e.g. interpreter start is not executable because the channel is already busy, no program is loaded or in an error state.
410A	**16650**	Function	**"ItpGoAhead not executable"** The requested command is not executable, because the interpreter is not executing a decoder stop.
4110	**16656**	Parameter	**"Error opening a file"** The specified file does not exist. Sample: NC program unknown.
4111	**16657**	NC programming	**"Syntax error during loading"** The NC has found a syntax error when loading an NC program.
4112	**16658**	NC programming	**"Syntax error during interpretation"** The NC has found a syntax error when executing an NC program.
4113	**16659**	NC programming	**"Missing subroutine"** The NC has found a missing subroutine while loading.
4114	**16660**	Memory	**"Loading buffer of interpreter is too small"** The capacity of the interpreter loading buffer has been exceeded.
4115	**16661**	Internal	“**Symbolic**” - reserved
4116	**16662**	Internal	“**Symbolic**” - reserved

Error(Hex)	Error(Dec)	Error type	Description
4117	**16663**	NC programming	**"Subroutine incomplete"** Header of subroutine is missing
4118	**16664**	NC programming	**"Error while loading the NC program"** The maximum number of loadable NC programs has been reached. Possible cause: Too many sub-programs were loaded from a main program.
4119	**16665**	NC programming	**"Error while loading the NC program"** The program name is too long.
4120	**16672**	NC programming	**"Divide by zero"** The NC encountered a computation error during execution: division by 0.
4121	**16673**	NC programming	**"Invalid circle parameterization"** The NC encountered a computation error during execution: The specified circle cannot be calculated.
4122	**16674**	NC programming	**"Invalid FPU-Operation"** The NC encountered an invalid FPU-Operation during execution. This error occurs e.g. by calculating the square root of a negative number.
4130	**16688**	NC programming	**"Stack overflow: subroutines"** The NC encountered a stack overflow during execution: too many subroutine levels.
4131	**16689**	NC programming	**"Stack underflow: subroutines"** The NC encountered a stack underflow during execution: too many subroutine return commands. Note: A main program must not end with a return command.
4132	**16690**	NC programming	**"Stack overflow: arithmetic unit"** The NC encountered a stack overflow during execution: The calculation is too complex, or has not been correctly written.
4133	**16691**	NC programming	**"Stack underflow: arithmetic unit"** The NC encountered a stack underflow during execution: The calculation is too complex, or has not been correctly written.
4140	**16704**	Parameter	**"Register index not allowed"** The NC encountered an unacceptable register index during execution: Either the program contains an unacceptable value (not R0...R999) or a pointer register contains an unacceptable value.
4141	**16705**	NC programming	**"Unacceptable G-function index"** The NC has encountered an unacceptable G-function (not 0...159) during execution.
4142	**16706**	NC programming	**"Unacceptable M-function index"** The NC has encountered an unacceptable M-function (not 0...159) during execution.
4143	**16707**	NC programming	**"Unacceptable extended address"** The NC has encountered an unacceptable extended address (not 1...9) during execution.
4144	**16708**	NC programming	**"Unacceptable index to the internal H-function"** The NC has encountered an unacceptable internal H-function in the course of processing. This is usually a consequence of an error during loading.
4145	**16709**	Parameter	**"Machine data value unacceptable"** While processing instructions the NC has detected an impermissible value for the machine data (MDB) (not 0…7).

Error(Hex)	Error(Dec)	Error type	Description
4150	**16720**	Parameter	**"Cannot change tool params here"** The NC has encountered an unacceptable change of parameters for the tool compensation during execution. This error occurred for instance by changing the tool radius and programming a circle in the same block.
4151	**16721**	Parameter	**"Cannot calculate tool compensation"** The NC has encountered an error by the calculation of the tool compensation.
4152	**16722**	NC programming	**Tool compensation:** The plane for the tool compensation cannot be changed here. This error occurred for instance by changing the tool plane when the compensation is turned on or active.
4153	**16723**	NC programming	**Tool compensation:** The D-Word is missing or invalid by turning on the tool compensation.
4154	**16724**	NC programming	**Tool compensation:** The specified tool radius is invalid because the value is less or equal zero.
4155	**16725**	NC programming	**Tool compensation:** The tool radius cannot be changed here
4156	**16726**	Internal	**Tool compensation:** Collision Detection Table is full.
4157	**16727**	Internal	**Tool compensation:** Internal error while turning on the contour collision detection.
4158	**16728**	Internal	**Tool compensation:** Internal error within the contour collision detection: update reversed geo failed.
4159	**16729**	NC programming	**Tool compensation:** Unexpected combination of geometry types by active contour collision detection.
415A	**16730**	NC programming	**Tool compensation:** Programmed inner circle is smaller than the cutter radius
415B	**16731**	NC programming	**Tool compensation:** Bottle neck detection recognized contour violation
415C	**16732**	Memory	Table for corrected entries is full
415D	**16733**	Memory	Input table for tangential following is full
415E	**16734**	Memory	Executing table for tangential following is full
415F	**16735**	Internal	Geometric entry for tangential following cannot be calculated
4160	**16736**	Internal	reserved
4161	**16737**	Internal	reserved
4162	**16738**	Parameter	The actual active interpolation rules (g-code), zero-shifts, or rotation cannot be detected
4170	**16752**	NC programming	**"Error while loading: Invalid parameter"** The NC has found an invalid parameter while loading an NC program.
4171	**16753**	Internal	**"Invalid contour start position"** The NC encountered a computation error during execution: The specified contour cannot be calculated because the initial position is not on the contour.
4172	**16754**	Internal	**"Retrace: Invalid internal entry index"** The NC encountered an invalid internal entry index during execution of the retrace function.
4173	**16755**	NC Programming	**Invalid G Code** Invalid default G Code. False expression/syntax in default G Code.

Error(Hex)	Error(Dec)	Error type	Description
4174	**16756**	NC Programming	**Error while Opening the G Code File** Error while opening the default G code file.

9.2.3 Group Errors

Error(Hex)	Error(Dec)	Error type	Description	
4200	**16896**	Parameter	**"Group ID not allowed"** The value for the group ID is not allowed, e.g. because it has already been assigned, is less than or equal to zero, or is greater than 255.	
			Value range: [1 ... 255]	Unit: 1
4201	**16897**	Parameter	**"Group type not allowed"** The value for the group type is unacceptable because it is not defined. Type 1: PTP group with slaves (servo) Type 4: DXD group with slaves (3D group) Type 5: High/low speed group Type 6: Stepper motor group Type 9: Encoder group with slaves (servo) …	
			Value range: [1 ... 12]	Unit: 1
4202	**16898**	Initialization	**"Master axis index not allowed"** The value for the master axis index in an interpolating 3D group is not allowed, because, for instance, it has gone outside the value range. Index 0: X axis (first master axis) Index 1: Y axis (second master axis) Index 2 : Z axis (third master axis)	
			Value range: [0, 1, 2]	Unit: 1
4203	**16899**	Initialization	**"Slave axis index not allowed" (INTERNAL ERROR)** The value for the slave axis index in a group is not allowed, because, for instance, it has passed outside the value range, the slave location to be used when inserting a new slave connection is already occupied, or because no slave is present when such a connection is being removed. Index 0: First slave axis Index 1: Second slave axis Index 2: etc.	
			Value range: [0 ... 7]	Unit: 1
4204	**16900**	Initializing	**Internal Error** A nonexpected internal error has occurred. The following situations may have caused this effect: There is not enough TC router memory or Windows memory to establish the internal NC objects, internal NC structures and links (pointers between NC objects) are erroneous or are missing, a fatal internal error in calculating a stop command or a halt command has occurred, internal checking of NC own logic and algorithms (self-checking software), nonexpected modes and cases that are not intended regularly, but are recognized being erroneous. Note: Quite often in such an error situation an additional error message in the Windows event logger is thrown that can be helpful for a more detailed analysis by Beckhoff or by the user.	

Error(Hex)	Error(Dec)	Error type	Description	
4205	**16901**	Parameter	**"Invalid cycle time for statement execution task (SAF)"** The value of the cycle time for the NC block execution task (SAF 1/2) is not allowed, because it has passed outside the value range.	
			Value range: [0.001 ... 0.1]	Unit: s
4206	**16902**	Initialization	**"**GROUPERR_RANGE_MAXELEMENTSINAXIS **"**	
4207	**16903**	Parameter	**"Invalid cycle time for the statement preparation task (SVB)"** The value of the cycle time for the NC statement preparation task (SVB 1/2) is not allowed, because it has passed outside the value range.	
			Value range: [0.001 ... 1.0]	Unit: s
4208	**16904**	Parameter	**"Single step mode not allowed"** The flag for the activation or deactivation of single step mode is not allowed. Value 0: Passive (buffered operation) Value 1: Active (single-block operation)	
			Value range: [0, 1]	Unit: 1
4209	**16905**	Parameter	**"Group deactivation not allowed" (INTERNAL ERROR)** The flag for the deactivation or activation of the complete group is not allowed. Value 0: Group active Value 1: Group passive	
			Value range: [0, 1]	Unit: 1
420A	**16906**	Initialization	**"Statement execution state (SAF state) not allowed" (INTERNAL ERROR)** The value for the state of the block execution state machine (SAF state) is not allowed. This error occurs on passing outside the range of values, or if the state machine enters an error state.	
			Value range: [0 ... 5]	Unit: 1
420B	**16907**	Address	**"Channel address"** The group does not have a channel, or the channel address has not been initialized.	
420C	**16908**	Address	**"Axis address (master axis)"** The group does not have a master axis (or axes) or the axis address(es) has (have) not been initialized.	
420D	**16909**	Address	**"Master axis address"** A new master/slave coupling is to be inserted into the group, but there is no valid address for the leading master axis.	
420E	**16910**	Address	**"Slave axis address"** A master/slave coupling is to be inserted into the group, but there is no valid address for the slave axis.	
420F	**16911**	Address	**"Slave set value generator address"** A master/slave coupling is to be inserted into the group, but there is no valid address for the slave set value generator.	
4210	**16912**	Address	**"Encoder address"** An axis in the group does not have an encoder, or the encoder address has not been initialized.	
4211	**16913**	Address	**"Controller address"** An axis in the group does not have a controller, or the controller address has not been initialized.	
4212	**16914**	Address	**"Drive address"** An axis in the group does not have a drive, or the drive address has not been initialized.	
4213	**16915**	Address	**Address Master Setpoint Generator** A group (e.g. `FIFO` group) does not own a master setpoint generator or a setpoint generator address has not been initialized. Possibly, there may not be enough memory available.	
4214	**16916**	Address	**"Axis interface NC to PLC address"** Group/axis does not have an axis interface from the NC to the PLC, or the axis interface address has not been initialized.	

Error(Hex)	Error(Dec)	Error type	Description
4215	**16917**	Address	**"Slave axis address"** An existing master/slave coupling is to be removed from the group, but there is no valid address for the slave axis.
4216	**16918**	Address	**"Table address unknown"** The table, respectively the table ID, is unknown. This table is used for the master/slave coupling or for the characteristic curve.
4217	**16919**	Address	**"NcControl address"** The NcControl address has not been initialized.
4218	**16920**	Initialization	**"Axis is blocked for commands while persistent NC data are queued"** Axis is blocked for commands while waiting for valid IO data to accept the queued persistent NC data.
4219	**16921**	Function	**"The scaling mode MASTER-AUTOOFFSET is invalid because no reference table was found".** The used scaling mode MASTER-AUTOOFFSET is invalid in this context because an existing reference table is missing. This error can occur for example when adding cam tables without a unique reference to an existing cam table.
421A	**16922**	Parameter	**"The master axis start position does not permit synchronization"** When a slave axis is being coupled on, the position of the master axis does not permit synchronization at the given synchronization positions.
421B	**16923**	Parameter	**"Slave coupling factor (gearing factor) of 0.0 is not allowed"** A master/slave coupling with a gearing factor of 0.0 is being created. This value is not allowed, since it does not correspond to any possible coupling, and division will generate an FPU exception.
421C	**16924**	Function	**"Insertion of master axis into group not allowed"** A master axis is to be inserted into a group at a location that is already occupied by another master axis. Maybe the reconfiguration cannot be done, because this axis has got an existing slave coupling. This master/slave coupling must be revoked before.
421D	**16925**	Function	**"Deletion of master axis from group not allowed" (INTERNAL ERROR)** A master axis is to be removed from a location in a group that is not in fact occupied by master axis.
421E	**16926**	Function	**"Function/feature is not supported from the setpoint generator** A function or feature is not supported from the setpoint generator (e.g. PTP master setpoint generator). This can be in general or only in a special situation.
421F	**16927**	Initialization	**"Group initialization"** Group has not been initialized. Although the group has been created, the rest of the initialization has not been performed (1. Initialization of group I/O, 2. Initialization of group, 3. Reset group).
4220	**16928**	Monitoring	**"Group not ready / group not ready for new task"** The group is being given a new task while it is still in the process of executing an existing task. This request is not allowed because it would interrupt the execution of the previous task. The new task could, for instance, be a positioning command, or the "set actual position" function. Precisely the converse relationships apply for the "set new end position" function. In that case, the group/axis must still be actively moving in order to be able to cause a change in the end position.

Error(Hex)	Error(Dec)	Error type	Description
4221	**16929**	Monitoring	**"Requested set velocity is not allowed"** The value requested for the set velocity of a positioning task is less than or equal to zero, larger than the "maximum velocity" (see axis parameters), or, in the case of servo-drives, is larger than the "reference velocity" of the axis (see drive parameters).
4222	**16930**	Monitoring	**"Requested target position is not allowed (master axis)"** The requested value for the target position of a positioning task is not within the software end locations. In other words, it is either less than the minimum software end location or larger than the maximum software end location. This check is only carried out if the relevant end position monitoring is active.
4223	**16931**	Monitoring	**"No enable for controller and/or feed (Master axis)"** The axis enables for the master axis needed for positioning are not present. This can involve the controller enable and/or the relevant, direction-dependent feed enable (see axis interface PlcToNc).
4224	**16932**	Monitoring	**"Movement smaller than one encoder increment" (INTERNAL ERROR)** The distance that a group/axis is supposed to move is smaller than the physical significance of one encoder increment. In other words the movement is smaller than the scaling factor of the axis. The reaction to this is that the axis is reported as having logically finished without having actively moved. This means that an external error is not generated for the user. This error is also issued for high/low speed axes if a loop movement with nonzero parameters is smaller than the sum of the creeping and braking distances. In such a case it is not meaningful to either exceed or to fail to reach the target position.
4225	**16933**	Monitoring	**"Drive not ready during axis start"** During an axis start it is ascertained that the drive is not ready. The following are possible causes: - the drive is in the error state (hardware error) - the drive is in the start-up phase (e.g. after an axis reset that was preceded by a hardware error) - the drive is missing the controller enable (ENABLE) Note: The time required for "booting" a drive after a hardware fault can amount to several seconds.
4226	**16934**	Monitoring	**"Invalid parameters of the emergency stop."** Either, both, the deceleration and the jerk are less than zero or one of the parameters is weaker than the corresponding parameter of the start data.
4227	**16935**	Function	**"The setpoint generator is inactive such that no instructions are accepted."**
4228	**16936**	Monitoring	**"Requested traverse distance is not allowed"** The requested traverse distance or looping distance is smaller than the braking distance of the two/speed axis.
4229	**16937**	Monitoring	**"Requested target position is not allowed (slave axis)"** The value for the target position of a positioning task when calculated for the slave axis is not within the software end locations. In other words, it is either less than the minimum software end location or larger than the maximum software end location. This check is only carried out if the relevant end position monitoring is active.
422A	**16938**	Monitoring	**"No enable for controller and/or feed (slave axis)"** The axis enables for one or more coupled slave axes needed for positioning are not present. This can involve the controller enable and/or the relevant, direction-dependent feed enable (see axis interface PlcToNc).

Error(Hex)	Error(Dec)	Error type	Description
422B	**16939**	Parameter	**"The activation position (position threshold) is out of range of the actual positioning"** The activation position (position threshold) of a new axis command (e.g. "new velocity activated at a position") is out of range. E.g. the activation position is before the actual position or behind the target position.
422C	**16940**	Parameter	**"The start or activation data of the external setpoint generation are not valid"** This may be caused through: 1. The external setpoint generation is active and a new activation with a start type (1: absolute, 2: relative) unequal to the current one is send. 2. The internal setpoint generation is active (e.g. PTP) and the external one is activated with the type absolute (two setpoint generators of the type absolute are not possible).
422D	**16941**	Parameter	**"Velocity is not constant"** For changing the dynamic parameter 'acceleration' und 'deceleration' the axis has to be in dynamic state without acceleration and deceleration (that means constant velocity).
422E	**16942**	Parameter	**"Jerk less than or equal to 0.0 is not allowed"** A value less than or equal to 0.0 for the jerk (PTP and CNC) is not allowed, since the jerk is by definition positive, and with a jerk of 0.0, division will generate an FPU exception.
422F	**16943**	Parameter	**"Acceleration less than or equal to 0.0 is not allowed"** A value less than or equal to 0.0 for the acceleration (PTP and CNC) is not allowed, since the acceleration is positive by definition, and an acceleration of 0.0 will not allow a motion to be generated.
4230	**16944**	Parameter	**"Absolute deceleration value less than or equal to 0.0 is not allowed"** A value less than or equal to 0.0 for the absolute value of the deceleration (PTP and CNC) is not allowed, since the absolute value of the deceleration is positive by definition, and an absolute value of the deceleration of 0.0 will not allow a motion to be generated.
4231	**16945**	Parameter	**"Set velocity less than or equal to 0.0 is not allowed"** A value less than or equal to 0.0 or outside the range from 10^{-3} up to 10^{+10} for the set velocity (PTP and CNC) is not allowed, since the set velocity is by definition strictly positive, and with a set velocity of 0.0, division will generate an FPU exception.
4232	**16946**	Monitoring	**"Loss of precision when trying a positioning"** The positioning is so long in space or time that decimal parts loose there relevance LOSS_OF_PRECISION).
4233	**16947**	Parameter	**"Cycle time less than or equal to 0.0 is not allowed"** A value less than or equal to 0.0 for the cycle time (PTP and CNC) is not allowed, since the cycle time is by definition strictly positive, and with a cycle time of 0.0, division will generate an FPU exception.
4234	**16948**	Internal	**"PTP data type <intasdouble> range exceeded"** Such extreme parameters have been supplied for the start task, the override or the new target position that the internal data type loses its precision.
4235	**16949**	Function	**"PTP LHL velocity profile cannot be generated" (INTERNAL ERROR)** Such extreme parameters have been supplied for the start task, the override or the new target position that it is not possible to generate a velocity profile of the type LHL (Low-High-Low).

