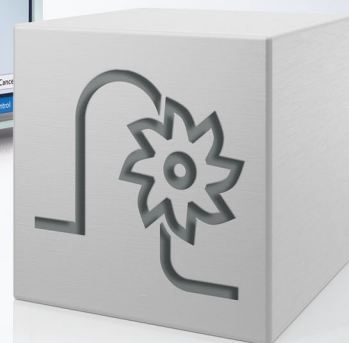
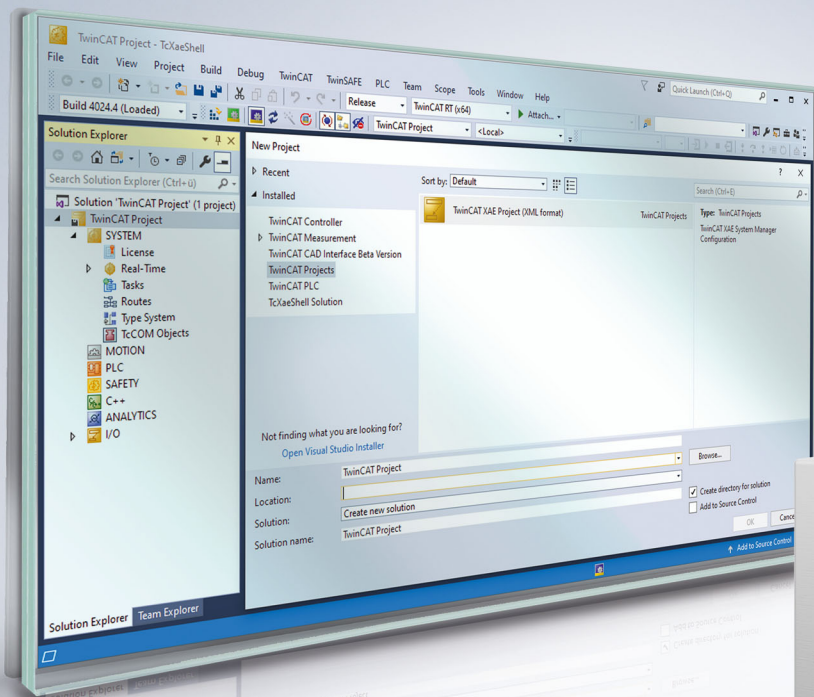


Functional description | EN

## TF5200 | TwinCAT 3 CNC

Manual mode offset limits





## 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.

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# General and safety instructions

## Icons used and their meanings

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

### Icons in explanatory text

1. Indicates an action.
- ⇒ Indicates an action statement.

#### **DANGER**

##### **Acute danger to life!**

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

#### **CAUTION**

##### **Personal injury and damage to machines!**


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

#### **NOTICE**

##### **Restriction or error**

This icon describes restrictions or warns of errors.

#### **Tips and other notes**

 This icon indicates information to assist in general understanding or to provide additional information.


### General example

Example that clarifies the text.

### NC programming example

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

#### **Specific version information**

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

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# 1 Overview

## Task

Manual mode Manual mode (HB) permits the control of individual axes using manual operation elements (handwheel, inching keys, joystick). The operator can move axes in manual mode either

- in a user-defined operating mode (i.e. exclusive) or
- during a running NC program

i.e. apply additional command values.

The motion range of axes is limited by 'Offset limits in manual mode' (referred to below as: offset limits).

## Properties

Offset limits can be monitored in manual modes with parallel interpolation (G201) and without parallel interpolation (G200). This is applicable to all axis types.

## Parameterisation

Offset limit values can be configured for each axis.

- relative offset limits P-AXIS-00137 and P-AXIS-00138)
- absolute offset limits (P-AXIS-00492 and P-AXIS-00493)

## Programming

Relative offset limits can also be set by #MANUAL LIMITS[...].

### ***Mandatory note on references to other documents***

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

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



## 2 Description

### Task

Monitor offset limits and limit the possible motion paths for:

- all axis types and
- every axis direction

Command values are added to their motion direction while manual mode G200 or G201 is active and up to the point of deselection as programmed by G202.

