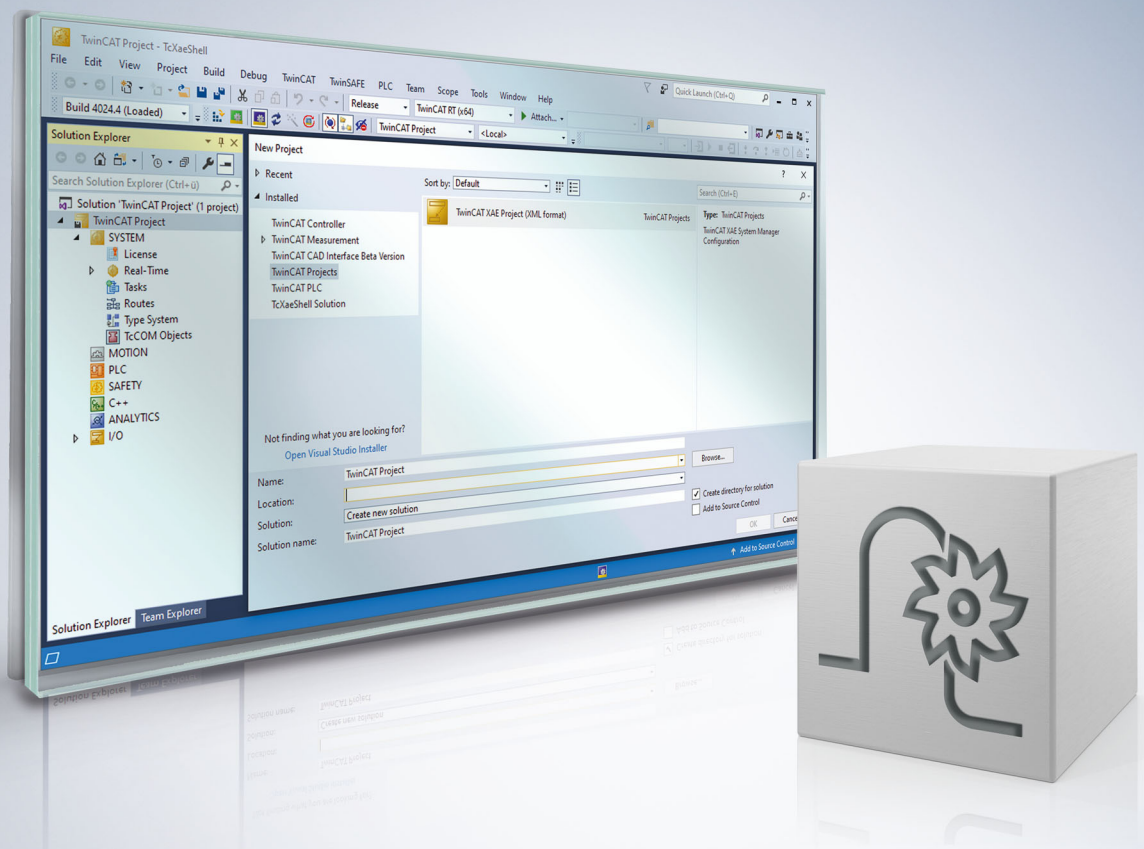
BECKHOFF New Automation Technology

Functional description | EN

TF5200 | TwinCAT 3 CNC

Syntax check



12/18/2023 | Version: 1.04

Notes on the documentation

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

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

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⇨ Indicates an action statement.

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NOTICE

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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

With very large, complex or manually created NC programs in particular, it is advisable to check the correctness of the syntax in advance. This is carried out by using the special “Syntax check mode”.

The syntax check can be executed

- either offline on a separate test system
- or directly on the machine controller.

Characteristics

Syntax errors detected in the NC program are displayed or optionally logged to a file so that the operator can then access them at a later date to correct the program.

NC program decoding is not aborted in the event of a syntax error. Instead, the check algorithm attempts to continue working on the next NC line.

To permit rapid processing of the NC program under test,

- the axes/drives are not moved during the syntax check.
- Technology functions (M, H and T functions) are not executed.

Since the entire NC channel (except for the position controller) participates in the syntax check, incorrect programming items are displayed, i.e. axis positions containing violations of software limit switches etc.. In these cases the syntax check is aborted and issues an error message.

Parametrisation

The syntax check can be run in 2 modes:

- Single step mode
- Automatic mode

The associated configuration is carried out in the channel parameter list.

After a syntax error message, a defined restart can be executed and largely avoids any follow-up errors.

The technology commands used in the NC program (M, H and T functions) must be specified for decoding by setting them in the channel parameter list accordingly.

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

Operation

The syntax check is run via the operating mode interface according to real program execution. The following can be evaluated:

- START, STOP, CONTINUE and RESET commands
- ERROR and HOLD display states

Display

In real program execution, the file position (filename and file offset, mc_active_file_offset_r and mc_active_file_name_r) is displayed synchronously with the real axis motion. It no longer has any timing reference to program decoding.

When the syntax check is active, the file position is automatically displayed synchronously to decoding.

Therefore, the operator need not consider any distinction to display the file.

The table below shows the various error scenarios and the possible error responses in syntax check mode:

Error type	Error category	Error response
Response to resource errors	e.g. stack overflow	Discard the NC line
Response to syntax error	Errors in $ and # commands	Discard the NC line
	Unexpected character/term after $ and # commands	Use of information pertaining to the current NC line
	Unexpected/invalid characters/ terms	Use of information pertaining to the current NC line
Response to semantic errors	Left-handed error in an allocation	Reposition after allocation
	Select NC commands that are not permitted simultaneously	Continued decoding **without** repositioning
	Overshoot/undershoot a limit	Continued decoding **without** repositioning
	Programmed value impractical	Continued decoding **without** repositioning
	Incomplete information	Continued decoding **without** repositioning

NC program with syntax errors

The example below contains various syntax errors which can be used for continued decoding. The program can be processed in the syntax check and individual errors are signalled.

```
;Test syntax check of decoder)
%check_syntax

;□ overflow error
N40 G01 X10 F111111111111111

(□ syntax error
N50 #COMMAND UNKNOWN [...]

(□ syntax error
N60 V.E.not_present = 1

(□ syntax error
N70 #CALL AX [X2, 11, 0]

(-> semantic error
N80 G00 G01 X100 F1000

N130 M30
```

Stop single step mode/decoding

- If configured accordingly (P-CHAN-00028) acts during the syntax check, **single-step mode** acts at decoder level.
- The program stops at the end of every NC line and this is indicated by the HOLD mode state.
- Decoding continues by one NC line when the START transition is commanded to the active mode. In this way, individual NC commands (parameter allocations, branches, loops, etc.) can be decoded to ensure that the program sequence can be viewed during decoding.
- The STOP / RESUME command also acts at the decoder level in the same way as the single step mode.
- In other words, decoding is interrupted by commanding the stop transition to the active mode.
- Decoding can be resumed with the RESUME command.

Automatic mode

- If configured accordingly (P-CHAN-00028) acts during the syntax check of theautomatic mode.
- The NC program runs without stopping.
- Errors detected are displayed.

Syntax check without drives (MACHINE_LOCK)

- The syntax check must always be selected in combination with MACHINE_LOCK. The following properties apply here:
- The NC program is decoded as normal.
- To ensure that the syntax check runs faster, axes and drives are not moved (dry run). Interpolation is limited to the output of the target points of the motion blocks.
- Technology information, spindle commands or waiting times are not executed.
- Certain real-time influences such as feedhold, override or axis-specific feed enables are not considered.
- If MACHINE_LOCK is not set, the message P-ERR-21309 is output. In this case MACHINE_LOCK is set implicitly and syntax check is started.