Error(Hex)	Error(Dec)	Error type	Description
4236	**16950**	Function	**"PTP HML velocity profile cannot be generated" (INTERNAL ERROR)** Such extreme parameters have been supplied for the override or the new target position that it is not possible to generate a velocity profile of the type HML (High-Middle-Low).
4237	**16951**	Address	**"Start data address is invalid"** The address of the start data is invalid.
4238	**16952**	Parameter	**"Velocity override (start override) is not allowed"** The value for the velocity override is not allowed, because it is less than 0.0% or more than 100.0% (see axis interface PlcToNc). Here, 100.0 % corresponds to the integral value 1000000 in the axis interface. Value range: [0 ... 1000000]
4239	**16953**	Parameter	**"Start type not allowed"** The start type supplied does not exist.
423A	**16954**	Monitoring	**"Velocity overflow (overshoot in the velocity)"** The new dynamic with the parameterized jerk is so weak that a velocity overflow will occur (overshoot in the velocity). The command is therefore not supported.
423B	**16955**	Parameter	**"Start parameter for the axis structure is invalid"** External or internal parameters for the start structure for a positioning task are invalid. Thus, for instance, the scaling factor, the SAF cycle time or the requested velocity may be less than or equal to zero, which is not allowed.
423C	**16956**	Parameter	**"Override generator initialization parameter invalid"** One of the override generator (re)initialization parameters is invalid.
423D	**16957**	Monitoring	**"Slave axis has not set value generator" (INTERNAL ERROR)** It is found that a slave axis within a group does not have a valid slave generator (set value generator). A slave axis and a slave set value generator must always be present as a pair. This is an internal error.
423E	**16958**	Function	**"Table is empty"** Either the SVB table or the SAF table does not contain any entries.
423F	**16959**	Function	**"Table is full"** The SVB table or the SAF table has no more free lines.
4240	**16960**	Memory	**"No memory available"** SVB memory allocation for dynamic entry in SAF table failed.
4241	**16961**	Function	**"Table already contains an entry" (INTERNAL ERROR)** SAF table entry abandoned, because, incorrectly, an entry already exists.
4242	**16962**	Function	**"Stop is already active"** The stop instruction is not forwarded, because it has already been activated.
4243	**16963**	Function	**"Compensation has not been carried out over the full compensation section"** The compensations start parameters do not permit compensation over the full section to be compensated. For this reason the compensation will be carried out over a smaller section.
4244	**16964**	Parameter	**"Internal parameters for the compensation are invalid" (INTERNAL ERROR)** Invalid internal parameters or start parameters of the lower-level generator.
4245	**16965**	Function	**"Compensation active"** Start of compensation refused, because compensation is already active. It's also possible that the M/S axes are not active moved. Therefore an execution of the compensation is impossible.
4246	**16966**	Function	**"Compensation not active"** Stop of compensation refused, because compensation is not active.

Error(Hex)	Error(Dec)	Error type	Description
4247	**16967**	Function	**"Compensation type invalid"** The type supplied for the section compensation is invalid. At the present time only compensation type 1 (trapezoidal velocity profile) is allowed.
4248	**16968**	Function	**"Axis address for compensation invalid" (INTERNAL ERROR)** The address of the master of slave axis on which the section compensation is to act is invalid. This is an internal error.
4249	**16969**	Address	**"Invalid slave address" (INTERNAL ERROR)** The slave address given for on-line coupling/decoupling is invalid.
424A	**16970**	Function	**"Coupling velocity invalid"** The velocity of what is to become the master axis is 0, which means that on-line coupling is not possible.
424B	**16971**	Function	**"Coupling velocities not constant"** The velocity of what is to become the master axis and the velocity of what is to become the slave axis are not constant, so that on-line coupling is not possible.
424C	**16972**	Parameter	**"Cycle time less than or equal to 0.0 is not allowed"** A value less than or equal to 0.0 for the cycle time (Slave) is not allowed, since the cycle time is by definition strictly positive, and with a cycle time of 0.0, division will generate an FPU exception.
424D	**16973**	Function	**"Decoupling task not allowed"** The slave axis is of such a type (e.g. a table slave) or is in such a state (master velocity 0) that on-line decoupling is not possible.
424E	**16974**	Function	**"Function not allowed"** The function cannot logically be executed, e.g. some commands are not possible and not allowed for slave axes.
424F	**16975**	Parameter	**"No valid table weighting has been set"** The weighting factor of each table is 0, so that no table can be read.
4250	**16976**	Function	**"Axis type, actual position type or end position type is not allowed"** The start type for a positioning task in invalid. Valid start types are ABSOLUTE (1), RELATIVE (2), CONTINUOUS POSITIVE (3), CONTINUOUS NEGATIVE (4), MODULO (5), etc. It is also possible that the types for setting a new actual position or for travel to a new end position are invalid.
4251	**16977**	Function	**"Function not presently supported"** An NC function has been activated that is currently not released for use, or which is not even implemented. This can be a command which is not possible or not allowed for master axes.
4252	**16978**	Monitoring	**"State of state machine invalid" (INTERNAL ERROR)** The state of an internal state machine is invalid. This is an internal error.
4253	**16979**	Monitoring	**"Reference cam became free too soon"** During the referencing process for an axis it is moved in the direction of the referencing cam, and is only stopped again when the cam signal is reached. After the axis has then also physically stopped, the referencing cam must remain occupied until the axis subsequently starts back down from the cam in the normal way.
4254	**16980**	Monitoring	**"Clearance monitoring between activation of the hardware latch and appearance of the sync pulse"** When the clearance monitoring is active, a check is kept on whether the number of increments between activation of the hardware latch and occurrence of the sync pulse (zero pulse) has become smaller than a pre-set value. This error is generated when that happens. (See parameters for the incremental encoder)

Error(Hex)	Error(Dec)	Error type	Description
4255	**16981**	Memory	**"No memory available"** The dynamic memory allocation for the set value generator, the SVB table or the SAF table has failed.
4256	**16982**	Monitoring	**"The table slave axis has no active table"** Although the table slave axis has tables, none of the tables is designated as active. If this occurs during the run time the whole master/slave group is stopped by a run time error.
4257	**16983**	Function	**"Function not allowed"** The requested function or the requested task is not logically allowed. An example for such an error message would be "set an actual position" for an absolute encoder (M3000, KL5001, etc.).
4258	**16984**	Function	**"Stopping compensation not allowed"** It is not possible to stop the compensation, since compensation is already in the stopping phase.
4259	**16985**	Function	**"Slave table is being used"** The slave table cannot be activated, because it is currently being used.
425A	**16986**	Function	**"Master or slave axis is processing a job (e.g. positioning command) while coupling is requested"** A master/slave coupling of a certain slave type (e.g. linear coupling) cannot be executed. he master or intended slave axis is not in stand still state and is executing a job (e.g. positioning) at the same time as the coupling request received. For this couple type this is not allowed.
425B	**16987**	Parameter	**"Slave (start) parameter is incorrect"** One of the slave start/coupling parameters is not allowed (Coupling factor is zero, the master position scaling of an cam is zero, etc.).
425C	**16988**	Parameter	**"Slave type is incorrect"** The slave type does not match up to the (SVB) start type.
425D	**16989**	Function	**"Axis stop is already active"** The axis stop/Estop is not initiated, because the stop/estop is already active.
425E	**16990**	Function	**"Maximum number of tables per slavegenerator reached"** The maximum number of tables per slave generator is reached (e.g. "MC_MultiCamIn" is limited to 4 tables).
425F	**16991**	Function	**"The scaling mode is invalid".** The used scaling is invalid in this context. Either the mode is not defined or yet not implemented or however it cannot in this constellation be put into action. For example MASTER-AUTOOFFSET cannot be used when a cam table is coupled in relative mode because this is a contradiction. Further MASTER-AUTOOFFSET cannot be used when a cam table is coupled for the first time because a relationship to an existing reference table is missing.
4260	**16992**	Monitoring	**"Controller enable"** Controller enable for the axis or for a coupled slave axis is not present (see axis interface PlcToNc). This error occurs if the controller enable is withdrawn while an axis or a group of axes (also a master/slave group) is being actively positioned. The error also occurs if a PTP axis or a coupled slave axis is started without controller enable.
4261	**16993**	Function	**"Table not found"** No table exists with the ID prescribed or the table ID is not unique.
4262	**16994**	Function	**"Incorrect table type"** The table referred to in the function is of the incorrect type.
4263	**16995**	Function	**"Single step mode"** This error occurs if single step mode is selected for a group or axis and a new task is requested while one of the individual tasks is still being processed.

Error(Hex)	Error(Dec)	Error type	Description
4264	**16996**	Function	**"Group task unknown (asynchronous table entry)"** The group has received a task whose type or sub-type is unknown. Valid tasks can be single or multi-dimensional positioning tasks (Geo 1D, Geo 3D), referencing tasks, etc.
4265	**16997**	Function	**"Group function unknown (synchronous function)"** The group has received a function whose type is unknown. Valid functions are "Reset", "Stop", "New end position", "Start/stop section compensation", "Set actual position", "Set/reset referencing status" etc.
4266	**16998**	Function	**"Group task for slave not allowed"** Group tasks are usually only possible for master axes, not for slave axes. A slave axis only moves as an indirect result of a positioning task given to its associated master axis. A slave can thus never directly be given a task. Exception: see axis parameter "Allow motion commands to slave axis".
4267	**16999**	Function	**"Group function for slave not allowed"** Group functions are in principle only possible for master axes, not for slave axes. The only exception is represented by the "Start/stop section compensation" function, which is possible both for masters and for slaves. A slave cannot directly execute any other functions beyond this.
4268	**17000**	Function	**NCI Setpoint Generator is Inactive** An `NCI` command like e.g. “StopAndKeep” is sent to a logically inactive `DXD` group or to a group with the state channel override zero. Though, it is expected that for performing this command the `NCI` group resides actively in setpoint generation. This error can occur related to the functions “delete distance to go” and “measurement event (latch actual position)”.
4269	**17001**	Parameter	**"Startposition=Setpoint Position"** Invalid position parameters.
426A	**17002**	Parameter	**"Parameters of the delay-generator are invalid"** Invalid external/internal parameters of the delay generator (delay time, cycle time, tics).
426B	**17003**	Parameter	**"External parameters of the superimposed instruction are invalid"** Invalid external parameters of the superimposed functionality (acceleration, deceleration, velocity, process velocity, length).
426C	**17004**	Parameter	**"Invalid override type."**
426D	**17005**	Function	**"Activation position under/overrun"** The requested activation position is located in the past of the master (e.g. when exchanging a cam table).
426E	**17006**	Function	**"Activation impossible: Master is standing"** The required activation of the correction is impossible since the master axis is not moving. A synchronization is not possible, because the master axis standing and the slave axis is still not synchronous.
426F	**17007**	Function	**"Activation mode not possible"** The requested activation mode is not possible when the slave axis is moving. Otherwise the slave velocity would jump to zero.
4270	**17008**	Parameter	**"Start parameter for the compensation is invalid"** One of the dynamic parameters for the compensation is invalid (necessary condition): Acceleration (>0) Deceleration (>0) Process velocity (>0)
4271	**17009**	Parameter	**"Start parameter for the compensation is invalid"** Velocity camber is negative.

Error(Hex)	Error(Dec)	Error type	Description
4272	**17010**	Parameter	**"Start parameter for the compensation is invalid"** The section on which the compensation is to occur is not positive.
4273	**17011**	Monitoring	**"Target position under/overrun" (INTERNAL ERROR)** The position (calculated from the modulo-target-position) where the axis should stand at end of oriented stop has been run over.
4274	**17012**	Monitoring	**"Target position will be under/overrun" (INTERNAL ERROR)** The position (calculated from the modulo-target-position) where the axis should stand at end of oriented stop is too near and will be run over.
4275	**17013**	Parameter	**Group Parameter is Invalid** A group parameter is invalid. In this connection it may be e.g. a parameterized velocity, acceleration, deceleration, jerk or NC cycle time whose value has been parameterized smaller than or equal to zero.
4276	**17014**	Monitoring	**Joint Error at Start of Setpoint Generation** At start of setpoint generation for e.g. a flying saw different parameters or states may lead to this error. E.g. dynamic parameters as acceleration, deceleration and jerk may be invalid (smaller than or equal to zero) or the NC cycle time or the override value may reside apart from the interval 0% to 100%.
4277	**17015**	Monitoring	**"Dynamic parameters not permitted" (INTERNAL ERROR)** The dynamic parameters resulting from internal calculation like acceleration, deceleration and jerk are not permitted.
4279	**17017**	Monitoring	**The New Target Position is Invalid or Cannot be Reached** A new commanded target position is invalid because it has already been gone through or will be gone through while stopping with the currently active dynamic.
427A	**17018**	Monitoring	**New Velocity for Moving or the Final Target Velocity is Invalid** For a newly commanded command the demanded moving velocity or the demanded final velocity (target velocity in the target position) is invalid. The moving velocity has to be greater than zero value and the final target velocity has always to be greater than or equal to zero (default case is zero value).
427B	**17019**	Monitoring	**The Final Velocity or the New Target Position is Invalid** For a newly commanded command the demanded final velocity (target velocity in the target position) or the demanded target position is invalid. The final velocity has to be greater than or equal to zero (default case is zero value).
427C	**17020**	Monitoring	**The New Moving Velocity is Invalid** The newly commanded moving velocity is invalid because it is smaller than or equal to zero or other reasons do not facilitate this velocity.
427D	**17021**	Monitoring	**Internal Starting Mode is Invalid** For a newly commanded command this starting mode is invalid or is not permitted within this situation of movement. The user cannot influence the starting mode directly.

Error(Hex)	Error(Dec)	Error type	Description
427E	**17022**	Monitoring	**"A requested motion command could not be realized (BISECTION)"** A requested motion command could not be realized using the requested parameters. The command has been executed best possible and this message is therefore to be understood just as a warning. Samples: An axis motion command is requested while the axis is in a unfavorable dynamic situation (acceleration phase), in which the covered distance is too short or the velocity is clearly too high. Another possibility is a slave axis, which is decoupled in motion in an unfavorable dynamic situation and is afterwards given a motion as in the previous case.
427F	**17023**	Monitoring	**"The new target position either has been overrun or will be overrun"** The new target position either has been overrun or will be overrun, since until there it is impossible to stop. An internal stop command is commended.
4280	**17024**	Monitoring	**"Group not ready / group not ready for new task" (INTERNAL ERROR / INFORMATION)** The group is being given a new task while it is still in the process of executing an existing task. This request is not allowed because it would interrupt the execution of the previous task. The new task could, for instance, be a positioning command, or the "set actual position" function. Precisely the converse relationships apply for the "set new end position" function. In that case, the group/axis must still be actively moving in order to be able to cause a change in the end position.
4281	**17025**	Parameter	**"The parameters of the oriented stop (O-Stop) are not admitted."** The modulo-target position should not be smaller than zero and not larger or equal than the encoder mod-period (e.g. in the interval [0.0,360.0]). **Note:** In the case of error the axis is safely stopped, but is afterwards not at the requested oriented position.
4282	**17026**	Monitoring	**"The modulo target position of the modulo-start is invalid"** The modulo target position is outside of the valid parameter range. So the position value should not be smaller than zero and not greater or equal than the encoder modulo-period (e. g. in the interval [0.0,360.0] for the modulo start type "SHORTEST_WAY (261)").
4283	**17027**	Parameter	**"The online change activation mode is invalid".** The activation can be used with online scaling or with online modification of motion function. The used activation is invalid in this context. Either the mode is not defined or yet not implemented or however it cannot in this constellation be put into action (e.g. when linear tables are used with an unexpected cyclic activation mode NEXTCYCLE or NEXTCYCLEONCE). In some case, the activation mode may be valid but the command cannot be executed due to a pending previous command.
4284	**17028**	Parameter	**"The parameterized jerk rate is not permitted".** The jerk rate is smaller than the minimum jerk rate. The minimum value for jerk rate is 1.0 (e.g. mm/s^3).
4285	**17029**	Parameter	**"The parameterized acceleration or deceleration is not permitted".** The parameterized acceleration or deceleration is lower than the permitted minimum acceleration. The value for minimum acceleration is calculated from minimum jerk rate and NC cycle time (minimum jerk rate multiplied with NC cycle time). The unit for example is mm/s^2.

Error(Hex)	Error(Dec)	Error type	Description
4286	**17030**	Parameter	**"The parameterized velocity is not permitted".** The parameterized target velocity is lower than the minimum velocity (but the value zero is permitted). The value for minimum velocity is calculated from the minimum jerk rate and the NC cycle time (minimum jerk rate multiplied with the square of the NC cycle time). The unit for example is mm/s.
4287	**17031**	Monitoring	**"A activation cannot be executed due to a pending activation"** A activation e.g. "CamIn", "CamScaling" or "WriteMotionFunction" cannot be executed due to a pending activation (e.g. "CamIn", "CamScaling", "WriteMotionFunction"). Only activation can be enabled.
4288	**17032**	Monitoring	**"Illegal combination of different cycle times within an axis group"** A logical axis group includes elements (axes) with different cycle times for a common setpoint generator and I/O-execution, resp. This situation can occur with Master/Slave-coupling or configuring 3D- and FIFO-groups (including path, auxiliary, and slave axes).
4289	**17033**	Monitoring	**"Illegal motion reversal"** Due to the actual dynamical state a motion reversal will happen. To avoid this motion reversal the axis command is not performed and the previous system state restored.
428A	**17034**	Monitoring	**"Illegal moment for an axis command because there is an old axis command with activation position still active"** The moment for the command is illegal because there is still an old command with activation position active (e.g. "go to new velocity at threshold position" or "reach new velocity at threshold position").
428B	**17035**	Monitoring	**"Error in the stop-calculation routine" (INTERNAL ERROR)** Due to an internal error in the stop-calculation routine the current commando cannot be performed. The previous system state is restored.
428C	**17036**	Monitoring	**"A command with activation position cannot fully be performed because the remaining path is too short"**A command with activation position (threshold) like "reach a new velocity at a position" can be just partially executed because the path from the actual position to the activation position is too short.
428D	**17037**	Monitoring	**"Illegal decouple type when decoupling a slave axis"** The decouple and restart command contains an invalid decouple type.
428E	**17038**	Monitoring	**"Illegal target velocity when decoupling a slave axis"** The decouple and restart command contains an illegal target velocity [1 < V <Vmax].
428F	**17039**	Monitoring	**"The command new dynamic parameter cannot be performed since this would require a new target velocity"**Das Kommando zum Aktivieren neuer Dynamikparameter wie Beschleunigung, Verzögerung und Ruck kann nicht durchgeführt werden, da dies eine neue beauftragte Fahrgeschwindigkeit erfordern würde. This situation can occur, for example, if the axis is near the target position in an accelerated state and the dynamics parameter are chosen softer.
4290	**17040**	Monitoring	**"A command with activation position cannot be performed because the axis is already in the brake phase"** A command with activation position (threshold) e.g. "reach new velocity at position" cannot be performed because the axis is already in the brake phase and the remaining path from the actual position to the activation position is too short.