### Offset limit types

A distinction is made between:

- relative and
- absolute offset limits

They apply to G200 and G201. With G200, relative offset limits only act if P-CHAN-00114 is configured accordingly.

If both relative and absolute offset limits are active, the innermost limits are always active.

## 2.1 Relative offset limits

### Definition

After HB is selected, offset limits act relative to the current axis position (start position) and are defined by:

- P-AXIS-00137 and P-AXIS-00138 or
- #MANUAL LIMITS[...]

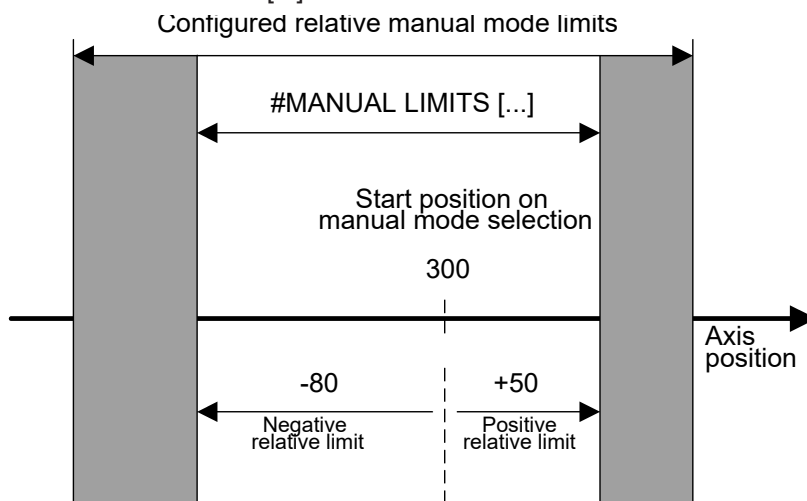


Fig. 1: Definition ranges of relative offset limits

### Activate the monitor

To activate the relative offset limit monitor, at least one of the limits P-AXIS-00137 or P-AXIS-00138 must be configured with the value  $\neq 0$ .

1. The monitor is activated.



If both limits = 0, the monitor is not active.

### Warnings, errors and reactions

- Warning P-ERR-50720: When the monitor is active, the relative offset limits are reached. The warning is output only if P-MANU-00014 is configured accordingly.
2. Interpolation is stopped.
    - ⇒ Move back within the valid range.
  - Warning P-ERR-150008: When the monitor is active, the relative offset limits are exceeded in jog mode by additional command values.
    1. The additional command values are deleted.
      - ⇒ Move back within the valid range.
    - Error message P-ERR-50041 or P-ERR-50042: With G201, software limits switches are exceeded.
      1. Interpolation is stopped.
        - ⇒ Reset the controller.
        - ⇒ Move back within the valid range. The valid range is defined by the software limit switches.

### Modulo axis

For modulo axes, relative offset limits can include several modulo revolutions. The specified relative offset limits refer to the axis position that was valid when it was activated by G200 or G201.

This reference position can be determined by the CNC object with (index group 0x21301 and index offset 0x2000C) or directly on the HLI.

For example, the second axis in the first channel can be read via the GEO port with index group 0x21301 and offset 0x20007.

### Change reference position

If the reference position is changed, a path motion and re-activation of the manual mode axis are required.

Offset limits with modulo axes

Initial situation	Rel. neg.	Abs. neg.	Rel. pos.	Abs. pos.	
1. Offset limits lie within one modulo revolution	-60 °	120 °	-40 °	220 °	
2. Offset limits comprise several modulo revolutions	-850 °	-670 °	380 °	560 °	
3.1 Offset limits lie within another modulo range		800 °		920 °	<p>Based on the current position of 100°, offset limits should be within the range of 800° to 920°.</p>
3.2 Motion path about +740°	-40 °	800 °	80 °	920 °	<p>Based on the above state, a path motion and a reactivation of the HB axis are required.</p>

**Legend:** Rel. neg.: Relative negative offset limit  
 Abs. neg.: Absolute negative offset limit  
 Rel. pos.: Relative positive offset limit  
 Abs. pos.: Absolute positive offset limit

## 2.2 Absolute offset limits

### Definition

Absolute offset limits are defined by P-AXIS-00492 and P-AXIS-00493.