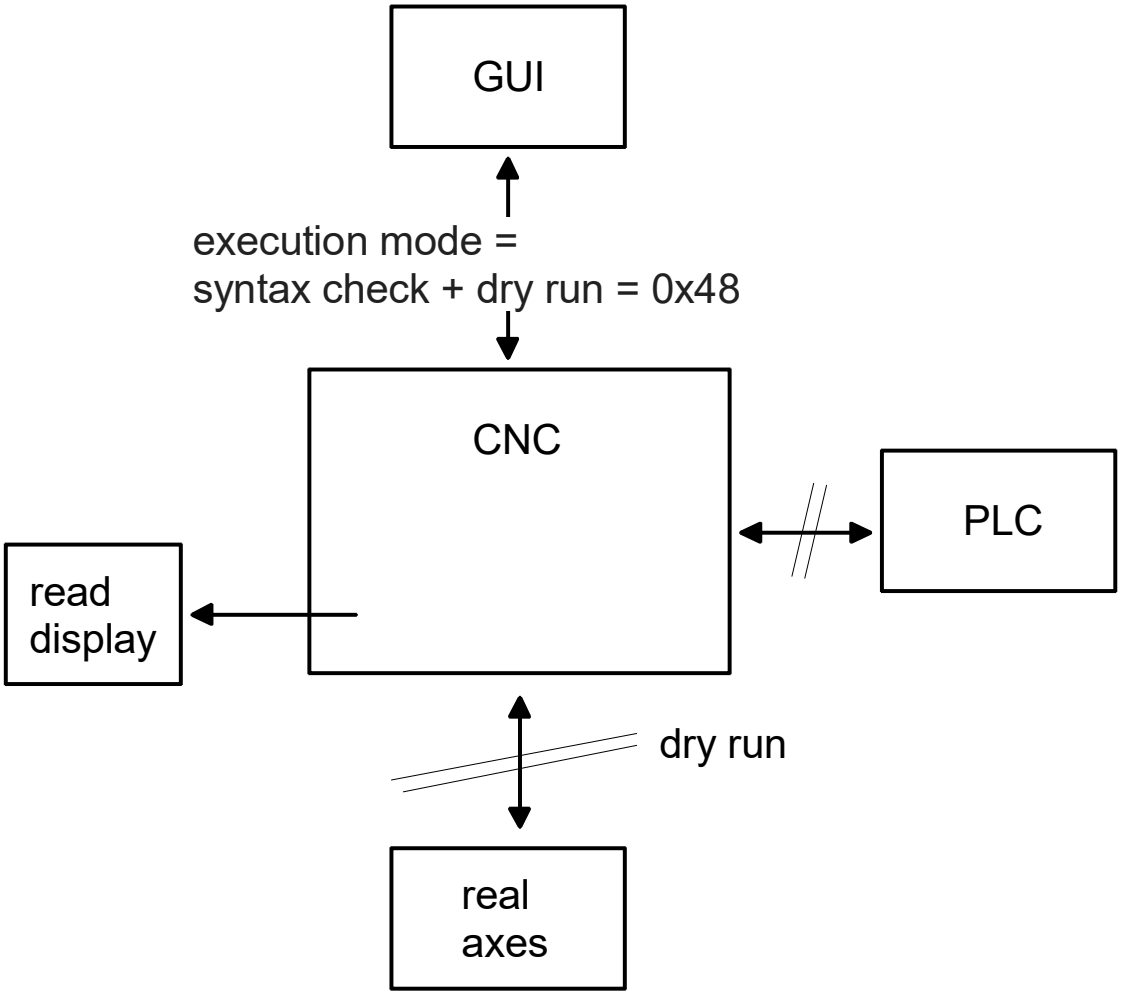

Fig. 1: Syntax check without drives

3 Interfacing

3.1 Selection via HMI interface

The operator sets the syntax check as an operating mode before starting the program. This setting is forwarded to the PLC via a control unit which the PLC can permit or reject.

The syntax check can be selected using the PLC without any previous request from the HMI.

Parameter	Description
mc_command_execution_mode_r, mc_command_execution_mode_w	Selecting syntax check
mc_active_file_offset_r, mc_active_file_name_r	Displays the current file position during the syntax check at the decoder level.
mc_command_single_block_w	This parameter selects the decoder single step mode in the syntax check.

Syntax check via HMI	
Description	A user interface can select the syntax check via this interface. At the same time, the dry run mode must always be selected together with the syntax check.
Type	32 Bit
Value range	0x0000 ISG_STANDARD Normal mode 0x0008 SYNCHK Syntax check simulation 0x0040 MACHINE_LOCK Dry run without axis motion
HMI elements	mc_command_execution_mode_r, mc_command_execution_mode_w
Access	Read, write
IndexOffset	0x40, 0x3f (IndexGroup = 0x000201<ii> where <ii> = channel)

3.2 Commands and display via PLC interface

Channel mode			
Description	Selection of a special channel mode such as syntax check or machining time calculation		
Data type	MC_CONTROL_SGN32_UNIT, see description of Control Unit		
Access	PLC reads request_r + state_r and writes command_w + enable_w		
ST Path	gpCh[*channel_idx*]^.decoder_mc_control.**execution_mode**		
Commanded, requested and return values			
ST Element	**.command_w** **.request_r** **.state_r**		
Data type	DINT		
Value range	**Value**	**Constant**	**Meaning**
	0x0000	ISG_STANDARD	Normal mode
	0x0001	SOLLKON	Block search
	0x0002	SOLLKON	Nominal contour visualisation simulation with output of visualisation data
	0x0802	SOLLKON_SUPRESS_OUTPUT & SOLLKON	Nominal contour visualisation simulation without output of visualisation data
	0x0004	ON_LINE	Online visualisation simulation
	0x0008	SYNCHK	Syntax check simulation
	0x0010	PROD_TIME	Simulation machining time calculation
	0x0020	ONLINE_PROD_TIME	Simulation online machining time calculation
	0x0040	MACHINE_LOCK	Dry run without axis motion
	0x0080	ADD_MDI_BLOCK	Extended manual block mode: the end of a manual block is not evaluated as a program end. It permits the commanding of further manual blocks.
	0x0100	KIN_TRAFO_OFF	Overwrites automatic enable for kinematic transformations by a characteristic parameter defined in the channel parameters (sda_mds*.lis).
	0x1000	BEARB_MODE_SCENE	When SCENE mode is enabled, the output of #SCENE commands is activated on the interface (see also [FCT-C17// Scene contour visualisation]). An additional client is linked to this output via DataFactory / CORBA.
	0x2000	SUPPRESS_TECHNO_OUTPUT	Without output of technology functions (M/H/T). Set implicitly in connection with syntax check.
Redirection			
ST element	**.enable_w**		

Display:

Parameter	**Description**
X_SyntaxCheck	Display: Syntax check active
X_WaitAfterError	Display: Decoder waits for enable to resume
X_SyntaxCheckWaitContinueCleared	Display: Decoder waits for cancellation of enable to resume

Syntax check active	
Description	Decoder is currently in the syntax check
Signal flow	CNC → PLC
ST path	pMC[*channel_idx*]^.addr^.StateDecoder_Data.**X_SyntaxCheck**
Data type	BOOL
Value range	[TRUE = decoder operates in the syntax check, FALSE]
Access	PLC is reading
Special features	-

Error occurred during syntax check – waiting for external input	
Description	In syntax check mode, the decoder waits after an error for an external input (continue, abort)
Signal flow	CNC → PLC
ST path	pMC[*channel_idx*]^.addr^.StateDecoder_Data.**X_WaitAfterError**
Data type	BOOL
Value range	[TRUE = error occurred in the syntax check – decoder waits, FALSE]
Access	PLC is reading
Special features	-

Syntax check active	
Description	Decoder is currently operating in the syntax check and, after an error and enable, waits until enable is cancelled.
Signal flow	CNC → PLC
ST path	pMC[*channel_idx*]^.addr^.StateDecoder_Data.**X_SyntaxCheckReleaseNextBlock Cleared**
Data type	BOOL
Value range	[TRUE = decoder waits for enable to be cancelled, FALSE]
Access	PLC is reading
Special features	-