Error(Hex)	Error(Dec)	Error type	Description
4291	**17041**	Monitoring	**"Decouple routine of slave axis doesn't return a valid solution"** Internal jerk scaling of decouple routine cannot evaluate a valid solution (decoupling slave axis and transform to master axis). The command is rejected because velocity can become too high, a reversal of movement can occur, or the target position can be passed.
4292	**17042**	Monitoring	**"Command not be executed because the command buffer is full filled"** The command is rejected because the command buffer is full filled.
4293	**17043**	Internal	**"Command is rejected due to an internal error in the Look Ahead" (INTERNAL ERROR)** The command is rejected due to an internal error in the "look ahead".
4294	**17044**	Monitoring	**"Command is rejected because the segment target velocity is not realized"** The command is rejected, because the new target segment velocity *Vrequ* is not realizable and an internal optimizing is impossible.
4295	**17045**	Monitoring	**"Successive commands have the same final position"** Successive commands have the same final position. So the moving distance is zero.
4296	**17046**	Monitoring	**"Logical positioning direction is inconsistent with the direction of the buffer command"** In the extended buffer mode, where the actual end position is replaced by the new buffer start position, the logical positioning direction is inconsistent with the direction of the buffer command (=> contradiction). A buffered command (*BufferMode, BlendingLow, BlendingPrevious, BlendingNext, BlendingHigh*) is rejected with error 0x4296 if the command is using the Beckhoff specific *optional BlendingPosition* but the blending position is located beyond the target position of the previous motion command.
4297	**17047**	Monitoring	**"Command is rejected because the remaining positioning length is to small"** The command is rejected because the remaining path length is too small. E.g. when the buffer mode is used and the remaining positioning length in the actual segment is too small for getting the axis in a force free state or to reach the new target velocity at the change of segment.
429A	**17050**	Function	**Restart has Failed** There is already a motion command within the `PTP` command buffer and a further new motion command that should have modified the current motion command by restart has failed.
429B	**17051**	Monitoring	„collect error for invalid start parameters“ This error refers to a wrong parameterization of the user (collect error). E. g. dynamic parameters like Velo, Acc or Dec could be equal or less than zero. Or following errors: - BaseFrequence < 0.0 - StartFrequence < 1.0 - StepCount < 1, StepCount > 200 - BaseAmplitude <= 0.0 - StepDuration <= 0.0 - StopFrequence >= 1/(2*CycleTime)

Error(Hex)	Error(Dec)	Error type	Description	
429C	**17052**	Monitoring	**"Reference cam is not found"** During the referencing process for an axis it is moved in the direction of the referencing cam. This reference cam, however, was not found as expected (=> leads to the abortion of the referencing procedure).	
429D	**17053**	Monitoring	**"Reference cam became not free"** During the referencing process for an axis it is moved in the direction of the referencing cam, and is only stopped again when the cam signal is reached. After the axis has also come to a physical standstill, the axis is subsequently started regularly from the cam again. In this case, the reference cam did not become free again as expected when driving down (=> leads to the abortion of the referencing procedure).	
429E	**17054**	Monitoring	**"IO sync pulse was not found (only when using hardware latch)"** If the hardware latch is activated, a sync pulse (zero pulse) is expected to be found and a sync event triggered following the expiry of a certain time or a certain distance. If this is not the case, the reaction is an error and the abortion of the referencing procedure.	
429F	**17055**	Function	**The Used Buffer Mode is Unknown or not Supported in this Context** The buffer mode used for a `PTP` command (e.g. `ABORTING`, etc.) is unknown or not supported in this context.	
42A0	**17056**	Internal	**"Group/axis consequential error"** Consequential error resulting from another causative error related to another axis within the group. Group/axis consequential errors can occur in relation to master/slave couplings or with multiple axis interpolating DXD groups. If, for instance, it is detected that the following error limit of a master axis has been exceeded, then this consequential error is assigned to all the other master axes and slave axes in this group.	
42A1	**17057**	Parameter	**"Velocity reduction factor for C0/C1 transition is not allowed"** A C0 transition describes two geometries which, while they are themselves continuous, no not have either continuous first or second differentials. The velocity reduction factor C0 acts on such transitions. Note: A C1 transition is characterized by the two geometries being continuous, but having only a first differential that is continuous. The velocity reduction factor C1 acts on such transitions.	
			Value range: [0.0 ... 1.0]	Unit: 1
42A2	**17058**	Parameter	**"Critical angle at segment transition not allowed"**	
			Value range: (0.0 ... 180.0]	Unit: degree
42A3	**17059**	Parameter	**"Radius of the tolerance sphere"** is in an invalid rang	
			Value range: [0.0 ... 100.0]	Unit: e.g. mm
42A4	**17060**	Parameter	Not implemented.	
42A5	**17061**	Parameter	**"Start type"**	
			Value range: [0,1]	Unit: 1
42A6	**17062**	Parameter	Not implemented.	
42A7	**17063**	Parameter	**"Blending"** with given parameters not possible	
42A8	**17064**	Parameter	Not implemented.	
42A9	**17065**	Parameter	**"Curve velocity reduction method not allowed" (INTERNAL ERROR)** The curve velocity reduction method does not exist.	
42AA	**17066**	Parameter	**"Minimum velocity not allowed"** The minimum velocity that has been entered is less than 0.0.	

Error(Hex)	Error(Dec)	Error type	Description
42AB	**17067**	Parameter	**"Power function input not allowed" (INTERNAL ERROR)** The input parameters in the power_() function lead to an FPU exception.
42AC	**17068**	Parameter	**"Dynamic change parameter not allowed"** A parameter that controls alterations to the dynamics is invalid. Parameter: 1. Absolute motion dynamics change: All parameters must be strictly positive. 2. Relative reduction c_f: 0.0 < c_f <= 1.0
42AD	**17069**	Memory	**"Memory allocation error" (INTERNAL ERROR)**
42AE	**17070**	Function	**"The calculated end position differs from the end position in the nc instruction (internal error)."**
42AF	**17071**	Parameter	**"Calculate remaining chord length"** invalid value Value range: [0,1]
42B0	**17072**	Function	**"Set value generator SVB active"** Starting the set value generator (SVB, SAF) has been refused, since the SVB task is already active.
42B1	**17073**	Parameter	**"SVB parameter not allowed" (INTERNAL ERROR)** A parameter related to the internal structure of the set value generator (SVB) results in logical errors and/or to an FPU exception. Affects these parameters: Minimum velocity (>0.0), TimeMode, ModeDyn, ModeGeo, StartType, DistanceToEnd, TBallRadius.
42B2	**17074**	Parameter	**"Velocity reduction factor not allowed"** A parameter that controls reduction of the velocity at segment transitions is invalid. Parameter: 1. Transitions with continuous first differential: VeloVertexFactorC1 2. Not once continuously differentiable transitions: VeloVertexFactorC0, CriticalVertexAngleLow, CriticalVertexAngleHigh.
42B3	**17075**	Parameter	**"Helix is a circle"** The helix has degenerated to a circle, and should be entered as such.
42B4	**17076**	Parameter	**"Helix is a straight line"** The helix has degenerated to a straight line, and should be entered as such.
42B5	**17077**	Parameter	**"Guider parameter not allowed"** One of the guider's parameters leads to logical errors and/or to an FPU exception.
42B6	**17078**	Address	**"Invalid segment address" (INTERNAL ERROR)** The geometry segment does not have a valid geometry structure address or does not have a valid dynamic structure address.
42B7	**17079**	Parameter	**"Unparameterized generator" (INTERNAL ERROR)** The SVB generator is not yet parameterized and is therefore unable to operate.
42B8	**17080**	Address	**"Unparameterized table" (INTERNAL ERROR)** The table has no information concerning the address of the corresponding dynamic generator.
42BA	**17082**	Internal	**"The calculation of the arc length of the smoothed path failed (internal error)."**
42BB	**17083**	Parameter	**"The radius of the tolerance ball is too small (smaller than 0.1 mm)."**
42BC	**17084**	Internal	Error while calculating DXD-Software-Limit switches (internal error)
42BD	**17085**	Function	**"NC-Block violates software limit switches of the group"** At least one path axis with active software limit monitoring has violated the limit switches. Therefore the geometric entry is denied with an error.

Error(Hex)	Error(Dec)	Error type	Description
42BE	**17086**	Parameter	**“Internal error in the evaluation of a possible software limit switch violation for the segment with the block-number xx.”** At least one path axis with active position limit monitoring has violated the limit switches.
42BF	**17087**	Parameter	Invalid reference speed type.
42C0	**17088**	Internal	**"Interpolating group contains axes of an incorrect axis type"** An interpolating 3D group may only contain continuously guided axes of axis type 1 (SERVO).
42C1	**17089**	Internal	**"Scalar product cannot be calculated"** The length of one of the given vectors is 0.0.
42C2	**17090**	Internal	**"Inverse cosine cannot be calculated"** The length of one of the given vectors is 0.0.
42C3	**17091**	Parameter	**"Invalid table entry type"** The given table entry type is unknown.
42C4	**17092**	Parameter	**"Invalid DIN66025 information type" (INTERNAL ERROR)** The given DIN66025 information type is unknown. Known types: G0, G1, G2, G3, G17, G18, G19.
42C5	**17093**	Parameter	**"Invalid dimension" (INTERNAL ERROR)** The CNC dimension is unknown. Known dimensions: 1, 2, 3. Or: The CNC dimension is invalid for the given geometrical object. For a circle the dimension must be 2 or 3, while for a helix it must be 3.
42C6	**17094**	Parameter	**"Geometrical object is not a straight line"** The given object, interpreted as a straight line, has a length of 0.0.
42C7	**17095**	Parameter	**"Geometrical object is not a circle"** Interpreted as a circular arc, the given object has a length of 0.0, or an angle of 0.0 or a radius of 0.0.
42C8	**17096**	Parameter	**"Geometrical object is not a helix"** Interpreted as a circular arc, the given object has a length of 0.0, or an angle of 0.0, or a radius of 0.0. or a height of 0.0.
42C9	**17097**	Parameter	**"Set velocity less than or equal to 0.0 is invalid"** A value less than or equal to 0.0 for the set velocity (CNC) is not allowed, since the set velocity is positive by definition, and a set velocity of 0.0 cannot generate any motion.
42CA	**17098**	Address	**"Address for look-ahead invalid" (INTERNAL ERROR)** The address supplied for the look-ahead is invalid.
42CB	**17099**	Function	**"Set value generator SAF active"** Starting the set value generator (SAF) has been refused, since the SAF task is already active.
42CC	**17100**	Function	**"CNC set value generation not active"** Stop or change of override refused, because the set value generation is not active.
42CD	**17101**	Function	**"CNC set value generation in the stop phase"** Stop or change of override refused, because the set value generation is in the stop phase.
42CE	**17102**	Parameter	**"Override not allowed"** An override of less than 0.0 % or more than 100.0 % is invalid.
42CF	**17103**	Address	**"Invalid table address" (INTERNAL ERROR)** The table address given for the initialization of the set value generator is invalid, or no valid logger connection (report file) is present.
42D0	**17104**	Parameter	**"Invalid table entry type"** The given table entry type is unknown.
42D1	**17105**	Memory	**"Memory allocation failed"** Memory allocation for the table has failed.

Error(Hex)	Error(Dec)	Error type	Description
42D2	**17106**	Memory	**"Memory allocation failed"** Memory allocation for the filter has failed.
42D3	**17107**	Parameter	**"Invalid parameter"** Filter parameter is not allowed.
42D4	**17108**	Function	**"Delete Distance To Go failed"** Delete Distance to go (only interpolation) failed. This error occurred, if e.g. the command 'DelDTG' was not programmed in the actual movement of the nc program.
42D5	**17109**	Internal	**"The setpoint generator of the flying saw generates incompatible values (internal error)"**
42D6	**17110**	Function	**"Axis will be stopped since otherwise it will overrun its target position (old PTP setpoint generator)"** If, for example, in case of a slave to master transformation for the new master a target position is commanded that will be overrun because of the actual dynamics the axis will be stopped internally to guarantee that the target position will not be overrun.
42D7	**17111**	Function	**"Internal error in the transformation from slave to master."**
42D8	**17112**	Function	**"Wrong direction in the transformation of slave to master."**
42DA	**17114**	Parameter	**"Parameter of Motion Function (MF) table incorrect"** The parameter of the Motion Function (MF) are invalid. This may refer to the first time created data set or to online changed data.
42DB	**17115**	Parameter	**"Parameter of Motion Function (MF) table incorrect"** The parameter of the Motion Function (MF) are invalid. This may refer to the first time created data set or to online changed data. The error cause can be, that an active MF point (no IGNORE point) points at a passive MF point (IGNORE point).
42DC	**17116**	Monitoring	**"Internal error by using Motion Function (MF)"** An internal error occurs by using the Function (MF). This error cannot be solved by the user. Please ask the TwinCAT Support.
42DD	**17117**	Function	**"Axis coupling with synchronization generator declined because of incorrect axis dynamic values"** The axis coupling with the synchronization generator has been declined, because one of the slave dynamic parameter (machine data) is incorrect. Either the maximum velocity, the acceleration, the deceleration or the jerk is smaller or equal to zero, or the expected synchronous velocity of the slave axis is higher as the maximum allowed slave velocity.
42DE	**17118**	Function	**"Coupling conditions of synchronization generator incorrect"** During positive motion of the master axis it has to be considered, that the master synchronous position is larger than the master coupling position ("to be in the future"). During negative motion of the master axis it has to be considered that the master synchronous position is smaller than the master coupling position.

Error(Hex)	Error(Dec)	Error type	Description	
42DF	**17119**	Monitoring	**"Moving profile of synchronization generator declines dynamic limit of slave axis or required characteristic of profile"** One of the parameterized checks has recognized an overstepping of the dynamic limits (max. velocity, max. acceleration, max. deceleration or max. jerk) of the slave axis, or an profile characteristic (e.g. overshoot or undershoot in the position or velocity) is incorrect. See also further messages in the windows event log and in the message window of the System Manager.	
42E0	**17120**	Parameter	**"Invalid parameter"** The encoder generator parameter is not allowed.	
42E1	**17121**	Parameter	**"Invalid parameter"** The external (Fifo) generator parameter is not allowed.	
42E2	**17122**	Function	**"External generator is active"** The external generator cannot be started, as it is already active.	
42E3	**17123**	Function	**"External generator is not active"** The external generator cannot be stopped, as it is not active.	
42E4	**17124**	Function	**"NC-Block with auxiliary axis violates software limit switches of the group"** At least one auxiliary axis with active software limit monitoring has violated the limit switches. Therefore the geometric entry is denied with an error.	
42E5	**17125**	Function	**"NC-Block type Bezier spline curve contains a cusp (singularity)"** The Bezier spline curve contain a cusp, i.e. at a certain interior point both the curvature and the modulus of the velocity tend to 0 such that the radius of curvature is infinite. Note: Split the Bezier curve at that point into two Bezier spline curves according to the de "Casteljau algorithm". This preserves the geometry and eliminates the interior singularity.	
42E7	**17127**	Parameter	**"Value for dead time compensation not allowed"** The value for the dead time compensation in seconds for a slave coupling to an encoder axis (virtual axis) is not allowed.	
			Value range: [0.0 ... 60.0]	Unit: s
42E8	**17128**	Parameter	**"GROUPERR_RANGE_NOMOTIONWINDOW"**	
			Value range: [0.0 ... 1000.0]	Unit: e.g. mm/s
42E9	**17129**	Parameter	**"GROUPERR_RANGE_NOMOTIONFILTERTIME"**	
			Value range: [0.0 ... 60.0]	Unit: s
42EA	**17130**	Parameter	**"GROUPERR_RANGE_TIMEUNITFIFO"**	
			Value range: (0.0 ... 1000.0]	Unit: s
42EB	**17131**	Parameter	**"GROUPERR_RANGE_OVERRIDETYPE"**	
			Value range: [1, 2]	Unit: 1
42EC	**17132**	Parameter	**"GROUPERR_RANGE_OVERRIDECHANGETIME"**	
			Value range: (0.0 ... 1000.0]	Unit: s
42ED	**17133**	Parameter	**"GROUPERR_FIFO_INVALIDDIMENSION"** **Note:** Since TC 2.11 Build 1547 the FIFO-dimension (number of axes) has been increased from 8 to 16.	
			Value range: [1 ... 8] resp. [1 ... 16]	Unit: 1 (number of axes)
42EE	**17134**	Address	**"GROUPERR_ADDR_FIFOTABLE"**	

Error(Hex)	Error(Dec)	Error type	Description
42EF	**17135**	Monitoring	**"Axis is locked for motion commands because a stop command is still active"** The axis/group is locked for motion commands because a stop command is still active. The axis can be released by calling *MC_Stop* with Execute=FALSE or by using *MC_Reset* (*TcMC2.Lib*).
42F0	**17136**	Parameter	**"Invalid number of auxiliary axes"** The local number of auxiliary axes does not tally with the global number of auxiliary axes.
42F1	**17137**	Parameter	**"Invalid reduction parameter for auxiliary axes"** The velocity reduction parameters for the auxiliary axes are inconsistent.
42F2	**17138**	Parameter	**"Invalid dynamic parameter for auxiliary axes"** The dynamic parameters for the auxiliary axes are inconsistent.
42F3	**17139**	Parameter	**"Invalid coupling parameter for auxiliary axes"** The coupling parameters for the auxiliary axes are inconsistent.
42F4	**17140**	Parameter	**"Invalid auxiliary axis entry"** The auxiliary axis entry is empty (no axis motion).
42F6	**17142**	Parameter	**"Invalid parameter"** The limit for velocity reduction of the auxiliary axes is invalid. It has to be in the interval 0..1.0
42F8	**17144**	Parameter	**"Block search - segment not found"** The segment specified as a parameter could not be found by the end of the NC program. Possible cause: • nBlockId is not specified in the mode described by eBlockSearchMode
42F9	**17145**	Parameter	**"Blocksearch – invalid remaining segment length" The remaining travel in the parameter fLength is incorrectly parameterized**
42FB	**17147**	Internal	**Internal Error in the Context of Coupled Axes (Slave Axes)** Fatal internal error using coupled axes (slave axes). Inconsistent internal state. Please, contact the support team.
42FC	**17148**	Parameter	**Parameter for the Maximum Number of Jobs (Entries) to be Transferred is Invalid** The parameter that describes the maximum number of entries to transfer from the `SVB` to the `SAF` table per `NC` Cycle is invalid. Range of values: [1, 20] — Unit: 1
42FF	**17151**	Monitoring	**Customer Specific Error** In this connection it is about a customer specific monitoring function.