1. The monitor is activated.

The adjustable minimum/maximum values are limited by software limit switches.

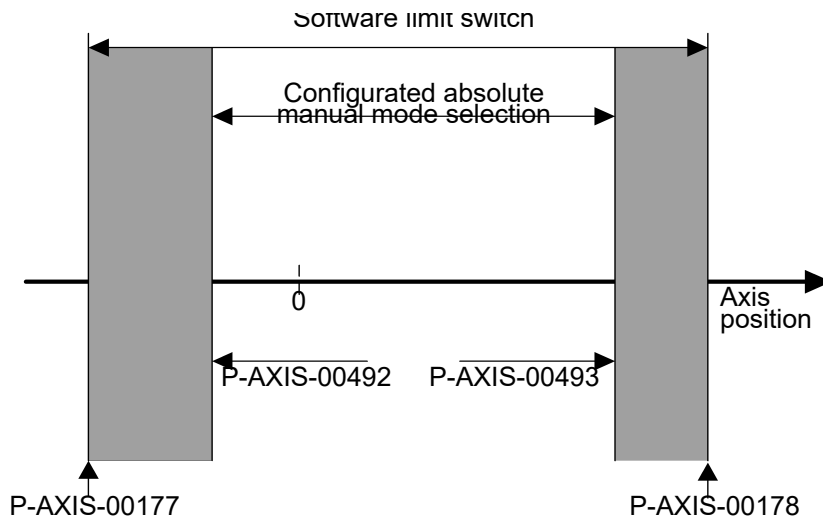


Fig. 2: Definition range of absolute offset limits

### Activate the monitor

To activate the relative offset limit monitor, at least one of the limits P-AXIS-00492 or P-AXIS-00493 must be configured with a value  $\neq 0$ .

2. The monitor is activated.



If both limits = 0, the monitor is not active.

**Warnings, errors and reactions**

- Warning P-ERR-50721: When the monitor is active, the absolute offset limits are reached. The warning is output only if P-MANU-00014 is configured accordingly.
3. Interpolation is stopped.
    - ⇒ Move back within the valid range.
    - Warning P-ERR-110570 or P-ERR-110571: The positive or negative absolute offset limits configured are located outside the software limit switches.
  1. Incorrectly configured absolute offset limits are set automatically to the software limits switches.
    - Error message P-ERR-50041 or P-ERR-50042: With G201, software limits switches are exceeded.
  2. Interpolation is stopped.
    - ⇒ Reset the controller.
    - ⇒ Move back within the valid range. The valid range is defined by the software limit switches.
      - The current axis position is outside the absolute offset limits (analogous to warning P-ERR-50721).
  1. Interpolation is not stopped.
    - ⇒ Move back within the valid range.

### 3 Programming relative offset limits



As of Build V2.11.2010.02, the command #MANUAL LIMITS [...] replaces the command #SET OFFSET [...]. For compatibility reasons, this command is still available but it is recommended not to use it in new NC programs.

Syntax:

```
#MANUAL LIMITS [ AX=<axis_name> | AXNR=.. NEGATIVE=.. POSITIVE=.. ]
```

AX=<axis_name>	Name of axis for which the offset limits are valid.
AXNR=..	Logical number of axis for which the offset limit is to be valid, Positive integer
NEGATIVE=..	Negative relative offset value. Must be programmed as <0 in [mm, inch]
POSITIVE=..	Positive relative offset value. Must be programmed as <0 in [mm, inch]

This command defines the positive and negative limits for the permissible relative path motion in G201/G202 manual mode for each path axis. The relative negative and positive offset limits refer here to the starting point when manual mode was selected. Offset limits are also considered in G200 by setting the parameter P-CHAN-00114.