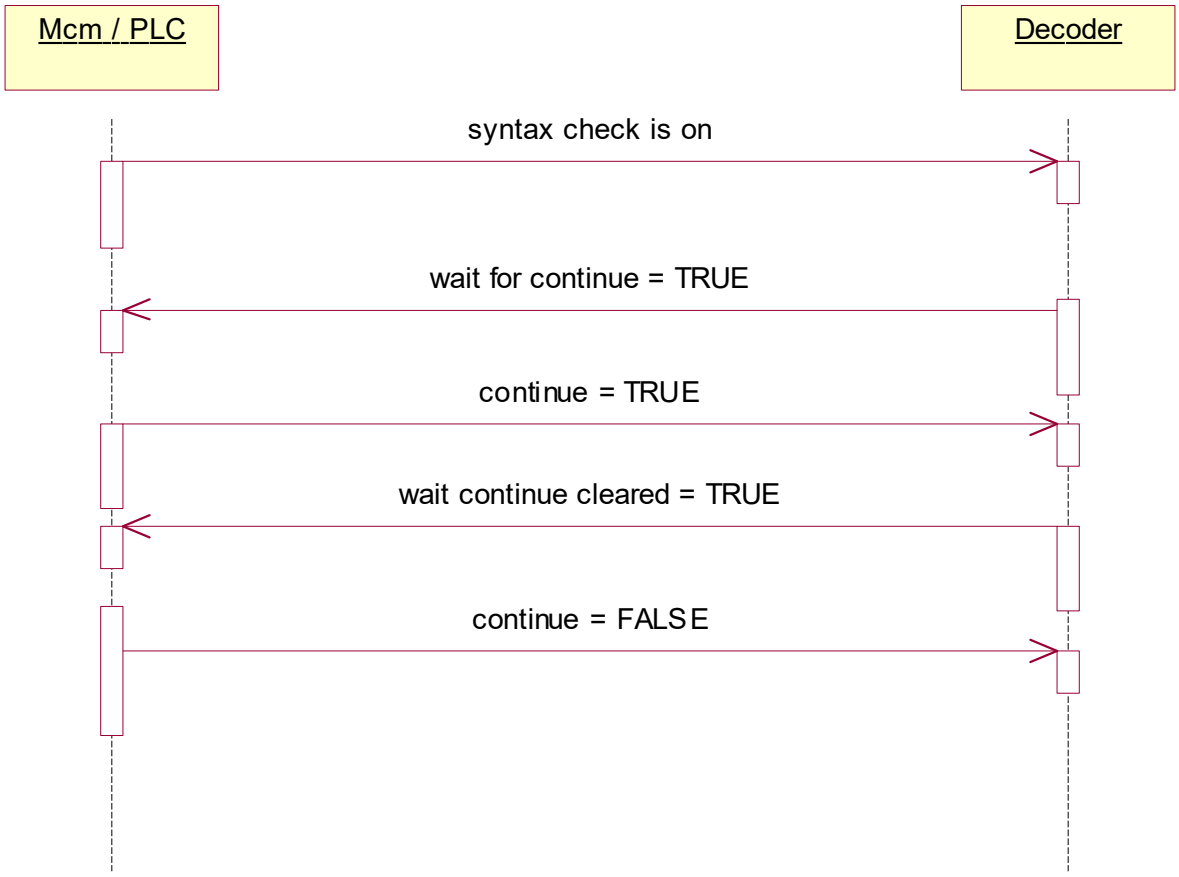

Fig. 2: Implicit handshake during interactive syntax check between decoder and Mcm/PLC

Decoding interrupted	
Description	Decoding was interrupted and waits for enable to continue.
Signal flow	CNC → PLC
ST path	pMC[*channel_idx*]^.addr^.StateDecoder_Data.**X_WaitContinue**
Data type	BOOL
Value range	[TRUE = decoder interrupted, FALSE]
Access	PLC is reading
Special features	-

Decoding interrupted	
Description	Decoding was interrupted and the decoder waits until enable is cancelled again resuming.
Signal flow	CNC → PLC
ST path	pMC[channel_idx]^.addr^.StateDecoder_Data.X_WaitReleaseNextBlockCleared
Data type	BOOL
Value range	[TRUE = decoder waits, FALSE]
Access	PLC is reading
Special features	-

3.2.1 HLI parameters up to CNC Build V2.20xx

Channel mode

Description	Selection of a special channel mode such as syntax check or machining time calculation		
Data type	MCControlSGN32Unit, see description of Control Unit		
Access	PLC reads Request + State and writes Command + Enable		
ST Path	pMC[*channel_idx*]^.addr^.MCControlDecoder_Data.**MCControlSGN32Unit_ExecutionMode**		
Commanded, requested and return values			
ST Element	**.D_Command** **.D_Request** **.D_State**		
Data type	DINT		
Value range	**Value**	**Constant**	**Meaning**
	0x0000	ISG_STANDARD	Normal mode
	0x0001	SOLLKON	Block search
	0x0002	SOLLKON	Nominal contour visualisation simulation with output of visualisation data
	0x0802	SOLLKON_SUPRESS_OUTPUT & SOLLKON	Nominal contour visualisation simulation without output of visualisation data
	0x0004	ON_LINE	Online visualisation simulation
	0x0008	SYNCHK	Syntax check simulation
	0x0010	PROD_TIME	Simulation machining time calculation (No function with TwinCAT)
	0x0020	ONLINE_PROD_TIME	Simulation online machining time calculation
	0x0040	MACHINE_LOCK	Dry run without axis motion
	0x0080	ADD_MDI_BLOCK	Extended manual block mode: the end of a manual block is not evaluated as a program end. It permits the commanding of further manual blocks.
	0x0100	KIN_TRAFO_OFF	Overwrites automatic enable for kinematic transformations by a characteristic parameter defined in the channel parameters (sda_mds*.lis).
	0x1000	BEARB_MODE_SCENE	When SCENE mode is enabled, the output of #SCENE commands is activated on the interface (see also [FCT-C17// Scene contour visualisation]). An additional client is linked to this output via DataFactory / CORBA.
	0x2000	SUPPRESS_TECHNO_OUTPUT	Without output of technology functions (M/H/T). Set implicitly in connection with syntax check
Redirection			
ST element	**.X_Enable**		

Display:

4 Parameter

Parametrisation

The operator sets the operation mode using P-CHAN-00028:

Single step mode: continues step by step over erroneous commands in the NC program and resumes decoding interactively

Automatic mode: checks the syntax in one run (without further manual intervention)

In addition, abort criteria can be configured for the syntax check using P-CHAN-00019 and P-CHAN-00020 for these two operation modes.

Produce a log file as of CNC Build V2.11.2033.08

If P-CHAN-00416 is set, all checked NC blocks and reported errors are logged to a file.

The operator can then use the error log to review the NC program and make it executable if required.

The file is created in the controller root directory. The filename consists of the 'dec0' string and the NC channel number in which the syntax check was executed.

The file extension is '.sc'.

Name of log file after a syntax check run in channel 1:*dec01.sc*

NOTICE

The settings for **Program processing in the syntax check** are selected before program run. Changes to the settings during the syntax check do not take immediate effect. This only occurs after a program restart.

4.1 Overview

ID	Parameter	Description
P-CHAN-00019	errors_total	Total number of permissible errors
P-CHAN-00020	errors_per_block	Errors per NC line
P-CHAN-00028	interactive	Operating mode
P-CHAN-00416	record_result	Log detected errors to file

4.2 Description of channel parameters

P-CHAN-00019	**Number of errors in an NC program on syntax check**
Description	This parameter defines the number of errors after which NC program decoding is aborted.
Parameter	syn_chk.errors_total
Data type	UNS16
Data range	0 ... MAX(UNS16)
Dimension	----
Default value	0
Remarks	*syn_chk.fehler_gesamt (old syntax up to V2.11.2012.07)* Parameterisation example: After a maximum of 20 errors in the NC program the syntax check is aborted. *syn_chk.errors_total 20*

P-CHAN-00020	**Number of errors per row on syntax check**
Description	This parameter defines the number of errors after which the program skips to the next program row.
Parameter	syn_chk.errors_per_block
Data type	UNS16
Data range	0 ... MAX(UNS16)
Dimension	----
Default value	0
Remarks	*syn_chk.fehler_pro_zeile (old syntax up to V2.11.2012.07)* Parameterisation example: After a maximum of 2 errors the program skips to the next NC row. *syn_chk.errors_per_block 2*

P-CHAN-00028	**Specify the operation mode on syntax check**
Description	The parameter defines the operation mode of the syntax check. Mode 1 - Automatic operation (0): After an error, decoding continues automatically. Syntax check is only aborted when the corresponding limits described in P-CHAN-00019 and P-CHAN-00020 are reached. Mode 2 - Step (interactive) mode (1): After each error, decoding is stopped. The operator decides whether the syntax check should continue or decoding should be aborted. When the corresponding limits described in P-CHAN-00019 and P-CHAN-00020 are reached, decoding is also aborted automatically.
Parameter	syn_chk.interactive
Data type	BOOLEAN
Data range	0/1
Dimension	----
Default value	0

Remarks	*interactive (old syntax up to V2.11.2012.07)* Parameterisation example: The syntax check runs in automatic mode. *syn_chk.interactive 0*

P-CHAN-00416	**Write results of syntax check to file**
Description	If this parameter is set to 1, all NC blocks and reported errors checked during the syntax check are logged to a file. The file is created in the controller root directory.
Parameter	syn_chk.record_result
Data type	BOOLEAN
Data range	0/1
Dimension	----
Default value	0
Remarks	The filename consists of the 'dec0' string and the NC channel number in which the syntax check was executed. The file extension is '.sc'. Example: Name of log file after a syntax check run in channel 1: *dec01.sc*

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PART 6

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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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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.