9.2.4 Axis Errors

Error(Hex)	Error(Dec)	Error type	Description	
4300	**17152**	Parameter	**"Axis ID not allowed"** The value for the axis ID is not allowed, e.g. because it has already been assigned, is less than or equal to zero, is greater than 255, or does not exist in the current configuration.	
			Value range: [1 ... 255]	Unit: 1
4301	**17153**	Parameter	**"Axis type not allowed"** The value for the axis type is unacceptable because it is not defined. Type 1: Servo Type 2: Fast/creep Type 3: Stepper motor	
			Value range: [1 ... 3]	Unit: 1
4306	**17158**	Parameter	**"Slow manual velocity not allowed"** The value for the slow manual velocity is not allowed.	
			Value range: [0.0, 10000.0]	Unit: e.g. m/min
4307	**17159**	Parameter	**"Fast manual velocity not allowed"** The value for the fast manual velocity is not allowed.	
			Value range: [0.0, 10000.0]	Unit: e.g. m/min
4308	**17160**	Parameter	**"High speed not allowed"** The value for the high speed is not allowed.	
			Value range: [0.0, 10000.0]	Unit: e.g. m/min
4309	**17161**	Parameter	**"Acceleration not allowed"** The value for the axis acceleration is not allowed.	
			Value range: [0.0, 1000000.0]	Unit: e.g. m/s/s
430A	**17162**	Parameter	**"Deceleration not allowed"** The value for the axis deceleration is not allowed.	
			Value range: [0.0, 1000000.0]	Unit: e.g. m/s/s
430B	**17163**	Parameter	**"Jerk not allowed"** The value for the axis jerk is not allowed.	
			Value range: [0.0, 1000000.0]	Unit: e.g. m/s/s/s
430C	**17164**	Parameter	**"Delay time between position and velocity is not allowed"** The value for the delay time between position and velocity ("idle time compensation") is not allowed.	
			Value range: [0, 0.1]	Unit: s
430D	**17165**	Parameter	**"Override-Type not allowed"** The value for the velocity override type is not allowed. Type 1: With respect to the internal reduced velocity (default value) Type 2: With respect to the original external start velocity	
			Value range: [1 ... 4]	Unit: 1
430E	**17166**	Parameter	**"NCI: Velo-Jump-Factor not allowed"** The value for the velo-jump-factor ("VeloJumpFactor") is not allowed. This parameter only works for TwinCAT NCI.	
			Value range: [0, 1000000]	Unit: 1

Error(Hex)	Error(Dec)	Error type	Description	
430F	**17167**	Parameter	**"NCI: Radius of tolerance sphere for the auxiliary axes is invalid"** It was tried to enter an invalid value for the size of the tolerance sphere. This sphere affects only auxiliary axes!	
			Value range: [0, 1000]	Unit: e.g. mm
4310	**17168**	Parameter	**"NCI: Value for maximum deviation for the auxiliary axes is invalid"** It was tried to enter an invalid value for the maximum allowed deviation. This parameter affects only auxiliary axes!	
			Value range: [0, 10000]	Unit: e.g. mm
4312	**17170**	Parameter	**"Referencing velocity in direction of cam not allowed"** The value for the referencing velocity in the direction of the referencing cam is not allowed.	
			Value range: [0.0, 10000.0]	Unit: e.g. m/min
4313	**17171**	Parameter	**"Referencing velocity in sync direction not allowed"** The value for the referencing velocity in the direction of the sync pulse (zero track) is not allowed.	
			Value range: [0.0, 10000.0]	Unit: e.g. m/min
4314	**17172**	Parameter	**"Pulse width in positive direction not allowed"** The value for the pulse width in the positive direction is not allowed (pulsed operation). The use of the pulse width for positioning is chosen implicitly through the axis start type. Pulsed operation corresponds to positioning with a relative displacement that corresponds precisely to the pulse width.	
			Value range: [0.0, 1000000.0]	Unit: e.g. mm
4315	**17173**	Parameter	**"Pulse width in negative direction not allowed"** The value for the pulse width in the negative direction is not allowed (pulsed operation). The use of the pulse width for positioning is chosen implicitly through the axis start type. Pulsed operation corresponds to positioning with a relative displacement that corresponds precisely to the pulse width.	
			Value range: [0.0, 1000000.0	Unit: e.g. mm
4316	**17174**	Parameter	**"Pulse time in positive direction not allowed"** The value for the pulse width in the positive direction is not allowed (pulsed operation).	
			Value range: [0.0, 600.0]	Unit: s
4317	**17175**	Parameter	**"Pulse time in negative direction not allowed"** The value for the pulse width in the negative direction is not allowed (pulsed operation).	
			Value range: [0.0, 600.0]	Unit: s
4318	**17176**	Parameter	**"Creep distance in positive direction not allowed"** The value for the creep distance in the positive direction is not allowed.	
			Value range: [0.0, 100000.0]	Unit: e.g. mm
4319	**17177**	Parameter	**"Creep distance in negative direction not allowed"** The value for the creep distance in the negative direction is not allowed.	
			Value range: [0.0, 100000.0]	Unit: e.g. mm
431A	**17178**	Parameter	**"Braking distance in positive direction not allowed"** The value for the braking distance in the positive direction is not allowed.	
			Value range: [0.0, 100000.0]	Unit: e.g. mm

Error(Hex)	Error(Dec)	Error type	Description	
431B	**17179**	Parameter	**"Braking distance in negative direction not allowed"** The value for the braking distance in the negative direction is not allowed.	
			Value range: [0.0, 100000.0]	Unit: e.g. mm
431C	**17180**	Parameter	**"Braking time in positive direction not allowed"** The value for the braking time in the positive direction is not allowed.	
			Value range: [0.0, 60.0]	Unit: s
431D	**17181**	Parameter	**"Braking time in negative direction not allowed"** The value for the braking time in the negative direction is not allowed.	
			Value range: [0.0, 60.0]	Unit: s
431E	**17182**	Parameter	**"Switching time from high to low speed not allowed"** The value for the time to switch from high to low speed is not allowed.	
			Value range: [0.0, 60.0]	Unit: s
431F	**17183**	Parameter	**"Creep distance for stop not allowed"** The value for the creep distance for an explicit stop is not allowed.	
			Value range: [0.0, 100000.0]	Unit: e.g. mm
4320	**17184**	Parameter	**"Motion monitoring not allowed"** The value for the activation of the motion monitoring is not allowed.	
			Value range: [0, 1]	Unit: 1
4321	**17185**	Parameter	**"Position window monitoring not allowed"** The value for the activation of the position window monitoring is not allowed.	
			Value range: [0, 1]	Unit: 1
4322	**17186**	Parameter	**"Target window monitoring not allowed"** The value for the activation of target window monitoring is not allowed.	
			Value range: [0, 1]	Unit: 1
4323	**17187**	Parameter	**"Loop not allowed"** The value for the activation of loop movement is not allowed.	
			Value range: [0, 1]	Unit: 1
4324	**17188**	Parameter	**"Motion monitoring time not allowed"** The value for the motion monitoring time is not allowed.	
			Value range: [0.0, 600.0]	Unit: s
4325	**17189**	Parameter	**"Target window range not allowed"** The value for the target window is not allowed.	
			Value range: [0.0, 10000.0]	Unit: e.g. mm
4326	**17190**	Parameter	**"Position window range not allowed"** The value for the position window is not allowed.	
			Value range: [0.0, 10000.0]	Unit: e.g. mm
4327	**17191**	Parameter	**"Position window monitoring time not allowed"** The value for the position window monitoring time is not allowed.	
			Value range: [0.0, 600.0]	Unit: s
4328	**17192**	Parameter	**"Loop movement not allowed"** The value for the loop movement is not allowed.	
			Value range: [0.0, 10000.0]	Unit: e.g. mm
4329	**17193**	Parameter	**"Axis cycle time not allowed"** The value for the axis cycle time is not allowed.	
			Value range: [0.001, 0.1]	Unit: s

Error(Hex)	Error(Dec)	Error type	Description	
432A	**17194**	Parameter	**"Stepper motor operating mode not allowed"** The value for the stepper motor operating mode is not allowed.	
			Value range: [1, 2]	Unit: 1
432B	**17195**	Parameter	**"Displacement per stepper motor step not allowed"** The value for the displacement associated with one step of the stepper motor is not allowed (step scaling).	
			Value range: [0.000001, 1000.0]	Unit: e.g. mm/ STEP
432C	**17196**	Parameter	**"Minimum speed for stepper motor set value profile not allowed"** The value for the minimum speed of the stepper motor speed profile is not allowed.	
			Value range: [0.0, 1000.0]	Unit: z. B. m/min
432D	**17197**	Parameter	**"Stepper motor stages for one speed stage not allowed"** The value for the number of steps for each speed stage in the set value generation is not allowed.	
			Value range: [0, 100]	Unit: 1
432E	**17198**	Parameter	**"DWORD for the interpretation of the axis units not allowed"** The value that contains the flags for the interpretation of the position and velocity units is not allowed.	
			Value range: [0, 0xFFFFFFFF]	Unit: 1
432F	**17199**	Parameter	**"Maximum velocity not allowed"** The value for the maximum permitted velocity is not allowed.	
			Value range: [0.0, 10000.0]	Unit: e.g. m/min
4330	**17200**	Parameter	**"Motion monitoring window not allowed"** The value for the motion monitoring window is not allowed.	
			Value range: [0.0, 10000.0]	Unit: e.g. mm
4331	**17201**	Parameter	**"PEH time monitoring not allowed"** The value for the activation of the PEH time monitoring is not allowed (PEH: positioning end and halt).	
			Value range: [0, 1]	Unit: 1
4332	**17202**	Parameter	**"PEH monitoring time not allowed"** The value for the PEH monitoring time (timeout) is not allowed (PEH: positioning end and halt). default value: 5s	
			Value range: [0.0, 600.0]	Unit: s
4333	**17203**	Parameter	**Parameter “Break Release Delay” is Invalid** The parameter for Break Release Delay of a discrete (two speed) axis is invalid.	
			Range of values: [0.0, 60.0]	Unit: s
4334	**17204**	Parameter	**Parameter “NC Data Persistence” is Invalid** The boolean parameter NC Data Persistence of an axis is invalid.	
			Range of values: [0, 1]	Unit: 1
4335	**17205**	Parameter	**Parameter for the Error Reaction Mode is Invalid** The parameter for the error reaction mode of the axis is invalid (instantaneous, delayed).	
			Range of values: [0, 1]	Unit: 1
4336	**17206**	Parameter	**Parameter for the Error Reaction Delay is Invalid** The parameter for the error reaction delay of the axis is invalid.	
			Range of values: [0.0, 1000.0]	Unit: s

Error(Hex)	Error(Dec)	Error type	Description
4337	**17207**	Parameter	**Parameter “Couple Slave to Actual Values if not Enabled” is Invalid** The parameter “Couple Slave to Actual Values if not Enabled” is invalid. Range of values: [0, 1] — Unit: 1
4338	**17208**	Parameter	**Parameter "Allow Motion Commands to Slave Axis” is Invalid** The boolean parameter “Allow Motion Commands to Slave Axis” is invalid. This parameter defines whether a motion command can be sent to a slave axis or whether this is rejected with the NC error 0x4266 or 0x4267. Range of values: [0, 1] — Unit: 1
4339	**17209**	Parameter	**Parameter “Allow Motion Commands to External Setpoint Axis” is Invalid** The boolean parameter “Allow Motion Commands to External Setpoint Axis” is invalid. This parameter defines whether a motion command may be send to an axis within the state of external setpoint generation or whether such a message is rejected with error 0x4257. Range of values: [0, 1] — Unit: 1
433A	**17210**	Parameter	**Parameter “Fading Acceleration” is Invalid** The parameter “Fading Acceleration” for the blending profile from set to actual values is invalid. This parameter defines how to blend from a setpoint based axis coupling to an actual value based coupling (indirectly there is a time for the blending). Note: The value 0.0 causes that the minimum of default acceleration and default deceleration is used as blending acceleration internally within the NC. Range of values: [0; 0.01 .. 1.0e +20] — Unit: e.g. mm/s^2
433B	**17211**	Parameter	**"Fast Axis Stop Signal Type not allowed"** The value for the Signal Type of the 'Fast Axis Stop' is not allowed [0...5].
4340	**17216**	Initialization	**"Axis initialization"** Axis has not been initialized. Although the axis has been created, the rest of the initialization has not been performed (1. Initialization of axis I/O, 2. Initialization of axis, 3. Reset axis).
4341	**17217**	Address	**"Group address"** Axis does not have a group, or the group address has not been initialized (group contains the set value generation).
4342	**17218**	Address	**"Encoder address"** The axis does not have an encoder, or the encoder address has not been initialized.
4343	**17219**	Address	**"Controller address"** The axis does not have a controller, or the controller address has not been initialized.
4344	**17220**	Address	**"Drive address"** The axis does not have a drive, or the drive address has not been initialized.
4345	**17221**	Address	**"Axis interface PLC to NC address"** Axis does not have an axis interface from the PLC to the NC, or the axis interface address has not been initialized.
4346	**17222**	Address	**"Axis interface NC to PLC address"** Axis does not have an axis interface from the NC to the PLC, or the axis interface address has not been initialized.

Error(Hex)	Error(Dec)	Error type	Description
4347	**17223**	Address	**"Size of axis interface NC to PLC is not allowed" (INTERNAL ERROR)** The size of the axis interface from NC to PLC is not allowed.
4348	**17224**	Address	**"Size of axis interface PLC to NC is not allowed" (INTERNAL ERROR)** The size of the axis interface from PLC to NC is not allowed.
4356	**17238**	Monitoring	**"Controller enable"** Controller enable for the axis is not present (see axis interface SPS®NC). This enable is required, for instance, for an axis positioning task.
4357	**17239**	Monitoring	**Feed enable negative:** There is no feed enable for negative motion direction (see axis interface PLC->NC). This enable is checked e.g. for a positioning task of an axis into negative motion direction.
4358	**17240**	Monitoring	**"Feed enable plus"** Feed enable for movement in the positive direction is not present (see axis interface SPS®NC). This enable is required, for instance, for an axis positioning task in the positive direction.
4359	**17241**	Monitoring	**"Set velocity not allowed"** The set velocity requested for a positioning task is not allowed. This can happen if the velocity is less than or equal to zero, larger than the maximum permitted axis velocity, or, in the case of servo-drives, is larger than the reference velocity of the axis (see axis and drive parameters).
435A	**17242**	Monitoring	**"Movement smaller than one encoder increment" (INTERNAL ERROR)** The movement required of an axis is, in relation to a positioning task, smaller than one encoder increment (see scaling factor). This information is, however, handled internally in such a way that the positioning is considered to have been completed without an error message being returned.
435B	**17243**	Monitoring	**"Set acceleration monitoring" (INTERNAL ERROR)** The set acceleration has exceeded the maximum permitted acceleration or deceleration parameters of the axis.
435C	**17244**	Monitoring	**"PEH time monitoring"** The PEH time monitoring has detected that, after the PEH monitoring time that follows a positioning has elapsed, the target position window has not been reached. The following points must be checked: Is the PEH monitoring time, in the sense of timeout monitoring, set to a sufficiently large value (e.g. 1-5 s)? The PEH monitoring time must be chosen to be significantly larger than the target position monitoring time. Have the criteria for the target position monitoring (range window and time) been set too strictly? **Note:** The PEH time monitoring only functions when target position monitoring is active!
435D	**17245**	Monitoring	**"Encoder existence monitoring / movement monitoring"** During the active positioning the actual encoder value has changed continuously for a default check time from NC cycle to NC cycle less than the default minimum movement limit. => Check, whether axis is mechanically blocked, or the encoder system failed, etc... **Note:** The check is not performed while the axis is logically standing (position control), but only at active positioning (it would make no sense if there is a mechanical holding brake at the standstill)!

Error(Hex)	Error(Dec)	Error type	Description
435E	**17246**	Monitoring	**"Looping distance less than breaking distance"** The absolute value of the looping distance is less or equal than the positive or negative breaking distance. This is not allowed.
435F	**17247**	Monitoring	**Starting Velocity Invalid** The required starting velocity for a positioning task is not permitted (usually the starting velocity is zero). This situation can occur if the velocity is smaller than or equal to zero, greater than the axis maximum permitted velocity or for servo motion controllers greater than the axis reference velocity (see axis and motion controller parameters).
4360	**17248**	Monitoring	**Final Velocity Invalid** The required final velocity for a positioning task is not permitted (normally the final velocity is zero). This situation can occur if the velocity is smaller than or equal to zero, greater than the axis maximum permitted velocity or for servo motion controllers greater than the axis reference velocity (see axis and motion controller parameters).
4361	**17249**	Monitoring	**"Time range exceeded (future)"** The calculated position lies too far in the future (e.g. when converting a position value in a DC time stamp).
4362	**17250**	Monitoring	**"Time range exceeded (past)"** The calculated position lies too far in the past (e.g. when converting a position value in a DC time stamp).
4363	**17251**	Monitoring	**"Position cannot be determined"** The requested position cannot be determined. Case 1: It was not passed through in the past. Case 2: It cannot be reached in future. A reason can be a zero velocity value or an acceleration that causes a turn back.
4364	**17252**	Monitoring	**"Position indeterminable (conflicting direction of travel)"** The direction of travel expected by the caller of the function deviates from the actual direction of travel (conflict between PLC and NC view, for example when converting a position to a DC time).
4370	**17264**	Monitoring	**No Slave Coupling Possible (Velocity Violation)** A slave coupling to a master axis (e.g. by a universal flying saw) is rejected because otherwise the maximum velocity of the slave axis would be exceeded (a velocity monitoring has been selected).
4371	**17265**	Monitoring	**No Slave Coupling Possible (Acceleration Violation)** A slave coupling to a master axis (e.g. by a universal flying saw) is rejected, because otherwise the maximum acceleration of the slave axis will be exceeded (an acceleration monitoring is selected).
4372	**17266**	Monitoring	**Final Velocity invalid** The required final velocity for a positioning task is not permitted (normally the final velocity is zero). This can happen if the velocity is smaller than or equal to zero, bigger than the axis maximum permitted velocity or for servo motion controllers bigger than the axis reference velocity (see axis and motion controller parameters).