Relative offset limits can be overwritten at any time in the NC program. A sign check is made. Relative offset limits apply to each axis in the programming coordinate system (PCS).

**Program relative offset limits**

```
%100
N010 G74 Y1
N015 G01 X10 Y10 F1000

N020 #MANUAL LIMITS[AX=X NEGATIVE=-200 POSITIVE=250]
N030 #MANUAL LIMITS[AX=Y NEGATIVE=-300 POSITIVE=350]

N015 G90 G01 X10 Y10 Z0 F1000
N050 G201 X1 Y1

N060 P1 = 1
N070 $WHILE P1 < 10000

N075 Z[P1/1000]

N080 $IF P1 == 100
N090 #MANUAL LIMITS[AX=X NEGATIVE=-14 POSITIVE=14]
N100 $ENDIF
N080 $IF P1 == 600
N050 G202 X1 Y1
N050 G201 X1 Y1
N100 $ENDIF
N080 $IF P1 == 500
N100 $ENDIF

N110 P1 = P1 + 1
N120 #FLUSH WAIT
N120 $ENDWHILE

N1800 M30
```

## 4 Parameter

### 4.1 Overview of parameters

ID	Description
P-AXIS-00137	Relative negative offset limit in manual mode
P-AXIS-00138	Relative positive offset limit in manual mode
P-AXIS-00492	Absolute negative ACS movement limit in manual mode
P-AXIS-00493	Absolute positive ACS movement limit in manual mode
P-CHAN-00114	Offset limits also apply to G200
P-MANU-00014	Output a message at offset limit

### 4.2 Axis parameters

<b>P-AXIS-00137</b>		<b>Relative negative offset limit in manual mode</b>	
Description	The parameter defines the relative negative offset limit.		
Parameter	handbetrieb.offsetgrenze_neg		
Data type	SGN32		
Data range	$\text{MIN}(\text{SGN32}) \leq \text{offsetgrenze\_neg} \leq 0$		
Axis types	T, R		
Dimension	T: 0.1µm	R: 0.0001 °	
Default value	-1000000		
drive types.	----		
Remarks	If both parameters offsetgrenze_neg and offsetgrenze_pos are set to 0, offset monitoring is inactive!		

<b>P-AXIS-00138</b>		<b>Relative positive offset limit in manual mode</b>	
Description	The parameter defines the relative positive offset limit.		
Parameter	handbetrieb.offsetgrenze_pos		
Data type	SGN32		
Data range	$0 \leq \text{offsetgrenze\_pos} \leq \text{MAX}(\text{SGN32})$		
Axis types	T, R		
Dimension	T: 0.1µm	R: 0.0001 °	
Default value	1000000		
drive types.	----		
Remarks	If both parameters offsetgrenze_neg and offsetgrenze_pos are set to 0, offset monitoring is inactive!		

<b>P-AXIS-00492</b>		<b>Absolute negative ACS movement limit in manual mode</b>	
Description	The parameter defines the absolute negative ACS movement limit.		
Parameter	handbetrieb.acs_limit_neg		
Data type	SGN32		
Data range	$\text{P-AXIS-00177} \leq \text{acs\_limit\_neg} \leq \text{P-AXIS-00178}$		
Axis types	T, R		
Dimension	T: 0.1µm	R: 0.0001 °	
Default value	0		
drive types.	----		
Remarks	If both parameters acs_limit_neg and acs_limit_pos are set to 0, the offset monitoring is inactive!		



<b>P-AXIS-00493</b>	<b>Absolute positive ACS movement limit in manual mode</b>	
Description	The parameter defines the absolute positive ACS movement limit.	
Parameter	handbetrieb.acs_limit_pos	
Data type	SGN32	
Data range	P-AXIS-00177 ≤ acs_limit_pos ≤ P-AXIS-00178	
Axis types	T, R	
Dimension	T: 0.1µm	R: 0.0001 °
Default value	0	
drive types.	----	
Remarks	If both parameters acs_limit_neg and acs_limit_pos are set to 0, the offset monitoring is inactive!	