6.1 Overview

Task

The CNC provides the user with 2 types of status information:

1. Status information and status signals of an informative nature provided to the user by means of display data or by the HMI or the PLC.
2. Status information on improved techniques to master machining technologies.

Characteristics

Real-time status signals consist of information from the real-time area of the CNC. The status information provided by the path interpolator is described below.

This mainly consists of information regarding CNC operation modes such as:

- active manual mode,
- active path interpolation,
- program status and
- state information regarding CNC-internal sequences.

This information is useful for diagnosis purposes. The PLC can control or influence the internal status process by the logical linking of status signals.

The CNC also provides status information to improve mastery of specific machining technologies with the support of the PLC.

The information signals described are located in the HLI interface.

Programming

Status information on the HLI with the structure **StateBahn** is created and is invokable in the PLC programming language *Structured Text* on the path pMC[*ChannelIdx*]^.addr^.StateBahn_Data…

Mandatory note on references to other documents

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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.

6.2 Status information

This documentation only lists the most important status information that is valid at interpolator level.

A complete description of all available access or influencing options can be found in the documentation [HLI, section "Status information of a channel"].

The information listed below is saved on the HLI in the structure **StateBahn** and can be invoked in the PLC programming language *structured text* on the path.

pMC[ChannelIdx]^.addr^.StateBahn_Data…

.

Status information	Meaning
D_CoveredDistance	Current block position or path distance
D_CommandFeed	Programmed feedrate (F word)

Status information	Meaning
D_ActiveFeed	Current path feedrate
D_StopConditions	Current stop condition (bit-encoded)
X_ProgramEnd	Program end reached (M30)
X_WaitErrorRemoval	Wait for error acknowledgement by user
X_InterpolationActive	Interpolation is active
X_AxesInPosition	Axis group is in position
X_WaitAxesInPosition	Wait until axes are in position
X_WaitTechnoAcknowledge	Wait for acknowledgement from PLC
X_WaitContinue	Wait for user continuation request
X_DwellTimeActive	Wait due to dwell time
X_BlockSearchActive	Interpolator block search active
X_SpeedLimitDetect	Speed limit undershot
HLIBahnCoordDispData_Coord	CNC coordinates and coordinate system
HLISAddProgInfo_Data	Additional program information

6.3 Description

6.3.1 D_CoveredDistance

Data type HLI_SGN32
ST path pMC[ChannelIdx]^.addr^.StateBahn_Data.D_CoveredDistance

This variable contains the current block position referred to the path distance in space in the motion block in per mil sd(t). The spatial path results from the
path components of the main axes and the path component of a single axis. Within a motion block, the value sd(t) always varies within the range of 0 < D_CoveredDistance < 1000.

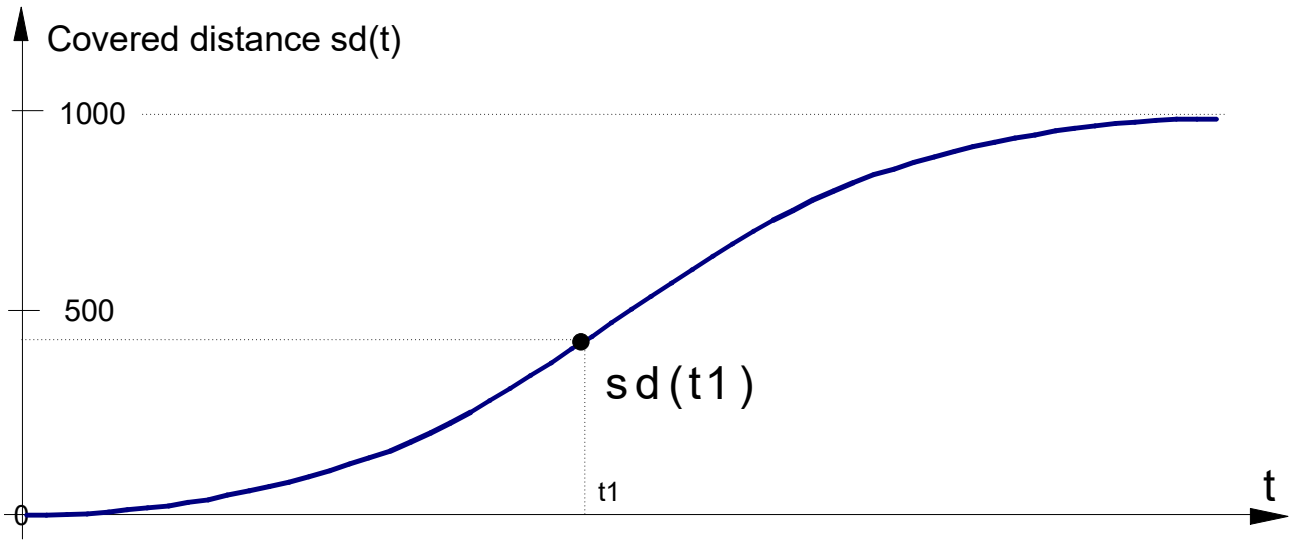

Fig. 3: Path shape block position over time of D_CoveredDistance

6.3.2 D_CommandFeed, D_ActiveFeed

Data type HLI_SGN32

ST path	pMC[ChannelIdx]^.addr^.StateBahn_Data.D_CommandFeed pMC[ChannelIdx]^.addr^.StateBahn_Data.D_ActiveFeed

The D_CommandFeed variable contains the path velocity programmed via the F word. D_ActiveFeed is the current command path feedrate in the block.

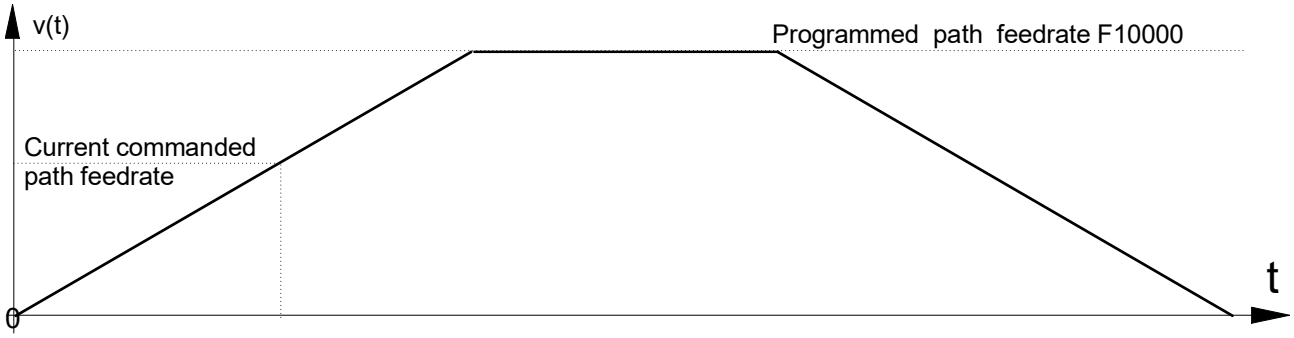

Fig. 4: Path velocity at D_ActiveFeed

6.3.3 D_StopConditions

Data type	HLI_UNS32
ST path	pMC[ChannelIdx]^.addr^.StateBahn_Data.D_StopConditions

In bit-encoded form, this contains the stop conditions which cause a motion stop or a program execution stop in the interpolator as a result of NC programming or a PLC command.