Error(Hex)	Error(Dec)	Error type	Description
43A0	**17312**	Internal	**"Axis consequential error"** Consequential error resulting from another causative error related to another axis. Axis consequential errors can occur in relation to master/slave couplings or with multiple axis interpolating DXD groups.

9.2.5 Encoder Errors

Error(Hex)	Error(Dez)	Error type	Description	
4400	**17408**	parameter	**"Encoder ID not allowed"** The value for the encoder ID is not allowed, e.g. because it has already been assigned, is less than or equal to zero, or is bigger than 255.	
			Value range: [1 ... 255]	Unit: 1
4401	**17409**	parameter	**"Encoder type not allowed"** The value for the encoder type is unacceptable because it is not defined. Type 1: Simulation (incremental) Type 2: M3000 (24 bit absolute) Type 3: M31x0 (24 bit incremental) Type 4: KL5101 (16 bit incremental) Type 5: KL5001 (24 bit absolute SSI) Type 6: KL5051 (16 bit BISSI)	
			Value range: [1 ... 6]	Unit: 1
4402	**17410**	parameter	**"Encoder mode"** The value for the encoder (operating) mode is not allowed. Mode 1: Determination of the actual position Mode 2: Determination of the actual position and the actual velocity (filter)	
			Value range: [1, 2]	Unit: 1
4403	**17411**	parameter	**"Encoder counting direction inverted?"** The flag for the encoder counting direction is not allowed. Flag 0: Positive encoder counting direction Flag 1: Negative encoder counting direction	
			Value range: [0, 1]	Unit: 1
4404	**17412**	initialization	**"Referencing status"** The flag for the referencing status is not allowed. Flag 0: Axis has not been referenced Flag 1: Axis has been referenced	
			Value range: [0, 1]	Unit: 1
4405	**17413**	parameter	**"Encoder increments for each physical encoder rotation"** The value for the number of encoder increments for each physical rotation of the encoder is not allowed. This value is used by the software for the calculation of encoder overruns and underruns.	
			Value range: [255, 0xFFFFFFFF]	Unit: INC

Error(Hex)	Error(Dez)	Error type	Description	
4406	**17414**	parameter	**"Scaling factor"** The value for the scaling factor is not allowed. This scaling factor provides the weighting for the conversion of an encoder increment (INC) to a physical unit such as millimeters or degrees.	
			Value range: [0.000001, 100.0]	Unit: e.g. mm/INC
4407	**17415**	parameter	**"Position offset (zero point offset)"** The value for the position offset of the encoder is not allowed. This value is added to the calculated encoder position, and is interpreted in the physical units of the encoder.	
			Value range: [-1000000.0, 1000000.0]	Unit: e.g. mm
4408	**17416**	parameter	**"Modulo factor"** The value for the encoder's modulo factor is not allowed.	
			Value range: [1.0, 1000000.0]	Unit: e.g. mm

Error(Hex)	Error(Dez)	Error type	Description	
4409	**17417**	parameter	**"Position filter time"** The value for the actual position filter time is not allowed (P-T1 filter).	
			Value range: [0.0, 60.0]	Unit: s
440A	**17418**	parameter	**"Velocity filter time"** The value for the actual velocity filter time is not allowed (P-T1 filter).	
			Value range: [0.0, 60.0]	Unit: s
440B	**17419**	parameter	**"Acceleration filter time"** The value for the actual acceleration filter time is not allowed (P-T1 filter).	
			Value range: [0.0, 60.0]	Unit: s
440C	**17420**	initialization	**"Cycle time not allowed" (INTERNAL ERROR)** The value of the SAF cycle time for the calculation of actual values is not allowed (e.g. is less than or equal to zero).	
440D	**17421**	initialization	**""** ENCERR_RANGE_UNITFLAGS	
440E	**17422**	parameter	**"Actual position correction / measurement system error correction"** The value for the activation of the actual position correction ("measuring system error correction") is not allowed.	
			Value range: [0, 1]	Unit: 1
440F	**17423**	parameter	**"Filter time actual position correction"** The value for the actual position correction filter time is not allowed (P-T1 filter).	
			Value range: [0.0, 60.0]	Unit: s
4410	**17424**	parameter	**"Search direction for referencing cam inverted"** The value of the search direction of the referencing cam in a referencing procedure is not allowed. Value 0: Positive direction Value 1: Negative direction	
			Value range: [0, 1]	Unit: 1
4411	**17425**	parameter	**"Search direction for sync pulse (zero pulse) inverted"** The value of the search direction of the sync pulse (zero pulse) in a referencing procedure is not allowed. Value 0: Positive direction Value 1: Negative direction	
			Value range: [0, 1]	Unit: 1
4412	**17426**	parameter	**"Reference position"** The value of the reference position in a referencing procedure is not allowed.	
			Value range: [-1000000.0, 1000000.0]	Unit: e.g. mm
4413	**17427**	parameter	**"Clearance monitoring between activation of the hardware latch and appearance of the sync pulse" (NOT IMPLEMENTED)** The flag for the clearance monitoring between activation of the hardware latch and occurrence of the sync/zero pulse ("latch valid") is not allowed. Value 0: Passive Value 1: Active	
			Value range: [0, 1]	Unit: 1
4414	**17428**	parameter	**"Minimum clearance between activation of the hardware latch and appearance of the sync pulse" (NOT IMPLEMENTED)** The value for the minimum clearance in increments between activation of the hardware latch and occurrence of the sync/zero pulse ("latch valid") during a referencing procedure is not allowed.	
			Value range: [0, 65536]	Unit: INC
4415	**17429**	parameter	**"External sync pulse" (NOT IMPLEMENTED)** The value of the activation or deactivation of the external sync pulse in a referencing procedure is not allowed. Value 0: Passive Value 1: Active	
			Value range: [0, 1]	Unit: 1

Error(Hex)	Error(Dez)	Error type	Description	
4416	**17430**	parameter	**"Scaling of the noise rate is not allowed"** The value of the scaling (weighting) of the synthetic noise rate is not allowed. This parameter exists only in the simulation encoder and serves to produce a realistic simulation.	
			Value range: [0, 1000000]	Unit: 1
4417	**17431**	parameter	**„Tolerance window for modulo-start“** The value for the tolerance window for the modulo-axis-start is invalid. The value must be greater or equal than zero and smaller than the half encoder modulo-period (e. g. in the interval [0.0,180.0)).	
			Value range: [0.0, 180], Max: 0.5*modulo-periode	Unit: e. g. mm or degree
4418	**17432**	parameter	**„Encoder reference mode“** The value for the encoder reference mode is not allowed, resp. is not supported for this encoder type.	
			Value range: [0, 5]	Unit: 1
4419	**17433**	parameter	**„Encoder evaluation direction“** The value for the encoder evaluation direction (log. counter direction) is not allowed.	
			Value range: [0, 3]	Unit: 1
441A	**17434**	parameter	**„Encoder reference system“** The value for the encoder reference system is invalid (0: incremental, 1: absolute, 2: absolute+modulo).	
			Value range: [0, 2]	Unit: 1
441B	**17435**	parameter	**„Encoder position initialization mode“** When starting the TC system the value for the encoder position initialization mode is invalid.	
			Value range: [0, 1]	Unit: 1
441C	**17436**	parameter	**„Encoder sign interpretation (UNSIGNED- / SIGNED- data type)“** The value for the encoder sign interpretation (data type) for the encoder the actual increment calculation (0: Default/not defined, 1: UNSIGNED, 2:/ SIGNED) is invalid.	
			Value range: [0, 2]	Unit: 1
4420	**17440**	parameter	**"Software end location monitoring minimum not allowed"** The value for the activation of the software location monitoring minimum is not allowed.	
			Value range: [0, 1]	Unit: 1
4421	**17441**	parameter	**"Software end location monitoring maximum not allowed"** The value for the activation of the software location monitoring maximum is not allowed.	
			Value range: [0, 1]	Unit: 1
4422	**17442**	function	**"Actual value setting is outside the value range"** The "set actual value" function cannot be carried out, because the new actual position is outside the expected range of values.	
			Value range: [-1000000.0, 1000000.0]	Unit: e.g. mm
4423	**17443**	parameter	**"Software end location minimum not allowed"** The value for the software end location minimum is not allowed.	
			Value range: [-1000000000.0, 1000000000.0]	Unit: e.g. mm
4424	**17444**	parameter	**"Software end location maximum not allowed"** The value for the software end location maximum is not allowed.	
			Value range: [-1000000000.0, 1000000000.0]	Unit: e.g. mm
4425	**17445**	parameter	**„Filter mask for the raw data of the encoder is invalid“** The value for the filter mask of the encoder raw data in increments is invalid.	
			Value range: [0, 0xFFFFFFFF]	Unit: 1

Error(Hex)	Error(Dez)	Error type	Description	
4426	**17446**	parameter	**„Reference mask for the raw data of the encoder is invalid“** The value for the reference mask (increments per encoder turn, absolute resolution) for the raw data of the encoder is invalid. E.g. this value is used for axis reference sequence (calibration) with the reference mode "Software Sync".	
			Value range: [0x0000000F, 0xFFFFFFFF]	Unit: 1
4427	**17447**	Parameter	**Parameter Dead Time Compensation Mode (Encoder) is Invalid** The parameter for the mode of dead time compensation at the NC encoder is invalid (OFF, ON with velocity, ON with velocity and acceleration).	
			Range of values: [0, 1, 2]	Unit: 1
4428	**17448**	Parameter	**Parameter “Control Bits of Dead Time Compensation” (Encoder) is Invalid** The parameter for the control bits of dead time compensation at the encoder is invalid (e.g. relative or absolute time interpretation).	
			Range of values: [>0]	Unit: 1
4429	**17449**	Parameter	**Parameter “Time Related Shift of Dead Time Compensation Mode” (Encoder) is Invalid** The parameter for time related shift of dead time compensation (time shift in nanoseconds) at the encoder is invalid.	
			Range of values: [-1.0E9 .. 1.0E9]	Unit: ns
4430	**17456**	function	**"Hardware latch activation (encoder)"** Activation of the encoder hardware latch was implicitly initiated by the referencing procedure. If this function has already been activated but a latch value has not yet become valid ("latch valid"), another call to the function is refused with this error.	
4431	**17457**	function	**"External hardware latch activation (encoder)"** The activation of the external hardware latch (only available on the KL5101) is initiated explicitly by an ADS command (called from the PLC program of the Visual Basic interface). If this function has already been activated, but the latch value has not yet been made valid by an external signal ("external latch valid"), another call to the function is refused with this error.	
4432	**17458**	function	**"External hardware latch activation (encoder)"** If a referencing procedure has previously been initiated and the hardware still signals a valid latch value ("latch valid"), this function must not be called. In practice, however, this error can almost never occur.	
4433	**17459**	function	**"External hardware latch activation (encoder)"** If this function has already been initiated and the hardware is still signaling that the external latch value is still valid ("extern latch valid"), a further activation should not be carried out and the commando will be declined with an error (the internal handshake communication between NC and IO device is still active). In that case the validity of the external hardware latch would immediately be signaled, although the old latch value would still be present.	
4434	**17460**	monitoring	**"Encoder function not supported"** An encoder function has been activated that is currently not released for use, or which is not even implemented.	

Error(Hex)	Error(Dez)	Error type	Description
4435	**17461**	monitoring	**„Encoder function is already active“** An encoder function can not been activated because this functionality is already active.
4440	**17472**	initialization	**"Encoder initialization"** Encoder has not been initialized. Although the axis has been created, the rest of the initialization has not been performed (1. Initialization of axis I/O, 2. Initialization of axis, 3. Reset axis).
4441	**17473**	address	**"Axis address"** The encoder does not have an axis, or the axis address has not been initialized.
4442	**17474**	address	**"I/O input structure address"** The drive does not have a valid I/O input address in the process image.
4443	**17475**	address	**"I/O output structure address"** The encoder does not have a valid I/O output address in the process image.
4450	**17488**	monitoring	**"Encoder counter underflow monitoring"** The encoder's incremental counter has underflowed.
4451	**17489**	monitoring	**"Encoder counter overflow monitoring"** The encoder's incremental counter has overflowed.
4460	**17504**	monitoring	**"Software end location minimum (axis start)"** With active monitoring of the software end location for a minimum, a start has been made from a position that lies below the software end location minimum.
4461	**17505**	monitoring	**"Software end location maximum (axis start)"** With active monitoring of the software end location for a maximum, a start has been made from a position that lies above the software end location maximum.
4462	**17506**	monitoring	**"Software end location minimum (positioning process)"** With active monitoring of the software end location for a minimum, the actual position has fallen below the software end location minimum. In the case of servo axes (continuously driven axes) this limit is expanded by the magnitude of the parameterized following error window (position).
4463	**17507**	monitoring	**"Software end location maximum (positioning process)"** With active monitoring of the software end location for a maximum, the actual position has exceeded the software end location maximum. In the case of servo axes (continuously driven axes) this limit is expanded by the magnitude of the parameterized following error window (position).
4464	**17508**	monitoring	**„Encoder hardware error“** The drive resp. the encoder system reports a hardware error of the encoder. An optimal error code is displayed in the message of the event log.
4465	**17509**	monitoring	**„Position initialization error at system start“** At the first initialization of the set position was this for all initialization trials (without over-/under-flow, with underflow and overflow) out of the final position minimum and maximum.

Error(Hex)	Error(Dez)	Error type	Description
4466	**17510**	Monitoring	**Invalid IO data for more than n subsequent NC cycles (encoder)** The axis (encoder) has detected for more than n subsequent NC cycles (NC SAF task) invalid encoder IO data (e.g. n=3). Typically, regarding an EtherCAT member it is about a Working Counter Error (WcState) what displays that data transfer between IO device and controller is disturbed. If this error is set for a longer period of time continuously, this situation can lead to losing the axis reference (the “homed” flag will be reset and the encoder will get the state “unreferenced”). Possible reasons for this error: An EtherCAT slave may have left its OP state or there is a too high real time usage or a too high real time jitter.
4467	**17511**	Monitoring	**Invalid Actual Position (Encoder)** The IO device delivers an invalid actual position (for CANopen/CoE look at bit 13 of encoder state “TxPDO data invalid” or “invalid actual position value”).
4468	**17512**	Monitoring	**Invalid IO Input Data (Error Type 1)** The monitoring of the “cyclic IO input counter” (2 bit counter) has detected an error. The input data has not been refreshed for at least 3 NC SAF cycles (the 2 bit counter displays a constant value for multiple NC SAF cycles, instead of incrementing by exactly one from cycle to cycle).
4469	**17513**	Monitoring	**Invalid IO Input Data (Error Type 2)** The monitoring of the “cyclic IO input counter” (2 bit counter) has detected an error. The quality of input data based on this two bit counter is not sufficient (there is here a simple statistic evaluation that evaluates GOOD cases and BAD cases and in exceeding a special limit value leads to an error).
4470	**17520**	monitoring	**"SSI transformation fault or not finished"** The SSI transformation of the FOX 50 module was faulty for some NC-cycles or did not finished respectively.
44A2	**17570**	monitoring	**"ENCERR_ADDR_CONTROLLER"**
44A3	**17571**	monitoring	**"ENCERR_INVALID_CONTROLLERTYPE"**

9.2.6 Controller Errors

Error(Hex)	Error(Dec)	Error type	Description	
4500	**17664**	parameter	**"Controller ID not allowed"** The value for the controller ID is not allowed, e.g. because it has already been assigned, is less than or equal to zero, or is greater than 255.	
			Value range: [1 ... 255]	Unit: 1
4501	**17665**	parameter	**"Controller type not allowed"** The value for the controller type is unacceptable because it is not defined. Type 1: P-controller (position) . . . Type 7: High/low speed controller Type 8: Stepper motor controller Type 9: Sercos controller	
			Value range: [1 ... 8]	Unit: 1
4502	**17666**	parameter	**"Controller operating mode not allowed"** The value for the controller operating mode is not allowed.	
			Value range: [1]	Unit: 1

Error(Hex)	Error(Dec)	Error type	Description	
4503	**17667**	parameter	**"Weighting of the velocity pre-control not allowed"** The value for the percentage weighting of the velocity pre-control is not allowed. The parameter is pre-set to 1.0 (100%) as standard.	
			Value range: [0.0 ... 1.0]	Unit: %
4504	**17668**	parameter	**"Following error monitoring (position) not allowed"** The value for the activation of the following error monitoring is not allowed.	
			Value range: [0, 1]	Unit: 1
4505	**17669**	parameter	**"Following error (velocity) not allowed"** The value for the activation of the following error monitoring (velocity) is not allowed.	
			Value range: [0, 1]	Unit: 1
4506	**17670**	parameter	**"Following error window (position) not allowed"** The value for the following error window (maximum allowable following error) is not allowed.	
			Value range: [0.0, 10000.0]	Unit: e.g. mm

Error(Hex)	Error(Dec)	Error type	Description	
4507	**17671**	parameter	**"Following error filter time (position) not allowed"** The value for the following error filter time (position) is not allowed.	
			Value range: [0.0, 600.0]	Unit: s
4508	**17672**	parameter	**"Following error window (velocity) not allowed"** The value for the following error window (velocity) is not allowed.	
			Value range: [0.0, 10000.0]	Unit: e.g. m/min
4509	**17673**	parameter	**"Following error filter time (velocity) not allowed"** The value for the following error filter time (velocity) is not allowed.	
			Value range: [0.0, 600.0]	Unit: s
450A	**17674**	Parameter	**“Controller Output Limitation” Improper** The value for output limitation of the controller at the overall setpoint quantity is improper. The presetting amounts to `0.5` (`50` percent). Typically, this parameter is at work if to the motion controller device the velocity interface has been parameterized and the `NC` performs position control of the position on the controller.	
4510	**17680**	parameter	**"Proportional gain Kv or Kp (controller) not allowed"** *position* The value for the proportional gain (Kv factor or Kp factor) is not allowed.	
			Value range: [0.0, 10000.0]	Unit: e.g. mm/s/mm
4511	**17681**	parameter	**"Integral-action time Tn (controller) not allowed"** *position* The value for the integral-action time is not allowed (I proportion of the PID T1 controller).	
			Value range: [0.0, 60.0]	Unit: s
4512	**17682**	parameter	**"Derivative action time Tv (controller) not allowed"** *position* The value for the derivative action time is not allowed (D proportion of the PID T1 controller).	
			Value range: [0.0, 60.0]	Unit: s
4513	**17683**	parameter	**"Damping time Td (controller) not allowed"** *position* The value for the damping time is not allowed (D proportion of the PID T1 controller). Suggested value: 0.1 * Tv	
			Value range: [0.0, 60.0]	Unit: s
4514	**17684**	function	**"Activation of the automatic offset compensation not allowed"** Activation of the automatic offset compensation is only possible for certain types of controller (with no I component).	