### 4.3 Channel parameters

<b>P-CHAN-00114</b>	<b>Relative manual mode offset limits with G200</b>	
Description	With active G200, travel limitation is controlled by predefined software limit switches if homing was done before.  If the relative offset limits (#MANUAL LIMITS, P-AXIS-00137, P-AXIS-00138) should also be taken into consideration, this can be controlled by setting this parameter.	
Parameter	rel_offset_limits_std_manual_mode	
Data type	BOOLEAN	
Data range	0: No consideration of relative offset limits with manual mode G200. 1: Consideration of relative offset limits with manual mode G200.	
Dimension	----	
Default value	0	
Remarks		

### 4.4 Manual mode parameters

<b>P-MANU-00014</b>	<b>Output a message at offset limit</b>	
Description	If this parameter is set to TRUE, the CNC generates a warning if a manual movement stops at a relative offset limit (P-AXIS-00137, P-AXIS-00138) or at an absolute offset limit (P-AXIS-00492, P-AXIS-00493).	
Parameter	move_limit_warning	
Data type	BOOLEAN	
Data range	0/1	
Dimension	----	
Default value	0	
Remarks	This parameter is available as of CNC Build <b>2.11.2804.12</b>	

## 4.5 CNC objects

### Notes on addressing

For further information on addressing CNC objects, see [FCT-C13//Description].

<b>Name</b>	manual act.abs.limit-		
<b>Description</b>	Read lower absolute manual mode offset limit.		
<b>Task</b>	GEO (Port 551)		
<b>Index group</b>	0x12130<C <sub>ID</sub> >	<b>Index offset</b>	0x<A <sub>ID</sub> >001D
<b>Data type</b>	SGN32	<b>Length/byte</b>	4
<b>Attributes</b>	read	<b>Unit</b>	[0.1 μm or 0.0001°]
<b>Remarks</b>			

<b>Name</b>	manual act.abs.limit+		
<b>Description</b>	Read upper absolute manual mode offset limit.		
<b>Task</b>	GEO (Port 551)		
<b>Index group</b>	0x12130<C <sub>ID</sub> >	<b>Index offset</b>	0x<A <sub>ID</sub> >001E
<b>Data type</b>	SGN32	<b>Length/byte</b>	4
<b>Attributes</b>	read	<b>Unit</b>	[0.1 μm or 0.0001°]
<b>Remarks</b>			

<b>Name</b>	manual cmd.abs.limit-		
<b>Description</b>	Define lower absolute manual mode offset limit.		
<b>Task</b>	GEO (Port 551)		
<b>Index group</b>	0x12130<C <sub>ID</sub> >	<b>Index offset</b>	0x<A <sub>ID</sub> >0019
<b>Data type</b>	SGN32	<b>Length/byte</b>	4
<b>Attributes</b>	read/ write	<b>Unit</b>	[0.1 μm or 0.0001°]
<b>Remarks</b>			

<b>Name</b>	manual cmd.abs.limit+		
<b>Description</b>	Read upper absolute manual mode offset limit.		
<b>Task</b>	GEO (Port 551)		
<b>Index group</b>	0x12130<C <sub>ID</sub> >	<b>Index offset</b>	0x<A <sub>ID</sub> >001A
<b>Data type</b>	SGN32	<b>Length/byte</b>	4
<b>Attributes</b>	read/ write	<b>Unit</b>	[0.1 μm or 0.0001°]
<b>Remarks</b>			

<b>Name</b>	manual additive offset		
<b>Description</b>	Offsets moved by handwheel		
<b>Task</b>	GEO (Port 551)		
<b>Index group</b>	0x12130<C <sub>ID</sub> >	<b>Index offset</b>	0x<A <sub>ID</sub> >001B
<b>Data type</b>	SGN32	<b>Length/byte</b>	4
<b>Attributes</b>	read	<b>Unit</b>	[0.1 μm or 0.0001°]
<b>Remarks</b>			