The table below shows the constants which are defined for these stop conditions in the PLC:

Stop condition	Constant in PLC	Status bit
Feedhold	SC_BIT_FEEDHOLD	0x0000 0001
No axis-specific feed enable	SC_BIT_VFG	0x0000 0002
Single step mode active	SC_BIT_SINGLE_BLOCK	0x0000 0004
Wait due to M00, M01	SC_BIT_M00_OR_M01	0x0000 0010
Wait for PLC acknowledgement	SC_BIT_PLC_ACKNOWLEDGE	0x0000 0020
Override = 0	SC_BIT_OVERRIDE_ZERO	0x0000 0040
Dwell time	SC_BIT_DELAY_TIME	0x0000 0200
Channel synchronisation active	SC_BIT_CHANNEL_SYNC	0x0000 0800
IPO input FIFO empty	SC_BIT_IPO_INPUT_EMPTY	0x0000 1000
Read-in enable	SC_BIT_IPO_INPUT_DISABLED	0x0000 2000
Wait for axes in case of axis exchange	SC_BIT_WAIT_FOR_AXES	0x0000 8000
Channel in error state	SC_BIT_CHANNEL_ERROR	0x0001 0000
Waiting for acknowledgement of M/H/ST technology functions	SC_BIT_STOP_WAIT_TECHNO_ACKN	0x0002 0000
Wait to continue motion after a collision is detected	SC_BIT_WAIT_CONT_AFTER_COLLISION	0x0004 0000
Block supply problem (HSC slope only)	SC_BIT_SLOPE_SUPPLY_PROBLEM	0x0008 0000
Back-interpolation after tracking mode active	SC_BIT_BACK_INTERPOLATION	0x0010 0000

6.3.4 X_ProgramEnd

Data type	HLI_BOOLEAN
ST path	pMC[ChannelIdx]^.addr^.StateBahn_Data.X_ProgramEnd

This status information indicates that the program end is reached or that no NC program is currently executed.

6.3.5 X_WaitErrorRemoval

Data type	HLI_BOOLEAN
ST path	pMC[ChannelIdx]^.addr^.StateBahn_Data.X_WaitErrorRemoval

This status is indicated in the event of a CNC error in the real-time area that can be removed by means of an NC reset (depending on the error reaction class).

6.3.6 X_InterpolationActive, X_DwellTimeActive

Data type	HLI_BOOLEAN
ST path	pMC[ChannelIdx]^.addr^.StateBahn_Data.X_InterpolationActive pMC[ChannelIdx]^.addr^.StateBahn_Data.X_DwellTimeActive

Block is in the process of being interpolated

The X_InterpolationActive status is indicated if a part program with path motions is in execution and if a path block is being currently interpolated in the real-time part.

```
N20 G01 X10 Y20 Z30 F2000 #Block is currently interpolated
```

Block currently executed with dwell time

The X_DwellTimeActive status is indicated if a part program with dwell time is in execution and a block with a dwell time is currently being executed in the real-time part.

```
N20 G04 10 #Block is currently executed with dwell time
```

6.3.7 HLIBahnCoordDispData_Coord

Data type	HLIBahnCoordDispData
ST path	pMC[*ChannelIdx*]^.addr^.StateBahn_Data.HLIBahnCoordDispData_Coord[ChAxIdx] …

This consists of the coordinates of various coordinate systems that the CNC can provide to the outside world.

6.3.8 HLISAddProgInfo_Data

Data type	HLISAddProgInfo
ST path	pMC[*ChannelIdx*]^.addr^.StateBahn_Data.HLISAddProgInfo_Data….

This consists of additional information that can be retrieved in relation to the NC program.

6.3.9 Extended status information

6.3.9.1 X_SpeedLimitDetect, Look Ahead für Geschwindigkeitsgrenzwert

Data type	HLISAddProgInfo
ST path	pMC[ChannelIdx]^.addr^.StateBahn_Data.X_SpeedLimitDetect

General

This function generates a CNC status signal depending on the motion blocks and the current path velocity. It is mainly used for plasma cutting technology to deactivate distance control of the cutting head via the PLC if the speed drops below a certain limit. This occurs, for example

- when decelerating ahead of and
- accelerating after a corner.

Therefore, the critical positions in the motion segment (corner) are defined by a speed limit.

"Speed limit detect" status flag

The “speed limit detect” status flag to the PLC is set if the current path velocity is below the specified limit. The drop in path velocity results from:

- Reduction in velocity at block transition due to a kink in the path contour.
- Reduction of velocity due to override setting.
- Expected M function acknowledgement from PLC at block transition.
- Look-ahead reduces velocity because of inadequate block supply.

Zone

In addition the signal can be set in advance or cleared with a delay at a specified distance (time/distance).

- Advance: The expected velocity at block end undershoots the speed limit, for example due to a geometrical corner. The status flag is set in advance at the specified distance to the expected limit undershoot.
- Delay: The expected velocity at block start already undershoots the speed limit. The status flag is again cleared with a delay at the specified distance to the actual speed overshoot.

Clear

I.e. the status flag is reset when both of the following conditions are met:

- The current path velocity rises above the speed limit.
- The path position is outside the specified time and distance delay.

6.3.9.2 Description

Activation

When the function is activated, a CNC status signal is generated according to the control flag P-CHAN-00017 and signals a speed limit undershoot or the detection of a future speed limit undershoot.

Limit value

The speed limit is defined via the percentage weighting (P-CHAN-00089) of the F word in the NC program.

Advance, delay

The expected drop in velocity at block end can be signalled in advance by the parameter P-CHAN-00013. Accordingly, the signal can also be cleared with a delay by the parameter P-CHAN-00012. The parameters P-CHAN-00012 / P-CHAN-00013 can therefore define a type of hysteresis.

Distance, time

The parameter P-CHAN-00018 defines the zone parameter unit as either a distance or time.

The CNC generates the “speed limit detect” status signal if the path position is inside this zone.

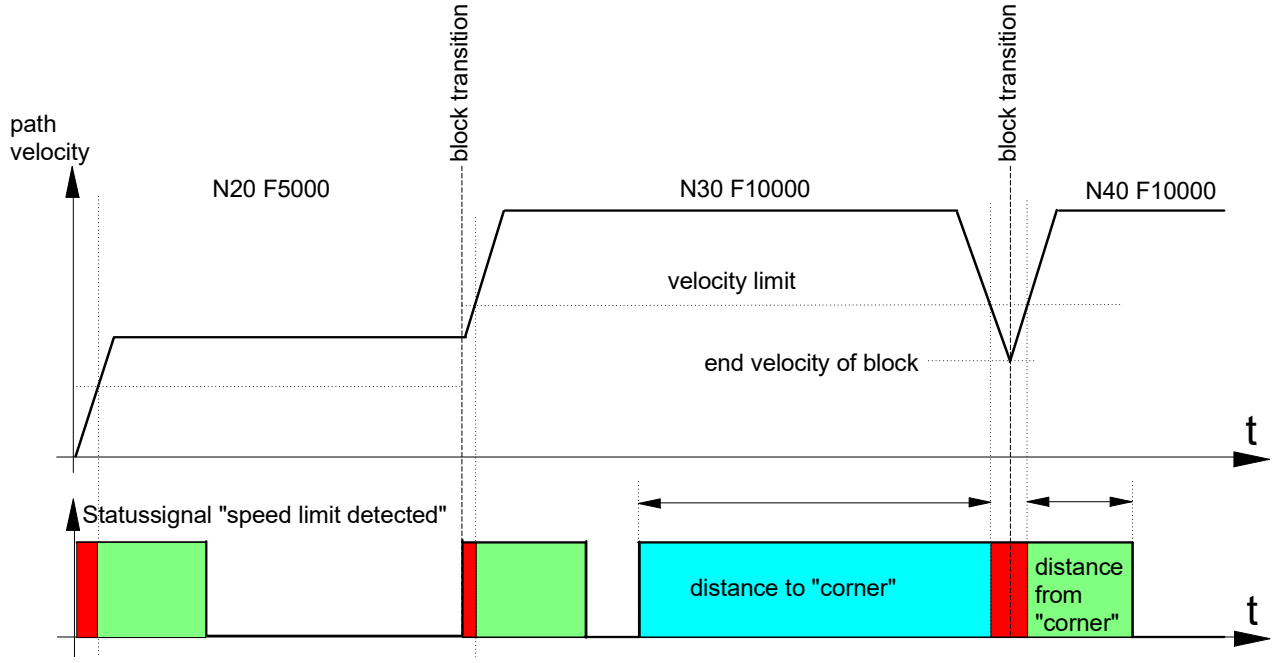

Fig. 5: F Word and status signal “speed limit detected”

Influence of override

The parameter P-CHAN-00155 controls the influence of the speed limit by means of the real-time feed override.