Error(Hex)	Error(Dec)	Error type	Description	
4515	**17685**	parameter	**"Additional proportional gain Kv or Kp (controller) not allowed"** *position* The value for the second term of the proportional gain (Kv factor or Kp factor) is not allowed.	
			Value range: [0.0, 10000.0]	Unit: e.g. mm/s/mm
4516	**17686**	parameter	**"Reference velocity for additional proportional gain Kv or Kp (controller) not allowed"** *position* The value for the reference velocity percentage data entry, to which the additional proportional gain is applied, is not allowed. The standard setting for the parameter is 0.5 (50%).	
			Value range: [0.0 ... 1.0]	Unit: %
4517	**17687**	parameter	**"Proportional gain Pa (proportion) not allowed"** *acceleration* The value for the proportional gain (Pa factor) is not allowed.	
			Value range: [0.0, 1000000.0]	Unit: s
4518	**17688**	parameter	**"Proportional gain Kv (velocity controller) not allowed"** The value for the proportional gain (Kv factor) is not allowed.	
			Value range: [0.0, 10000.0]	Unit: 1
4519	**17689**	parameter	**“Reset time Tn (velocity controller) not allowed”** The value for the integral-action time is not allowed (I proportion of the PID T1 controller).	
			Value range: [0.0, 60.0]	Unit: s
451A	**17690**	Parameter	**Reserved** Reserved, currently not used.	
451B	**17691**	Parameter	**Reserved** Reserved, currently not used.	
451C	**17692**	Parameter	**“Velocity Filter Time” Improper** The parameter for velocity filter time in seconds is improper (`P-T1` filter). This filter can be used within the `NC` for filtering an actual velocity or a velocity difference (`velocity error = setpoint velocity - actual velocity`) in special `NC` controllers (e.g. within the torque interface).	
			Range of values: [0.0, 60.0]	Unit: s
451D	**17693**	Parameter	**„Dead zone not allowed“** The value for the dead zone from the position error or the velocity error (system deviation) is not allowed (only for complex controller with velocity or torque interface).	
			Value range: [0.0, 10000.0]	Unit: mm resp. mm/s
451F	**17695**	Parameter	**“Proportionality Factor Kcp” Improper** The parameter for the “proportional factor `Kcp`” of the slave coupling differential control is improper.	
			Range of values: [0.0, 10000.0]	Unit: e.g. mm^2/mm
4520	**17696**	parameter	**”Rate time Tv (velocity controller) not allowed”** The value for the derivative action time is not allowed (D proportion of the PID T1 controller).	
			Value range: [0.0, 60.0]	Unit: s
4521	**17697**	parameter	**"Damping time Td (velocity controller) not allowed"** The value for the damping time is not allowed (D proportion of the PID T1 controller). Suggested value: 0.1 * Tv	
			Value range: [0.0, 60.0]	Unit: s

Error(Hex)	Error(Dec)	Error type	Description	
4522	**17698**	Parameter	**“Limitation of the I Part” Improper** The parameter for limiting the `I` part of a `PI` or `PID` controller is improper. This inner state quantity can be limited in percent (`1.0` refers to `100` percent).	
			Range of values: [0.0 .. 1.0]	Unit: %
4523	**17699**	Parameter	**“Limitation of the D Part” Improper** The parameter for limitation of the `D` part of a `PI` or `PID` controller is improper. This inner state quantity may be limited in percent (`1.0` refers to `100` percent).	
			Range of values: [0.0 .. 1.0]	Unit: %
4524	**17700**	Parameter	**Parameter “Switching Off the I Part During Motion” is Improper** The boolean parameter for switching off the `I` part during an active positioning is improper.	
			Range of values: [0, 1]	Unit: 1
4525	**17701**	Parameter	**Parameter “Filter Time for P-T2 Filter” Improper** The time `T0` in seconds is as filter time for the velocity controller `P-T2` element improper. The filter time has to be smaller than twice the `NC-SAF` cycle time.	
			Range of values: [0.0, 60.0]	Unit: s
4526	**17702**	Parameter	**Velocity Observer: “Parameterized Mode” is Improper** The parameterized mode (`0=OFF`, `1=LUENBERGER`) for the special `NC` controller velocity observer within the torque interface is improper.	
			Range of values: [0, 1]	Unit: 1
4527	**17703**	Parameter	**Velocity Observer: “Motor Torque Constant Kt or Kf” is Improper** The parameter for the motor torque constant `Kt` (rotational motor) or `Kf` (linear motor) of the special `NC` controller velocity observer within the torque interface is improper.	
			Range of values: [0.0 .. 100000.0]	Unit: Nm/A or N/A
4528	**17704**	Parameter	**Velocity Observer: “Motor Moment of Inertia JM” is Improper** The parameter for the motor moment of inertia J_M of the special `NC` controller velocity observer within the torque interface is improper.	
			Range of values: [0.0001 .. 100000.0]	Unit: kg cm^2
4529	**17705**	Parameter	**Velocity Observer: “Band Width f0” is Improper** The parameter for the band width f_0 of the special `NC` controller velocity observer within the torque interface is improper. The band width has to be smaller than the reciprocal value of six times the `NC` cycle time ($f_0 < 1/(6*T)$).	
			Range of values: [0.0 .. 10000.0]	Unit: Hz
452A	**17706**	Parameter	**Velocity Observer: “Correction Factor kc” is Improper** The parameter for the correction factor k_c of the special `NC` controller velocity observer within the torque interface is improper. The correction factor k_c implements the relation between current and acceleration or angular acceleration.	
			Range of values: [0.0 .. 100.0]	Unit: s

Error(Hex)	Error(Dec)	Error type	Description
452B	**17707**	Parameter	**Velocity Observer: “Time Constant T for First Order Filter” is Improper** The time constant T for the first order velocity filter (PID-T_2 or “Lead Lag”) of the specific NC controller velocity observer within the torque interface is improper. The correction factor k_c implements the relation between current and acceleration or angular acceleration. Range of values: [0.0 .. 100.0] Unit: s
452C	**17708**	Parameter	**Velocity Observer: “Amplitude Damping d for Second Order Filter” is Improper** The high pass/ low pass amplitude damping d_{HP} or d_{TP} for the second order velocity filter (“Bi-Quad”) of the special NC controller velocity observer within the torque interface is improper. Range of values: [0.2 .. 10.0] Unit: 1
452D	**17709**	Parameter	**Velocity Observer: “Frequency fHP or Frequency fTP for Filters of Second Order” is Improper** The high pass frequency f_{HP} or the low pass frequency f_{TP} for the second order velocity filter (“Bi-Quad”) of the specific NC controller velocity observer within the torque interface is improper. Range of values: [0.0, .. 10000.0] Unit: Hz
4540	**17728**	initialization	**"Controller initialization"** Controller has not been initialized. Although the controller has been created, the rest of the initialization has not been performed (1. Initialization of controller, 2. Reset controller).
4541	**17729**	address	**"Axis address"** Controller does not know its axis, or the axis address has not been initialized.
4542	**17730**	address	**"Drive address"** Controller does not know its drive, or the drive address has not been initialized.
4550	**17744**	monitoring	**"Following error monitoring (position)"** With active following error monitoring (position) a following error exceedance has occurred, whose magnitude is greater than the following error window, and whose duration is longer than the parameterized following error filter time.
4551	**17745**	monitoring	**"Following error monitoring (velocity)"** With active following error monitoring (velocity) a velocity following error exceedance has occurred, whose magnitude is greater than the following error window, and whose duration is longer than the parameterized following error filter time.
45A0	**17824**	monitoring	**"CONTROLERR_RANGE_AREA_ASIDE"**
45A1	**17825**	monitoring	**"CONTROLERR_RANGE_AREA_BSIDE"**
45A2	**17826**	monitoring	**"CONTROLERR_RANGE_QNENN"**
45A3	**17827**	monitoring	**"CONTROLERR_RANGE_PNENN"**
45A4	**17828**	monitoring	**"CONTROLERR_RANGE_AXISIDPRESP0"**

9.2.7 Drive Errors

Error(hex)	Error(dec)	Error type	Description	
4600	**17920**	Parameter	**'"Drive ID not allowed"** The value for the drive ID is not allowed, e.g. because it has already been assigned, is less than or equal to zero, or is greater than 255.	
			Value range: [1 ... 255]	Unit: 1
4601	**17921**	Parameter	**'Drive type impermissible'** The value for the drive type is impermissible, since it is not defined.	
			Value range: [1, 20]	Unit: 1
4602	**17922**	Parameter	**'Drive operating mode impermissible'** The value for the drive operating mode is impermissible (mode 1: standard).	
			Value range: [1]	Unit: 1
4603	**17923**	Parameter	**"Motor polarity inverted?"** The flag for the motor polarity is not allowed. Flag 0: Positive motor polarity flag 1: Negative motor polarity	
			Value range: [0, 1]	Unit: 1
4604	**17924**	Parameter	**'Drift compensation/speed offset (DAC offset)'** The value for the drift compensation (DAC offset) is impermissible.	
			Value range: [-100.0, 100.0]	Unit: e.g. m/min
4605	**17925**	Parameter	**'Reference speed (velocity pre-control)'** The value for the reference speed (also called velocity pilot control) is impermissible.	
			Value range: [0.0, 10000.0]	Unit: e.g. m/min
4606	**17926**	Parameter	**'Reference output in percent'** The value for the reference output in percent is impermissible. The value 1.0 (100 %) usually corresponds to a voltage of 10.0 V.	
			Value range: [0.0, 5.0]	Unit: %
4607	**17927**	Parameter	**'Quadrant compensation factor'** The value for the quadrant compensation factor is impermissible.	
			Value range: [0.0, 100.0]	Unit: 1
4608	**17928**	Parameter	**'Velocity reference point'** The value for the velocity reference point in percent is impermissible. The value 1.0 corresponds to 100 percent.	
			Value range: [0.01, 1.0]	Unit: %
4609	**17929**	Parameter	**'Output reference point'** The value for the output reference point in percent is impermissible. The value 1.0 corresponds to 100 percent.	
			Value range: [0.01, 1.0]	Unit: %

Error(hex)	Error(dec)	Error type	Description	
460A	**17930**	Parameter	**'Minimum or maximum output limits (output limitation)'** The value for the minimum and/or maximum output limit is impermissible. This will happen if the range of values is exceeded, the maximum limit is smaller than the minimum limit, or the distance between the minimum and maximum limits is zero. The minimum limit is initially set to –1.0 (-100 percent) and the maximum limit to 1.0 (100 percent).	
			Value range: [-1.0, 1.0]	Unit: %
460B	**17931**	Parameter	**Parameter "Maximum Value for Output" is Improper** The value for the maximum number of output digits of motion controllers (maximum output value) is improper. According to the used interface (e.g. position, velocity or torque/current). Regarding a velocity interface it is often about a signed 16 bit output value (± 32767).	
			Range of values: [0x000000FF .. 0xFFFFFFFF]	Unit: INC or Digits
460C	**17932**	Parameter	**Parameter "Internal Drive Control Word" is Improper** The value as Internal Drive Control Word for the NC is improper. In this control word information from the system manager to the NC is contained what is evaluated at the TC start of the NC.	
			Range of values: [>0]	Unit: 1
460D	**17933**	Parameter	**Parameter "Internal Timer for RESET Behavior of Motion Controller" is Improper** The special parameter that influences the internal timing behavior between the NC motion controller and the IO motion controller is improper.	
			Range of values: [>5]	Unit: 1 (NC SAF Cycles)
460E	**17934**	Parameter	**Parameter "Master Motion Controller ID" is Improper** The parameter "master motion controller ID" is improper for a further NC motion controller in slave mode. An additional NC motion controller in slave mode can be used if this usage is about the same motion controller device on that different NC information for e.g. different operation modes are joined (e.g. velocity mode and torque mode). Note: This parameter is not accessible by the user directly, but can be influenced indirectly by the configuration of additional NC motion controllers below the NC axis.	
			Range of values: [0 .. 255]	Unit: 1
460F	**17935**	Parameter	**'Drive torque output scaling impermissible'** The value is impermissible as drive torque output scaling (rotary motor) or as force output scaling (linear motor).	
			Value range: [0, 1000000]	Unit: 1
4610	**17936**	Parameter	**„Drive velocity output scaling is not allowed"** The value for the drive velocity output scaling is not allowed.	
			Value range: [0, 1000000]	Unit: 1
4611	**17937**	Parameter	**'Profi Drive DSC proportional gain Kpc (controller) impermissible'** *Positions* The value for the Profi Drive DSC position control gain (Kpc factor) is impermissible.	
			Value range: [0, 0xFFFFFF]	Unit: 0.001 * 1/s
4612	**17938**	Parameter	**'Table ID is impermissible'** The value for the table ID is impermissible.	
			Value range: [0, 255]	Unit: 1

Error(hex)	Error(dec)	Error type	Description	
4613	**17939**	Parameter	**'Table interpolation type is impermissible'** The value is impermissible as the table interpolation type.	
			Value range: 0 (LINEAR), 2 (SPLINE)	Unit: 1
4614	**17940**	Parameter	**'Output offset in percent is impermissible'** The value is impermissible as an output offset in percent (+/- 1.0).	
			Value range: [-1.0, 1.0]	Unit: %
4615	**17941**	Parameter	**'Profi Drive DSC scaling for calculation of "Xerr" (controller) impermissible'** *Positions:* the value is impermissible as Profi Drive DSC scaling for the calculation of 'Xerr'.	
			Value range: [0, 1000000]	Unit: 1
4616	**17942**	Parameter	**'Drive acceleration output scaling impermissible'** The value is impermissible as drive acceleration/deceleration output scaling.	
			Value range: [0, 1000000]	Unit: 1
4617	**17943**	Parameter	**'Drive position output scaling impermissible'** The value is impermissible as drive position output scaling.	
			Value range: [0, 1000000]	Unit: 1
4618	**17944**	Parameter	**Parameter "Dead Time Compensation Mode" (Motion Controller) is Invalid** The parameter for the mode of dead time compensation of NC motion controllers is invalid (OFF, ON with velocity, ON with velocity and acceleration).	
			Range of values: [0, 1, 2]	Unit: 1
4619	**17945**	Parameter	**Parameter "Control Bits of Dead Time Compensation" (Motion Controller) is Invalid** The parameter for "control bits of dead time compensation" of NC motion controllers is invalid (e.g. relative or absolute time interpretation).	
			Range of values: [>0]	Unit: 1
461A	**17946**	Parameter	**Parameter "Time Shift of Dead Time Compensation" (Motion Controller) is Invalid** The parameter for the time shift of dead time compensation (time shift in nanoseconds) of the NC motion controller is invalid.	
			Range of values: [-1.0E9 .. 1.0E9]	Unit: ns
461B	**17947**	Parameter	**Parameter "Output Delay (Velocity)" is Invalid** The parameter for an optional output delay within the velocity interface to the motion controller is invalid (output delay (velocity)). The maximum permitted delay time has to be smaller than 100 times the NC SAF cycle time.	
			Range of values: [0.0 .. 0.1]	Unit: s
461C	**17948**	Parameter	**'Drive filter type impermissible for command variable filter for the output position'** The value is impermissible as a drive filter type for the smoothing of the output position (command variable filter for the setpoint position).	
			Value range: [0, 2]	Unit: 1
461D	**17949**	Parameter	**'Drive filter time impermissible for command variable filter for the output position'** The value is impermissible as a drive filter time for the smoothing of the output position (command variable filter for the setpoint position).	
			Value range: [0.0, 1.0]	Unit: s

Error(hex)	Error(dec)	Error type	Description	
461E	**17950**	Parameter	**'Drive filter order impermissible for command variable filter for the output position'** The value is impermissible as a drive filter order (P-Tn) for the smoothing of the output position (command variable filter for the setpoint position).	
			Value range: [0, 10]	Unit: 1
4620	**17952**	Parameter	**'Bit mask for stepper motor cycle impermissible'** A value of the different stepper motor masks is impermissible for the respective cycle.	
			Value range: [0, 255]	Unit: 1
4621	**17953**	Parameter	**'Bit mask for stepper motor holding current impermissible'** The value for the stepper motor holding mask is impermissible.	
			Value range: [0, 255]	Unit: 1
4622	**17954**	Parameter	**'Scaling factor for actual torque (actual current) impermissible'** The value is impermissible as a scaling factor for the actual torque (or actual current).	
			Value range: [0, 1E+30]	Unit:
4623	**17955**	Parameter	**'Filter time for actual torque is impermissible'** The value is impermissible as a filter time for the actual torque (or the actual current) (P-T1 filter).	
			Value range: [0.0, 60.0]	Unit: s
4624	**17956**	Parameter	**'Filter time for the temporal derivation of the actual torque is impermissible'** The value is impermissible as a filter time for the temporal derivation of the actual torque (or actual current (P-T1 filter).	
			Value range: [0.0, 60.0]	Unit: s
4625	**17957**	Parameter	**Parameter for the "Motion Controller Operation Mode" is Invalid** The parameter for the motion controller operation mode (position mode, velocity mode, torque mode, …) is invalid. Possibly, an NC operation mode switching has been tried or at TC system start has been tried to activate a preconfigured operation mode. Annotations: The generic operation modes defined within the NC are realized by the NC motion controller specifically, i.e. in particular for the protocols SERCOS/ SoE and CANopen/ CoE (DS402). In this connection, protocol specific, motion controller specific or even customer specific peculiarities have to be obeyed (e.g. regarding SERCOS/ SoE merely in the SERCOS parameter range S-0-0032 to S-0-0035 predefined operation modes can be activated at runtime). Furthermore, not every generic NC operation mode can be converted into a motion controller specific operation mode (here gaps within the specification may exist). The generic NC operation mode 0 forms a special case. This value is used as a mark to activate an NC default operation mode (as long as this mark is known to the NC).	
			Range of values: [0, >=1]	Unit: 1