<b>Name</b>	manual active position		
<b>Description</b>	Current axis position including manual offset (without modulo calculation)		
<b>Task</b>	GEO (Port 551)		
<b>Index group</b>	0x12130<C <sub>ID</sub> >	<b>Index offset</b>	0x<A <sub>ID</sub> >001C

---

<b>Data type</b>	SGN32	<b>Length/byte</b>	4
<b>Attributes</b>	read	<b>Unit</b>	[0.1 μm or 0.0001°]
<b>Remarks</b>			

### Read the manual mode offset limits

The active absolute manual mode offset limits are read by CNC objects.

#### Read the absolute manual mode offset limits.

The following applies to the negative offset limits of the 2nd axis in Channel 1:

- Task GEO (Port 551)
- Index group 0x12301
- Index offset 0x2001D

The following applies to the positive offset limits of the 2nd axis in Channel 1:

- Task GEO (Port 551)
- Index group 0x12301
- Index offset 0x2001E

### Write the manual mode offset limits

The absolute manual mode offsets limits are read by CNC objects.

#### Define the offset limits in manual mode

The following applies to the negative offset limits of the 2nd axis in Channel 1:

- Task GEO (Port 551)
- Index group 0x12301
- Index offset 0x2001D

The following applies to the positive offset limits of the 2nd axis in Channel 1:

- Task GEO (Port 551)
- Index group 0x12301
- Index offset 0x2001E

### Verify absolute offset limits via the ISG object browser

Nr	Gruppe	Offset	Bezeichner	Datentyp	Länge	Einheit
25	0x121301	0x20018	link_state	UNS32	4	-
26	0x121301	0x20019	manual cmd. abs. limit-	SGN32	4	0.1 µm
27	0x121301	0x2001A	manual cmd. abs. limit+	SGN32	4	0.1 µm
28	0x121301	0x2001B	manual additive offset	SGN32	4	0.1 µm
29	0x121301	0x2001C	active position	SGN32	4	0.1 µm
30	0x121301	0x2001D	manual act. abs. limit-	SGN32	4	0.1 µm

Fig. 3: Access to absolute offset limits in the ISG object browser

## 4.6 ISG parameters

Command position (ACS)	
Description	Command position of current cycle in the axis coordinate system
Signal flow	CNC → PLC
ST path	gpAx[axis_idx]^lr_state.active_position_acs_r
Data type	DINT
Unit	0.1 μm
Access	PLC is reading

Move back manual mode offset	
Description	If manual mode is active in the channel and if the commanded axis fails to move, the axis is moved by this command so that afterwards manual mode offset is 0.
Data type	MC_CONTROL_BOOL_UNIT, see description Control unit
Characteristics	A rising edge (FALSE → TRUE) at <b>command_w</b> triggers the process. The signal is ignored if a manual mode motion is still active or manual mode offset is already 0.
Access	PLC reads request_r + state_r and writes command_w + enable_w
ST Path	gpAx[axis_idx]^ipo_mc_control.manual_mv_back_to_start
Commanded, requested and return values	
ST Element	.command_w .request_r .state_r
Data type	BOOL
Value range	rising edge (FALSE → TRUE) triggers backward motion
Redirection	
ST Element	.enable_w

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### Beckhoff Headquarters

Beckhoff Automation GmbH & Co. KG

Huelshorstweg 20  
33415 Verl  
Germany

Phone: +49 5246 963-0  
e-mail: [info@beckhoff.com](mailto:info@beckhoff.com)  
web: [www.beckhoff.com](http://www.beckhoff.com)

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More Information:  
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Beckhoff Automation GmbH & Co. KG  
Hülshorstweg 20  
33415 Verl  
Germany  
Phone: +49 5246 9630  
[info@beckhoff.com](mailto:info@beckhoff.com)  
[www.beckhoff.com](http://www.beckhoff.com)