In the default setting (P-CHAN-00155 = 0), the real-time
feed override does not influence the speed limit P-CHAN-00089. The “speed limit detect” status signal is also set if the path speed weighted by the override drops below the speed limit P-CHAN-00089.

Since an override is an online user-initiated influence on speed, the delay/advance of the status signal cannot be evaluated in this case.

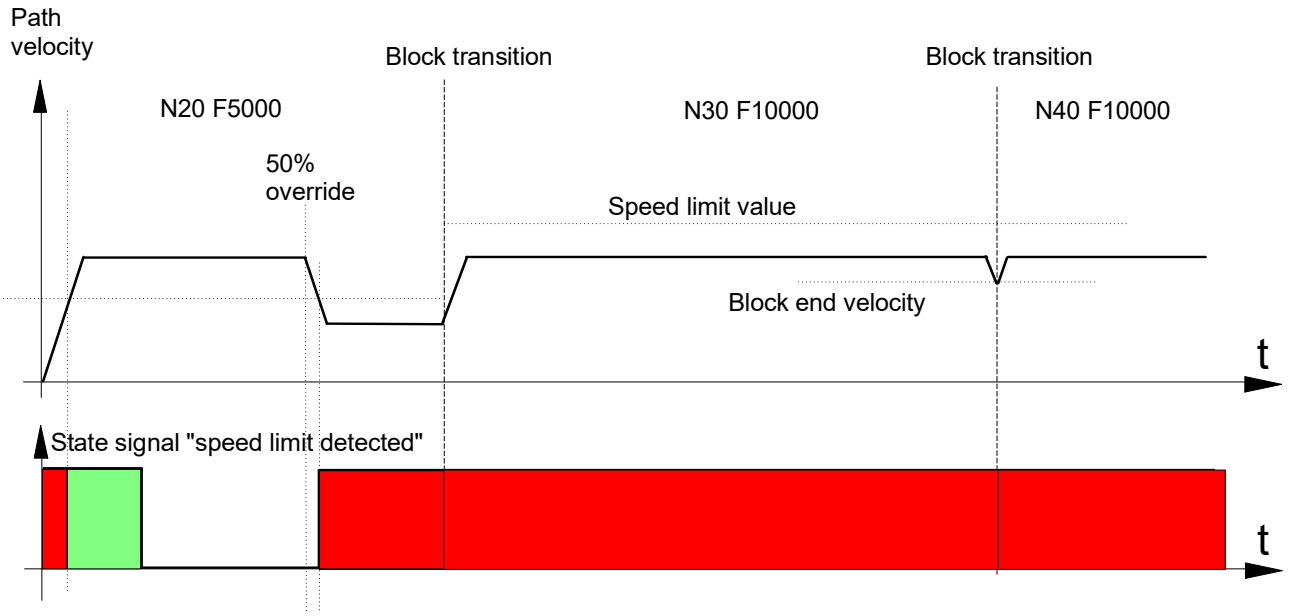

Fig. 6: Timing diagram without override weighting (f_override_weight_v_limit = 0)

When P-CHAN-00155 is set, the parameterised speed limit P-CHAN-00089 is weighted by the override value. This is desirable e.g. for path start-up or run-in.

Note that, with a non-constant programmed feed, the "speed limit detect" signal is activated in each acceleration phase because the speed limit at the start of the block is set to the new value.

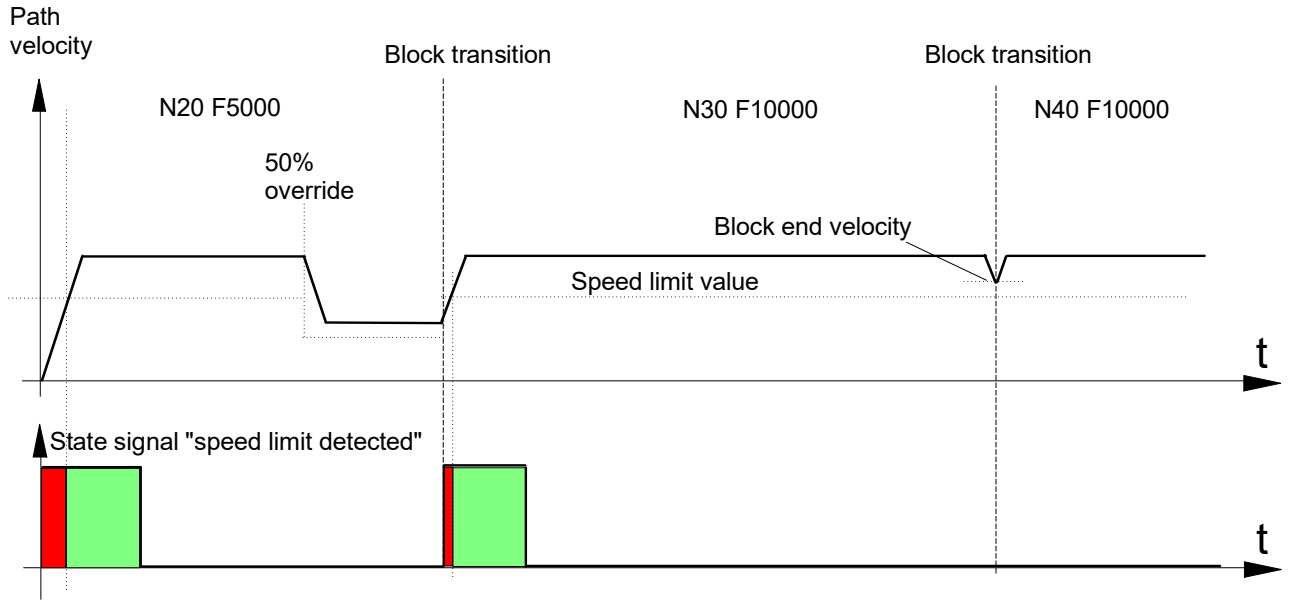

Fig. 7: Timing diagram with override weighting (f_override_weight_v_limit = 1)

Influence of technology functions

The “speed limit detect” status signal is set if the CNC has to stop and wait due to certain types of technology functions or missing PLC synchronisation. In this case, the signal advance or delay related to the set time or distance is also evaluated.