Error(hex)	Error(dec)	Error type	Description
4626	**17958**	Monitoring	**Motion Controller Functionality is Not Supported** A motion controller functionality has been set off that has not been released for usage or has not been implemented (e.g. writing or reading of a motion controller mode that is not supported by certain motion controllers). It is also possible that this functionality is merely not supported at times (e.g. because the motion controller device resides in error state or a motion controller enable is missing).
4627	**17959**	Function	**DRIVEOPERATIONMODEBUSY.** The activation of the motion controller controlling mode has failed because another object with OID… uses this interface already.
4628	**17960**	Monitoring	**Motion Controller Operation Mode Switching has not been configured or the desired motion controller operation mode cannot be found** There has not any motion controller operation mode switching been configured and thus no reading or writing of a motion controller operation mode is possible. Or the desired motion control operation mode has not been found in the list of the predefined motion controller operation modes (e.g. for SoE/ SERCOS). Annotation for CoE motion controllers: The reading or writing of the CoE Motion Control Operation Mode is merely possible if the CoE objects 0x6060 Modes Of Operation and 0x6061 Modes Of Operation Display can be found in the cyclic process data (PDO list) and a valid default operation mode has been configured. Annotation for SoE motion controllers: The reading or writing of the current SoE Motion Controller Operation Mode is merely possible if this operation mode has been predefined in one of the SoE Parameters S-0-0032 to S-0-0035.
0x4630 … 0x463F: Error codes are reserved for external motion controller errors (e.g. stepper motor terminal or function block MC_PowerStepper).			
4630	**17968**	Monitoring	**‘Overtemperature’** Overtemperature was detected or reported in the drive or terminal.
4631	**17969**	Monitoring	**‘Undervoltage’** Undervoltage was detected or reported in the drive or terminal.
4632	**17970**	Monitoring	**‘Wire break in phase A’** A wire break in phase A was detected or reported in the drive or terminal.
4633	**17971**	Monitoring	**‘Wire break in phase B’** A wire break in phase B was detected or reported in the drive or terminal.
4634	**17972**	Monitoring	**‘Overcurrent in phase A’** Overcurrent was detected or reported in phase A in the drive or terminal.
4635	**17973**	Monitoring	**‘Overcurrent in phase B’** Overcurrent was detected or reported in phase B in the drive or terminal.
4636	**17974**	Monitoring	**‘Torque overload (stall)’** A torque overload (stall) was detected or reported in the drive or terminal.
4640	**17984**	Initialization	**‘Drive initialization’** Drive has not been initialized. Although the drive has been created, the rest of the initialization has not been performed (1. Initialization of drive I/O, 2. Initialization of drive, 3. Reset drive).
4641	**17985**	Address	**‘Axis address’** Drive does not know its axis, or the axis address has not been initialized.
4642	**17986**	Address	**‘Address IO input structure’** Drive has no valid IO input address in the process image.

Error(hex)	Error(dec)	Error type	Description
4643	**17987**	Address	**'Address IO output structure'** Drive has no valid IO output address in the process image.
4650	**18000**	Monitoring	**'Drive hardware not ready to operate'** The drive hardware is not ready for operation. The following are possible causes: - the drive is in the error state (hardware error) - the drive is in the start-up phase (e.g. after an axis reset that was preceded by a hardware error) - the drive is missing the controller enable (ENABLE) Note: The time required for "booting" a drive after a hardware fault can amount to several seconds.
4651	**18001**	Monitoring	**Error in the cyclic communication of the drive (Life Counter).** Reasons for this could be an interrupted fieldbus or a drive that is in the error state.
4652	**18002**	Monitoring	**'Changing the table ID when active controller enable is impermissible'.** Changing (deselecting, selecting) the characteristic curve table ID is not permissible when the controller enable for the axis is active.
4655	**18005**	Monitoring	**'Invalid IO data for more than 'n' continuous NC cycles'** The axis (encoder or drive) has detected invalid IO data (e.g. n=3) for more than 'n' continuous NC cycles (NC SAF task). EtherCAT fieldbus: 'working counter error ('WCState')'As a result it is possible that the encoder referencing flag will be reset to FALSE (i.e. the encoder is given the status 'unreferenced'). Lightbus fieldbus: 'CDL state error ('CdlState')' As a result it is possible that the encoder calibration flag will set to FALSE (that means uncalibrated).

9.2.8 Table Errors

Error(Hex)	Error(Dec)	Error type	Description	
4A00	**18944**	parameter	**"Table ID not allowed"** The value for the table ID is not allowed, e.g. because it has already been assigned, is less than or equal to zero, or is greater than 255.	
			Value range: [1 ... 255]	Unit: 1
4A01	**18945**	parameter	**"Table type not allowed"** The value for the table type is unacceptable because it is not defined.	
			Value range: [1]	Unit: 1
4A02	**18946**	parameter	**"Number of lines in the table not allowed"** The value of the number of lines in the table is not allowed, because, for example, it is smaller than two at linear interpolation and smaller than four at spline interpolation.	
			Value range: [2, 0xFFFF]	Unit: 1
4A03	**18947**	parameter	**"Number of columns in the table is not allowed"** The value of the number of columns in the table is not allowed, because, for example, it is less than or equal to zero (depends upon the type of table or slave).	
			Value range: [1, 0xFFFF]	Unit: 1
4A04	**18948**	parameter	**"Step size (position delta) not allowed"** The value for the step size between two lines (position delta) is not allowed, because, for example, it is less than or equal to zero.	
			Value range: [0.001, 1.0E+6]	Unit: e.g. mm
4A05	**18949**	parameter	**"Period not allowed"** The value for the period is not allowed, because, for example, it is less than or equal to zero.	
			Value range: [0.001, 1.0E+9]	Unit: e.g. mm
4A06	**18950**	parameter	**"Table is not monotonic"** The value for the step size is not allowed, because, for example, it is less than or equal to zero.	
4A07	**18951**	initialization	**„Table sub type is not allowed“** The value for the table sub type is not allowed or otherwise the table class (slave type) do not match up to the table main type. Table sub type: (1) equidistant linear position table, (2) equidistant cyclic position table, (3) none equidistant linear position table, (4) none equidistant cyclic position table	
			Value range: [1, 4]	Unit: 1
4A08	**18952**	initialization	**„Table interpolation type is not allowed“** The value for the table interpolation type is allowed. Table interpolation type: (0) linear-interpolation, (1) 4-point-interpolation, (2) spline-interpolation	
			Value range: [0, 2]	Unit: 1

Error(Hex)	Error(Dec)	Error type	Description
4A09	**18953**	initialization	**"Incorrect table main type"** The table main type is unknown or otherwise the table class (slave type) do not match up to the table main type. Table main type: (1) camming table, (2) characteristic table, (3) 'motion function' table (MF)
4A10	**18960**	initialization	**"Table initialization"** Table has not been initialized. Although the table has been created, the rest of the initialization has not been performed. For instance, the number of lines or columns may be less than or equal to zero.
4A11	**18961**	initialization	**"Not enough memory"** Table could not be created, since there is not enough memory.
4A12	**18962**	function	**"Function not executed, function not available"** The function has not been implemented, or cannot be executed, for the present type of table.
4A13	**18963**	function	**"Line index not allowed"** The start line index or the stop line index to be used for read or write access to the table is not allowed. For instance, the line index may be greater than the total number of lines in the table.
4A14	**18964**	function	**"Column index not allowed"** The start column index or the stop column index to be used for read or write access to the table in not allowed. For instance, the column index may be greater than the total number of columns in the table.
4A15	**18965**	function	**"Number of lines not allowed"** The number of lines to be read from or written to the table is not allowed. The number of lines must be an integer multiple of the number of elements in a line (n * number of columns).
4A16	**18966**	function	**"Number of columns not allowed"** The number of columns to be read from or written to the table is not allowed. The number of columns must be an integer multiple of the number of elements in a column (n * number of lines).
4A17	**18967**	function	**"Error in scaling or in range entry"** The entries in the table header are inconsistent, e.g. the validity range is empty. If the error is generated during the run time it is a run time error and stops the master/slave group.
4A18	**18968**	function	**"Multi table slave out of range"** The slave master position is outside the table values for the master. The error is a run-time error, and stops the master/slave group.
4A19	**18969**	function	**"Solo table underflow"** The slave master position is outside the table values for the master. The master value of the equidistant table, to be processed linearly, lies under the first table value. The error is a run-time error, and stops the master/slave group.
4A1A	**18970**	function	**"Solo table overflow"** The slave master position is outside the table values for the master. The master value of the equidistant table, to be processed linearly, lies above the first table value. The error is a run-time error, and stops the master/slave group.
4A1B	**18971**	parameter	**"Incorrect execution mode"** The cyclic execution mode can only be "true" or "false".
4A1C	**18972**	parameter	**"Impermissible parameter"** The Fifo parameter is not allowed.
4A1D	**18973**	parameter	**"Fifo is empty"** The Fifo of the external generator is empty. This can signify end of track or a run time error.

Error(Hex)	Error(Dec)	Error type	Description
4A1E	**18974**	parameter	**"Fifo is full"** The Fifo of the external generator is full. It is the user‘s task to continue to attempt to fill the Fifo with the rejected values.
4A1F	**18975**	parameter	**„Point-Index of Motion Function invalid“** The point index of a Motion Function Point of a Function Table is invalid. First the point index has to be larger than zero and second it has to be numerical continuously for one column in the Motion Function Table (e.g. 1,2,3,... or 10,11,12,...). Remark: The point index is not online-changeable but must be constant.
4A20	**18976**	initialization	**„No diagonalization of matrix“** The spline can not be calculated. The master positions are not correct.
4A21	**18977**	initialization	**„Number of spline points to less“** The number of points of a cubic spline has to be greater than two.
4A22	**18978**	initialization	**„Fifo must not be overwritten“** Fifo must not be overwritten since then the active line would be overwritten. It is the task of the user to secure that the active line is not modified.
4A23	**18979**	function	**„Insufficient number of Motion Function points“** The number of valid Motion Function points is less than two. Either the entire number of points is to low or the point type of many points is set to *Ignore Point*.

9.2.9 NC-PLC Errors

Error(Hex)	Error(dec)	Error type	Description
4B00	**19200**	Parameter	**"Axis was stopped"** The axis was stopped during travel to the target position. The axis may have been stopped with a PLC command via ADS, a call via AXFNC, or by the System Manager.
4B01	**19201**	Parameter	**"Axis cannot be started"** The axis cannot be started because: • the axis is in error status, • the axis is executing another command, • the axis is in protected mode, • the axis is not ready for operation.
4B02	**19202**	Parameter	**"Control mode not permitted"** No target position control, and no position range control.
4B03	**19203**	Parameter	**"Axis is not moving"** The position and velocity can only be restarted while the axis is physically in motion.
4B04	**19204**	Parameter	**“Invalid Mode”** Examples: Invalid `Direction` input to `MC_MoveModulo`. Inactive axis parameter *position correction* for `MC_BacklashCompensation`.
4B05	**19205**	Parameter	**"Command not permitted"** • Continuous motion in an unspecified direction • Read/Write parameters: type mismatch
4B06	**19206**	Parameter	**"Parameter incorrect"** • Incorrect override: > 100% or < 0% • Incorrect gear ratio: RatioDenominator = 0

Error(Hex)	Error(dec)	Error type	Description
4B07	**19207**	Parameter	**"Timeout axis function block"** After positioning, all "MC_Move..." blocks check whether positioning was completed successfully. In the simplest case, the "AxisHasJob" flag of the NC axis is checked, which initially signifies that positioning was logically completed. Depending on the parameterization of the NC axis, further checks (quality criteria) are used: • "Position range monitoring" If position range monitoring is active, the system waits for feedback from the NC. After positioning, the axis must be within the specified positioning range window. If necessary, the position controller ensures that the axis is moved to the target position. If the position controller is switched off (Kv=0) or weak, the target may not be reached. • "Target position monitoring" If target position monitoring is active, the system waits for feedback from the NC. After positioning, the axis must be within the specified target position window for at least the specified time. If necessary, the position controller ensures that the axis is moved to the target position. If the position controller is switched off (Kv=0) or weak, the target may not be reached. Floating position control may lead to the axis oscillating around the window but not remaining inside the window. If the axis is logically at the target position (logical standstill) but the parameterized position window has not been reached, monitoring of the above-mentioned NC feedback is aborted with error 19207 (0x4B07) after a constant timeout of 6 seconds.
4B08	**19208**	Parameter	**"Axis is in protected mode"** The axis is in protected mode (e.g. coupled) and cannot be moved.
4B09	**19209**	Parameter	**"Axis is not ready"** The axis is not ready and cannot be moved.
4B0A	**19210**	Parameter	**"Error during referencing"** Referencing (homing) of the axis could not be started or was not successful.
4B0B	**19211**	Parameter	**"Incorrect definition of the trigger input"** The definition of the trigger signal for block MC_TouchProbe is incorrect. The defined encoder-ID, the trigger signal or the trigger edge are invalid.
4B0C	**19212**	Function	**"Position latch was disabled"** The function block MC_TouchProbe has detected that a measuring probe cycle it had started was disabled. The reason may be an axis reset, for example.
4B0D	**19213**	Function	**'NC status feedback timeout'** A function was successfully sent from the PLC to the NC. An expected feedback in the axis status word has not arrived.
4B0E	**19214**	Function	**"Additional product not installed"** The function is available as an additional product but is not installed on the system.
4B0F	**19215**	Function	**"No NC Cycle Counter Update"** – The NcToPlc Interface or the NC Cycle Counter in the NcToPlc Interface was not updated.
Error numbers 0x4B10 to 0x4B2F are used in the *TwinCAT NCI* context:			
4B10	**19216**	Function	**"M-function query missing"** This error occurs if the M-function was confirmed, but the request bit was not set.

Error(Hex)	Error(dec)	Error type	Description
4B11	**19217**	Parameter	**"Zero offset index is outside the range"** The index of the zero offset is invalid.
4B12	**19218**	Parameter	**"R-parameter index or size is invalid"** This error occurs if the R-parameters are written or read but the index or size are outside the range.
4B13	**19219**	Parameter	**"Index for tool description is invalid"**
4B14	**19220**	Function	**"Version of the cyclic channel interface does not match the requested function or the function block"** This error occurs if an older TwinCAT version is used to call new functions of a later TcNci.lib version.
4B15	**19221**	Function	**"Channel is not ready for the requested function"** The requested function cannot be executed, because the channel is in the wrong state. This error occurs during reverse travel, for example, if the axis was not stopped with ItpEStop first.
4B16	**19222**	Function	**"Requested function is not activated"** The requested function requires explicit activation.
4B17	**19223**	Function	**"Axis is already in another group"** The axis has already been added to another group.
4B18	**19224**	Function	**"Block search could not be executed successfully"** The block search has failed. Possible causes: • Invalid block number
4B19	**19225**	Parameter	**"Invalid block search parameter"** This error occurs if the FB ItpBlocksearch is called with invalid parameters (e.g. E_ItpDryRunMode, E_ItpBlockSearchMode)
4B20	**19232**	Function	**"Cannot add all axes"** This error occurs if an auxiliary axis is to be added to an interpolation group, but the function fails. It is likely that a preceding instruction of an auxiliary axis was skipped.
Error numbers 0x4B30 to 0x4B3F are used in the *TcMcCam library* (MC_NC_TableErrorCodes):			
4B30	**19248**	Parameter	**"Pointer is invalid"** A pointer to a data structure is invalid, e.g. Null • Data structure MC_CAM_REF was not initialized
4B31	**19249**	Parameter	**"Memory size invalid"** The specification of the memory size (SIZE) for a data structure is invalid. • The value of the size parameter is 0 or less than the size of one element of the addressed data structure. • The value of the size parameter is less than the requested amount of data. • The value of the size parameter does not match other parameters as number of points, number of rows or number of columns.
4B32	**19250**	Parameter	**"Cam table ID is invalid"** The ID of a cam table is not between 1 and 255.
4B33	**19251**	Parameter	**"Point ID is invalid"** The ID of a point (sampling point) of a motion function is less than 1.
4B34	**19252**	Parameter	**"Number of points is invalid"** The number of points (sampling points) of a cam plate to be read or written is less than 1.
4B35	**19253**	Parameter	**"MC table type is invalid"** The type of a cam plate does not match the definition *MC_TableType*.
4B36	**19254**	Parameter	**"Number of rows invalid"** The number of rows (sampling points) of a cam table is less than 1.

Error(Hex)	Error(dec)	Error type	Description
4B37	**19255**	Parameter	**"Number of columns invalid"** The number of columns of a cam table is invalid. • The number of columns of a motion function is not equal 1 • The number of columns of a standard cam table is not equal 2 • The number of columns does not match another parameter (ValueSelectMask)
4B38	**19256**	Parameter	**"Step size invalid"**. The increment for the interpolation is invalid, e.g. less than or equal to zero.
Error numbers 0x4B0F, 0x4B40 to 0x4B4F are used in the *TcNc-Lib*:			
4B40	**19264**	Monitoring	**"Terminal type not supported"** The terminal used is not supported by this function block.
4B41	**19265**	Monitoring	**"Register read/write error"** This error implies a validity error.
4B42	**19266**	Monitoring	**"Axis is enabled"** The axis is enabled but should not be enabled for this process.
4B43	**19267**	Parameter	**"Incorrect size of the compensation table"** The specified table size (in bytes) does not match the actual size
4B44	**19268**	Parameter	The minimum/maximum position in the compensation table does not match the position in the table description (ST_CompensationDesc)
4B45	**19269**	Parameter	**"Not implemented"** The requested function is not implemented in this combination
Error numbers 0x4B50 to 0x4B5F are used in the *TcRemoteSyn-Lib*:			
Error numbers 0x4B60 to 0x4B6F are used in the *TcMc2-Lib* in the *buffered commands* context:			
4B60	**19296**	Monitoring	**"Motion command did not become active"** A motion command has been started and has been buffered and confirmed by the NC. Nevertheless, the motion command did not become active (possibly due to a terminating condition or an internal NC error).
4B61	**19297**	Monitoring	**"Motion command could not be monitored by the PLC"** A motion command has been started and has been buffered and confirmed by the NC. The PLC has not been able to monitor the execution of this command and the execution status is unclear since the NC is already executing a more recent command. The execution state is unclear. This error may come up with very short buffered motion commands which are executed during one PLC cycle.
4B62	**19298**	Monitoring	**"Buffered command was terminated with an error"** A buffered command was terminated with an error. The error number is not available, because a new command is already being executed.
4B63	**19299**	Monitoring	**"Buffered command was completed without feedback"** A buffered command was completed but there was no feedback to indicate success or failure.
4B64	**19300**	Monitoring	**" 'BufferMode' is not supported by the command"** The 'BufferMode' is not supported by this command.
4B65	**19301**	Monitoring	**"Command number is zero"** The command number for queued commands managed by the system unexpectedly has the value 0.