Waiting for PLC acknowledgement

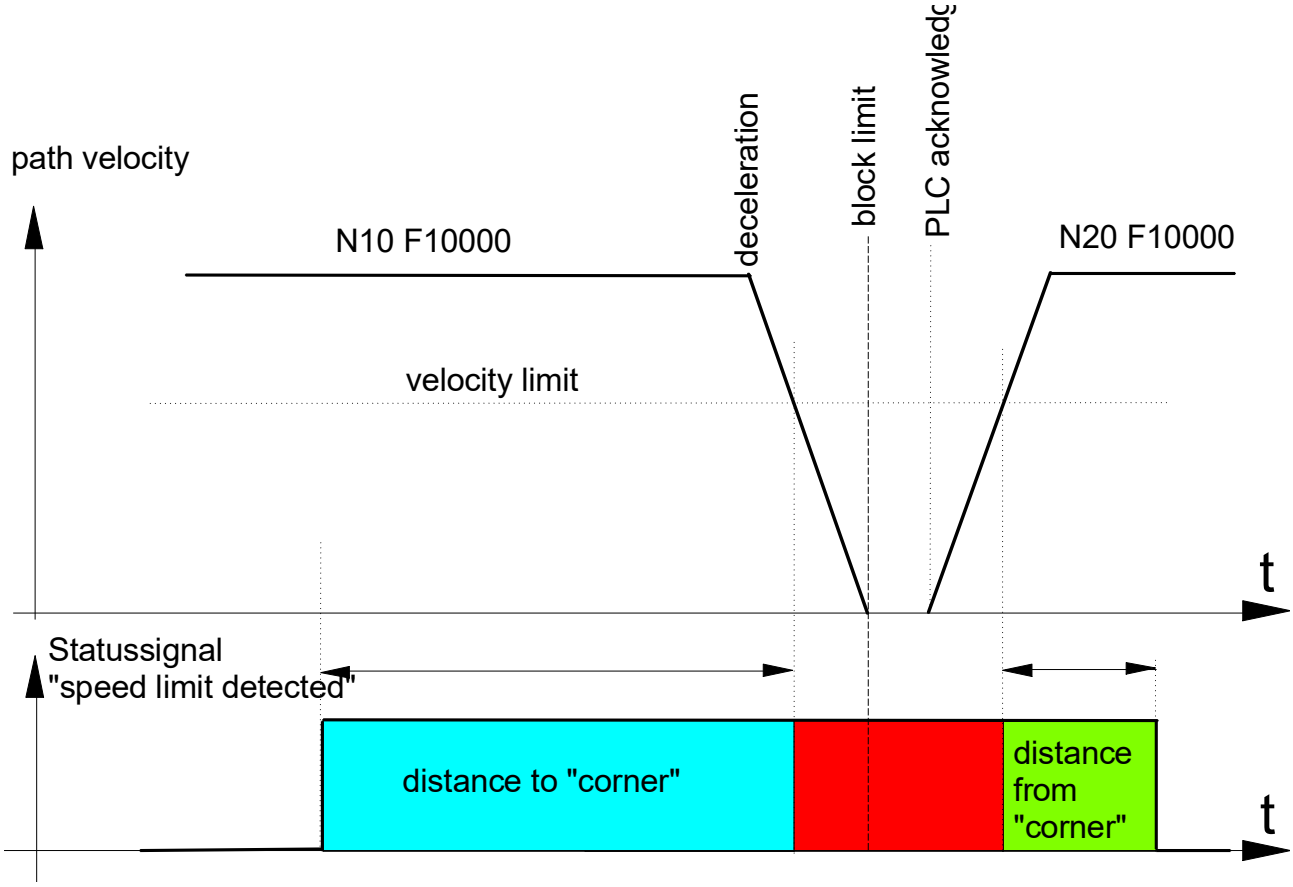

Fig. 8: Missing PLC acknowledgement and "speed limit detected" status signal

With M functions of the MVS_SNS type, later synchronisation or M functions with look-ahead are only stopped if the PLC acknowledgement is missing. If the PLC acknowledgement arrives before the motion, a restart can be executed immediately.

However, the advance signal (advance, distance to “corner”) can still be executed correctly although an actual speed undershoot no longer arrives.

PLC acknowledgement during deceleration

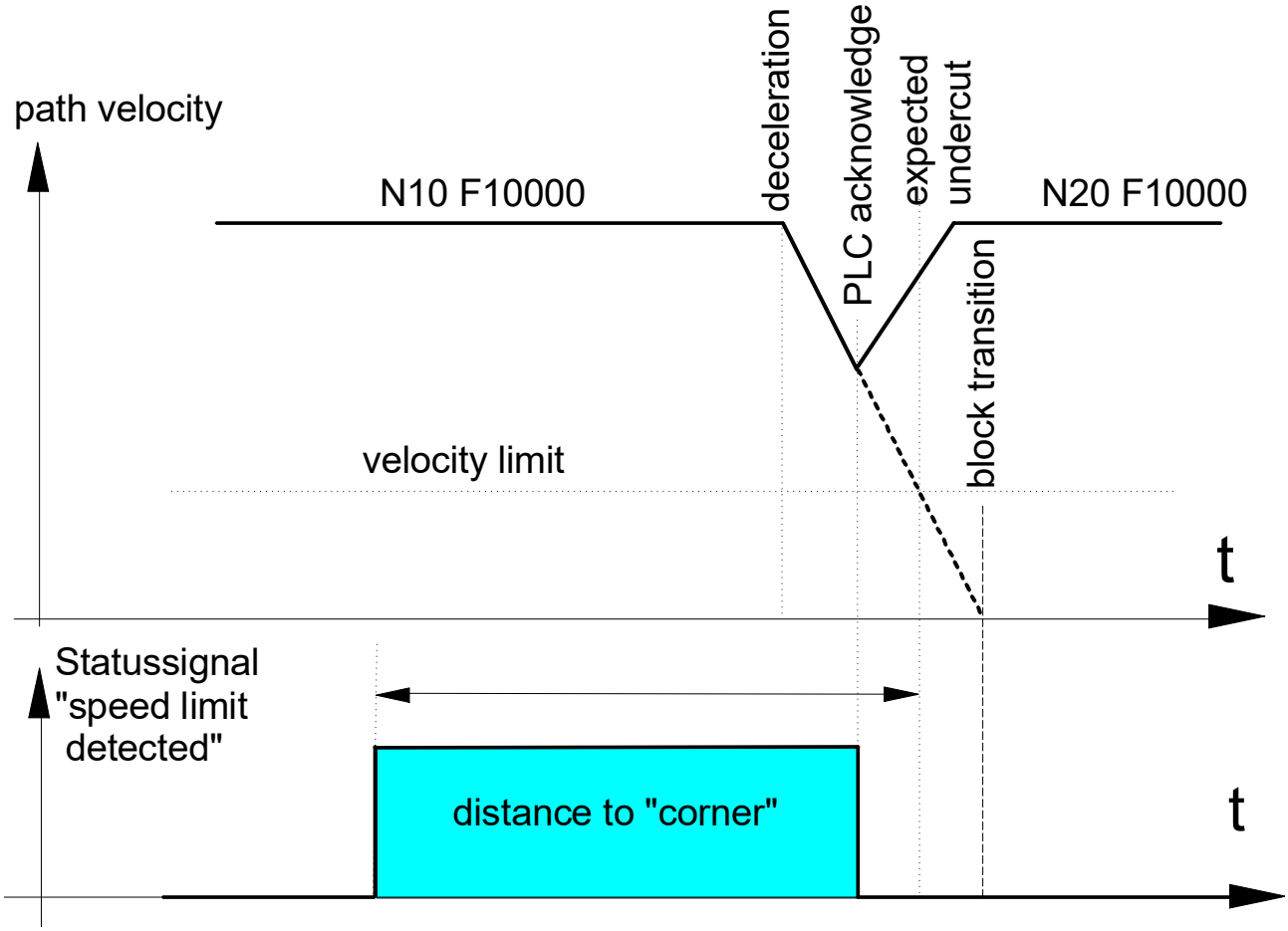

Fig. 9: A restart after PLC acknowledgement resets the “speed limit detect” status signal.

Each M or H function of the MVS_SVS or MNS_SNS type always results in a motion stop (see also [FCT-C1]).

Interruption of block supply

If the path velocity fluctuates due to short blocks and inadequate block supply, this may cause activation of the “speed limit detect” status signal. In the example below the advance/delay parameters (distance to corner and distance from corner) are disabled for the sake of simplification.