Error(Hex)	Error(dec)	Error type	Description
4B66	**19302**	Monitoring	**"Function block was not called cyclically"** The function block was not called cyclically. The command execution could not be monitored by the PLC, because the NC was already executing a subsequent command. The execution state is unclear.
Error numbers 0x4B70 to 0x4B8F are used in the *TcPlcInterpolation-Lib*:			
4B71	**19313**	Parameter	**"Invalid NCI entry type".** The FB FB_NciFeedTablePreparation was called with an unknown nEntryType.
4B72	**19314**	Function	**"NCI feed table full"** The table is full, and the entry is therefore not accepted. Remedy: Transfer the context of the table with FB_NciFeedTable to the NC-Kernel. If bFeedingDone = TRUE, the table can be reset in FB_NciFeedTablePreparation with bResetTable and then filled with new entries.
4B73	**19315**	Function	internal error
4B74	**19316**	Parameter	**"ST_NciTangentialFollowingDesc: tangential axis is not an auxiliary axis"** The entry for tangential following contains a tangential axis that is not an auxiliary axis.
4B75	**19317**	Parameter	**ST_NciTangentialFollowingDesc:** nPathAxis1 or nPathAxis2 is not a path axis. It is therefore not possible to determine the plane.
4B76	**19318**	Parameter	**ST_NciTangentialFollwoingDesc:** nPathAxis1 and nPathAxis2 are the same. It is therefore not possible to determine the plane.
4B77	**19319**	Parameter	**ST_NciGeoCirclePlane**: Circle incorrectly parameterized
4B78	**19320**	Function	Internal error during calculation of tangential following
4B79	**19321**	Monitoring	**Tangential following:** Monitoring of the deviation angle was activated during activation of tangential following (E_TfErrorOnCritical1), and an excessively large deviation angle was detected in the current segment.
4B7A	**19322**	Function	not implemented
4B7B	**19323**	Parameter	**Tangential following**: the radius of the current arc is too small
4B7C	**19324**	Parameter	**FB_NciFeedTablePreparation**: pEntry is NULL
4B7D	**19325**	Parameter	**FB_NciFeedTablePreparation**: the specified nEntryType does not match the structure type
4B7E	**19326**	Parameter	**ST_NciMFuncFast and ST_NciMFuncHsk**: the requested M-function is not between 0 and 159
4B7F	**19327**	Parameter	**ST_NciDynOvr**: the requested value for the dynamic override is not between 0.01 and 1
4B80	**19328**	Parameter	**ST_NciVertexSmoothing**: invalid parameter. This error is generated if a negative smoothing radius or an unknown smoothing type is encountered.
4B81	**19329**	Parameter	**FB_NciFeedTablePrepartion:** The requested velocity is not in the valid range
4B82	**19330**	Parameter	**ST_Nci***: invalid parameter
Error numbers 0x4B90 - 0x4B9F are used in the *Tc3_MC2_AdvancedHoming-Lib* (PLCopen Part 5: Homing Procedures):			
4B90	**19344**	Parameter	Determined **drive type** is not supported
4B91	**19345**	Parameter	**Direction** is impermissible
4B92	**19346**		**SwitchMode** is impermissible
4B93	**19347**		**Mode** for the parameter handling is impermissible
4B94	**19348**		Parameterization of the torque limits is inconsistent

Error(Hex)	Error(dec)	Error type	Description
4B95	**19349**		Parameterization of the position lag limit is impermissible (<=0).
4B96	**19350**		Parameterization of the distance limit is impermissible (<0)
4B97	**19351**		An attempt was made to back up parameters again, although they have already been backed up.
4B98	**19352**		An attempt was made to restore parameters, although none have been backed up.
Error numbers 0x4BA0 - 0x4BAF are used in the *TcNcKinematicTransformation-Lib*:			
4BA0	**19360**	Function	**KinGroup error:** the kinematic group is in an error state. This error may occur if the kinematic group is in an error state or an unexpected state when it is called (e.g. simultaneous call via several FB instances).
4BA1	**19361**	Function	**KinGroup timeout:** timeout during call of a kinematic block
Error numbers 0x4BB0 to 0x4BBF are used in the *Tc2_MC2_Drive-Lib*:			
4BB0	**19376**	Function	The current axis position or the axis position resulting from the new position offset exceeds the valid range of values.
4BB1	**19377**	Function	The new position offset exceeds the valid range of values [AX5000: 2^31]
4BB2	**19378**	Function	The current axis position or the axis position resulting from the new position offset falls below the valid range of values.
4BB3	**19379**	Function	The new position offset falls below the valid range of values [AX5000: -2^31]
4BB4	**19380**	Function	The activated feedback and/or storage location (AX5000: P-0-0275) differ from the parameterization on the function block.
4BB5	**19381**	Function	Reinitialisation of the Nc actual position has failed. e.g. reference system = “ABSOLUTE (with single overflow)” & software end position monitoring is disabled.
4BB6	**19382**	Function	The command for setting or deleting a position offset has been rejected without sending feedback data. E.g. if the motion controller firmware does not support the corresponding command.
4BB7	**19383**	Function	The command for setting or deleting a position offset has been rejected with sending feedback data. Informations within the feedback data may contain further indications on the origin of the error. E.g. if the motion controller firmware does not support the corresponding command.

9.2.10 Kinematic transformation

Error(Hex)	Error(Dec)	Error type	Description
4C00	**19456**		**Transformation failed.**
4C01	**19457**		**Ambiguous answer.** The answer of the transformation is not explicit.
4C02	**19458**		**Invalid axis position:** The transformation can not be calculated with the current position data. Possible causes: • The position is outside the working area of the kinematics
4C03	**19459**	Configuration	**Invalid dimension:** The dimension of the paramerterized input parameter does not match the dimension expected by the kinematic object. Possible causes: • Too many position values are supplied for this configuration. Check the number of parameterized axes.
4C04	**19460**		**NCERR_KINTRAFO_REGISTRATION**
4C05	**19461**	Internal	**Newton iteration failed:** The Newton iteration does not converge.
4C06	**19462**	Internal	**Jacobi matrix cannot be inverted**
4C07	**19463**	Configuration	**Invalid cascade:** This kinematic configuration is not permitted.
4C08	**19464**	Programming	**Singularity:** The machine configuration results in singular axis velocities.
4C0B	**19467**	Internal	**No metainfo:** Metainfo pointer is null.
4C13	**19475**	Internally	**NCERR_RBTFRAME_INVALIDWCSTOMCS** The employed `WcsToMcs` component leads to positions that the selected kinematics cannot adopt to. Tailoring the `WcsToMcs` parameters is required.
4C20	**19488**	Internal	**Transformation failed:** Call of extended kinematic model failed.
4C30	**19504**	Programming	**Invalid input frame:** Programmed Cartesian position cannot be reached in the ACS configuration.
4C50	**19536**	Internally	**Invalid Offset:** Access violation within the observer detected.

9.2.11 Bode Return Codes

The following bode plot specific error codes are used in the bode plot server:

Code Hex	Code Dec	Symbol	Description
0x8100	33024	INTERNAL	Internal error
0x8101	33025	NOTINITIALIZED	Not initialized (e.g. no nc axis)
0x8102	33026	INVALIDPARAM	Invalid parameter
0x8103	33027	INVALIDOFFSET	Invalid index offset
0x8104	33028	INVALIDSIZE	Invalid parameter size
0x8105	33029	INVALIDSTARTPARAM	Invalid start parameter (set point generator)
0x8106	33030	NOTSUPPORTED	Not supported
0x8107	33031	AXISNOTENABLED	Nc axis not enabled

0x8108	33032	AXISINERRORSTATE	Nc axis in error state
0x8109	33033	DRIVEINERRORSTATE	IO drive in error state
0x810A	33034	AXISANDDRIVEINERROR-STATE	Nc axis AND IO drive in error state
0x810B	33035	INVALIDDRIVEOPMODE	Invalid drive operation mode active or requested (no bode plot mode)
0x810C	33036	INVALIDCONTEXT	Invalid context for this command (mandatory task or windows context needed)
0x810D	33037	NOAXISINTERFACE	**Missing TCom axis interface (axis null pointer).** There is no connection to the NC axis. Either no axis (or axis ID) has been parameterized, or the parameterized axis does not exist.
0x810E	33038	INPUTCYCLECOUNTER	**Invalid input cycle counter from IO drive (e.g. frozen).** The cyclic drive data are backed up by an ‘InputCycleCounter’ during the bode plot recording. This allows firstly the detection of an unexpected communication loss (keyword: LifeCounter) and secondly a check for temporal data consistency to be performed. **Sample 1:** This error can occur if the cycle time of the calling task is larger than the assumed drive cycle time (in this case, however, the error occurs right at the start of the recording). **Sample 2:** This error can occur if the calling task has real-time errors (e.g. the "Exceed Counter" of the task increments or the task has a lower priority, as is often the case, for example, with the PLC). In this case the error can also occur at any time during the recording. **Sample 3:** This error can occur more frequently if the real-time load on the computer is quite high (>50 %). **Note:** Refer also to the corresponding AX5000 drive error code F440.
0x810F	33039	POSITIONMONITORING (=> NC Runtime Error)	**Position monitoring: Axis position is outside of the maximum allowed moving range.** The axis has left the parameterized position range window, whereupon the recording was aborted and the NC axis was placed in the error state 0x810F (with standard NC error handling). The position range window acts symmetrically around the initial position of the axis (see also parameter description *Position Monitoring Window*). Typical error message in the logger: *"BodePlot: 'Position Monitoring' error 0x%x because the actual position %f is above the maximum limit %f of the allowed position range (StartPos=%f, Window=%f)"*

0x8110	33040	DRIVELIMITATIONDETECTED	**Driver limitations detected (current or velocity limitations) which causes a nonlinear behavior and invalid results of the bode plot.** A bode plot recording requires an approximately linear transmission link. If the speed or current is limited in the drive unit, however, this non-linear behavior is detected and the bode plot recording is aborted. Reasons for these limitations can be: choosing too large an amplitude for the position, speed or torque interface, or an unsuitable choice of amplitude scaling mode (see also parameter description *Amplitude Scaling Mode, Base Amplitude, Signal Amplitude*). Typical error message in the logger: *"BodePlot: Sequence aborted with error 0x%x because the current limit of the drive has been exceeded (%d times) which causes a nonlinear behavior and invalid results of the bode plot"*
0x8111	33041	LIFECOUNTERMONITORING (=> NC Runtime Error)	**Life counter monitoring (heartbeat): Lost of communication to GUI detected after watchdog timeout is elapsed.** The graphical user interface from which the bode plot recording was started is no longer communicating with the bode plot driver in the expected rhythm (keyword: 'Life Counter'). Therefore the recording is terminated immediately and the NC axes are placed in the error state 0x8111 (with standard NC error handling). Possible reasons for this can be an operating interface crash or a major malfunction of the Windows context. Typical error message in the logger: *"BodePlot: Sequence aborted with GUI Life Counter error 0x%x because the WatchDog timeout of %f s elapsed ('%s')"*
0x8112	33042	NCERR_BODEPLOT_WCSTATE	**WC state error (IO data working counter)** IO working counter error (WC state), for example due to real-time errors, EtherCAT CRC errors or telegram failures, EtherCAT device not communicating (OP state), etc.
0x8113-0x811F	33043-33055	RESERVED	**Reserved area**

9.2.12 Further Error Codes

Error(Hex)	Error(Dec)	ErrorType	Description
0x8120	**33056**	Environment	**Invalid configuration for Object (e.g. in System Manager).**
0x8121	**33057**	Environment	**Invalid environment for Object (e.g. TcCom-Object's Hierarchy or missing/faulty Objects).**
0x8122	**33058**	Environment	**Incompatible Driver or Object.**
0x8130	**33072**	Communication	**Invalid ObjectID of Communication Target.**
0x8131	**33073**	Communication	**Communication Target expects Call in different Context.**
0x8132	**33074**	Communication	**Invalid State of Communication Target.**
0x8134	**33076**	Communication	**Communication with Communication Target cannot be established.**

Error(Hex)	Error(Dec)	ErrorType	Description
0x813b	**33083**	Parameter	**Transition Mode is invalid.**
0x813c	**33084**	Parameter	**BufferMode is invalid.**
0x813d	**33085**	FunctionBlock	**Only one active Instance of Function Block per Group is allowed.**
0x813e	**33086**	State	**Command is not allowed in current group state.**
0x813f	**33087**	FunctionBlock	**Slave cannot synchronize.** The slave cannot reach the SlaveSyncPosition by the time the master has reached the MasterSyncPos.
0x8140	**33088**	Parameter	**Invalid value for one or more of the dynamic parameters (Acceleration, Deceleration, Jerk).**
0x8141	**33089**	Parameter	**IdentInGroup is invalid.**
0x8142	**33090**	Parameter	**The number of axes in the group is incompatible with the axes convention.**
0x8143	**33091**	Communication	**Function Block or respective Command is not supported by Target.**
0x8145	**33093**	FunctionBlock	**Mapping of Cyclic Interface between Nc and Plc missing (e.g. AXIS_REF, AXES_GROUP_REF, ...).**
0x8146	**33094**	FunctionBlock	**Invalid Velocity Value.** The velocity was not set or the entered value is invalid.
0x8147	**33095**	Parameter	**Invalid Coordinate Dimension.** The dimension of the set coordinate interpretation does not meet the requirements.
0x8148	**33096**	FunctionBlock	**Invalid Input Value.**
0x8149	**33097**	Parameter	**Unsupported Dynamics for selected Group Kernel.**
0x814a	**33098**	Parameter	**The programmed position dimension incompatible with the axes convention.**
0x814b	**33099**	FunctionBlock	**Path buffer is invalid. E.g. because provided buffer has invalid address or is not big enough.**
0x814c	**33100**	FunctionBlock	**Path does not contain any element.**
0x814d	**33101**	FunctionBlock	**Provided Path buffer is too small to store more Path Elements.**
0x814e	**33102**	Parameter	**Dimension or at least one Value of Transition Parameters is invalid.**
0x814f	**33103**	FunctionBlock	**Invalid or Incomplete Input Array.**
0x8150	**33104**	FunctionBlock	**Path length is zero.**
0x8151	**33105**	State	**Command is not allowed in current axis state.**
0x8152	**33106**	State	**TwinCAT System is shutting down and cannot complete request.**
0x8153	**33107**	Parameter	**Configured axes convention and configured axes do not match.**
0x8154	**33108**	Initialization	**Invalid Number of ACS Axes** The number of ACS input axes does not match the number of ACS input axes expected by the kinematic transformation.
0x8155	**33109**	Initialization	**Invalid Number of MCS Data** The number of MCS input data does not match the number expected by the kinematic transformation. Check the Coordinate Definition: The number of MCS axes has to correspond to the used coordinates.
0x8156	**33110**	Initialization	**Invalid Value Set for Kinematic Parameters** The numeric value set for the parameter does not reside within the respective definition range.

Error(Hex)	Error(Dec)	ErrorType	Description
0x8158	**33112**	NC Programming	**The Given ACS Values Cannot be Reached** The given ACS values result in an invalid machine configuration. Invalid ACS values are often the result of geometric constraints due to the set parameters. Check whether the parameterizations of the involved kinematic components are correct.
0x8159	**33113**	NC Programming	**The Set Target Positions Cannot be Reached** The set target positions reside outside the admissible working space. Consider to enable a suitable projection mode to follow only certain aspects of the movement.
0x8160	**33120**	NC Programming	**Circle Specification in Path is invalid.** The specification of a circle segment in the programmed interpolated path (e.g. via MC_MovePath) has an invalid or ambiguous description. Probably its center cannot be determined reliably.
0x8161	**33121**	NC Programming	**Maximum stream lines reached.** The maximum number of stream lines is limited. Please refer to function block documentation for details.
0x8163	**33123**	FunctionBlock	**Invalid First Segment.** The corresponding element can only be analyzed with a well-defined start point.
0x8164	**33124**	FunctionBlock	**Invalid auxiliary point.** The auxiliary point is not well-defined.
0x8166	**33126**	FunctionBlock	**Invalid parameter for GapControlMode.** Invalid parameter for GapControlMode, most likely in combination with the group parameter GapControlDirection.
0x8167	**33127**	External	**Group got unsupported Axis Event (e.g. State Change).** Group got unsupported Axis Event (e.g. State Change e.g. triggered by a Single Axis Reset).
0x8168	**33128**	Parameter	**Unsupported Compensation Type.** The compensation type was either not set or is not supported by the addressed object.
0x816a	**33130**	Parameterization by the User	**Invalid or no Tracking Transformation** This error occurs at `MC_TrackConveyorBelt` if at the `CoordTransform` input an invalid object ID is used or the object ID points to an object that is not supported as coordinate transformation.
0x816d	**33133**	NC Programming	**Invalid Compensation ObjectId.** An Object with this ObjectId does not exist or it is not of the right type (has to be a compensation).
0x816f	**33135**	State	**Coupling would cause a cyclic dependency of axis (e.g. via MC_GearInPos).**
0x8170	**33136**	FunctionBlock	**Axis was not added to an axes group, the command is not valid.**
0x8f60 - 0x8f62	**36704 - 36706**	Internal	**Internal Error.**
0x8f69 - 0x8ffe	**36713 - 36862**	Internal	**Internal Error.**

Glossary

ACS

Axis Coordinate System

MCS

Machine Coordinate System

NC I

TwinCAT module for axis interpolation in three dimensions

TCP

Imaginary reference point, which is located at a suitable location on the tool and describes the tool position of an industrial robot.

UCS

User Coordinate System

WCS

Cartesian coordinate system origin, which describes the entire modeled system, all other Cartesian coordinate systems are referenced. So it is possible, to position a plurality of robots relative to each other.

XAE

TwinCAT 3 Engineering environment