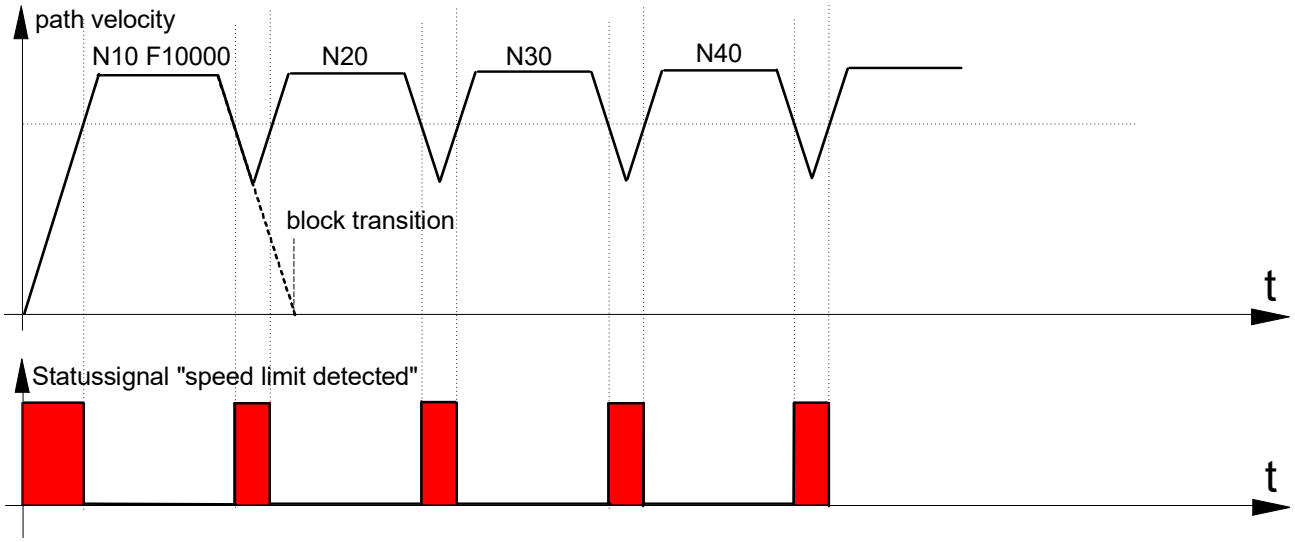

Fig. 10: Inadequate block supply results in the activation of the "speed limit detected" signal.

6.4 Example

The “speed limit detect” status signal is generated depending on the set parameters if the programmed paths cause deceleration along the path and the speed drops below the speed limit, e.g. due to a corner.

Parameter

Excerpt from the channel parameter list [CHAN]:

```
# Speed limit look ahead parameterisation
# =======================================
speed_limit_look_ahead.f_enable                          1
speed_limit_look_ahead.v_limit                         750
speed_limit_look_ahead.f_time                            0
speed_limit_look_ahead.dist_to_corner                10000
speed_limit_look_ahead.dist_from_corner              10000
speed_limit_look_ahead.f_override_weight_v_limit         0
```

Parameters can also be changed in the NC program by appropriate variables (V.G.SPEED_LIMIT.*) [PROG].

"Speed limit detect” status signal

Speed drop at end of NC block

```
%main
X0 Y0
N10 G01 X50 F5000
N20 X100
N30 X150
N40 X200 (speed drop at end of NC block)
N50 X250 Y-25
N60 X300 Y-50
M30
```

The parameters listed above and the F word in the NC program result in:

Speed limit = 75% of the programmed velocity

→ v_limit = 3750 mm/min (62500 um/s)

In the NC program example the path velocity drops to 8.562 um/s at block transition N40 -> N50 due to a path kink angle of 30 degrees. This means that the “speed limit detect” status signal is set 1 mm before limit speed undershoot at the block end of N40 and reset 1 mm after limit speed overshoot at the block start of N50.

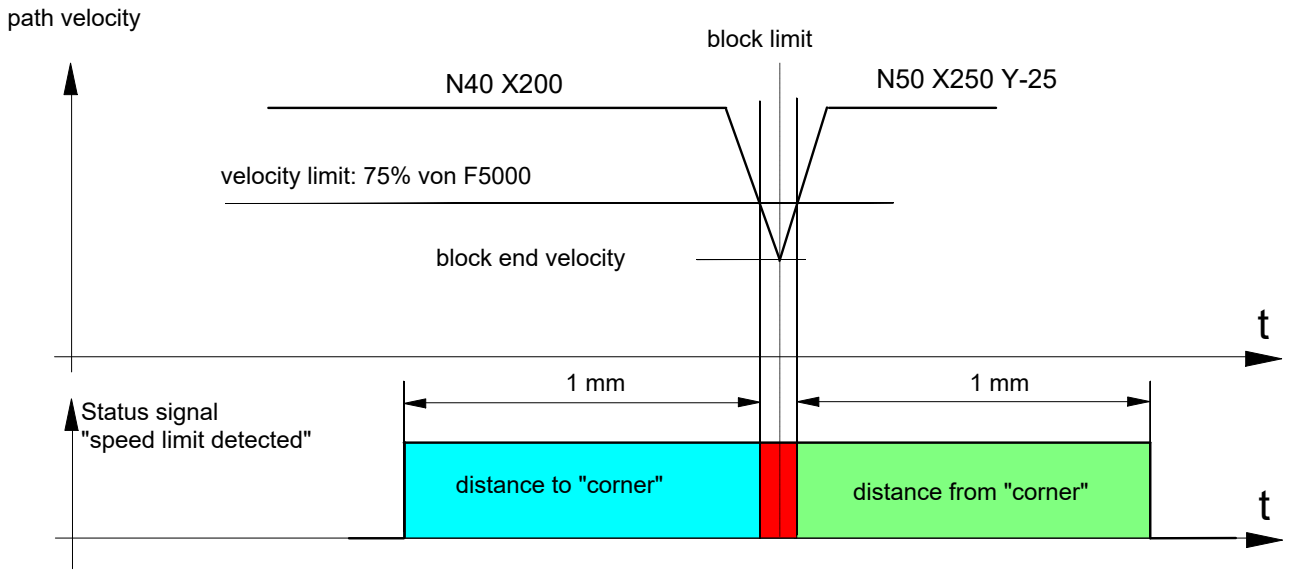

Fig. 11: F word and “speed limit detected” status signal

6.5 Parameter

6.5.1 Overview

ID	Parameter	Description
P-CHAN-00012	dist_from_corner	Distance to corner
P-CHAN-00013	dist_to_corner	Distance from corner
P-CHAN-00017	enable	Enabling/disabling the function
P-CHAN-00018	time	Control flag (distance or time) for P-CHAN-00012/13
P-CHAN-00089	limit	Weighting of the velocity limit
P-CHAN-00155	override_weight_v_limit	Weighting of the velocity limit value by override

6.5.2 Description

P-CHAN-00012	**Distance from corner for speed limit look ahead**
Description	The logical signal SLD 1 ->0 is generated depending on the parameters 'distance from corner' or 'time from corner'. Here, corner means the position in the block at which the speed rises again above the speed limit.
Parameter	speed_limit_look_ahead.dist_from_corner
Data type	UNS32
Data range	0 ... MAX(UNS32)
Dimension	0.1µm or µs
Default value	0
Remarks	

P-CHAN-00013	**Distance to corner for speed limit look ahead**

Description	The logical signal SLD 0 ->1 is generated in advance depending on the parameters 'distance to corner' or 'time to corner'. Here, corner means the position in the block at which the speed drops below the speed limit.
Parameter	speed_limit_look_ahead.dist_to_corner
Data type	UNS32
Data range	0 ... MAX(UNS32)
Dimension	0.1µm or µs
Default value	0
Remarks	

P-CHAN-00017	**Enable/disable speed limit look ahead**
Description	Parameter to enable or disable the speed limit look ahead function.
Parameter	speed_limit_look_ahead.enable
Data type	BOOLEAN
Data range	0: Speed limit look ahead is disabled. 1: Speed limit look ahead is enabled.
Dimension	----
Default value	0
Remarks	*speed_limit_look_ahead.f_enable (old syntax up to V2.11.2022.13)*

P-CHAN-00018	**Unit to interpret the SLD signal for look-ahead speed**
Description	The logical signal SLD is generated depending on the parameter values for distance or time.
Parameter	speed_limit_look_ahead.time
Data type	BOOLEAN
Data range	0: The distance parameters P-CHAN-00012 and P-CHAN-00013 are interpreted as path. 1: The parameters P-CHAN-00012 and P-CHAN-00013 are interpreted as time.
Dimension	----
Default value	0
Remarks	*speed_limit_look_ahead.f_time (old syntax up to V2.11.2022.13)*

P-CHAN-00089	**Weighting of speed limit for speed limit look ahead**
Description	Speed limit value in 0.1 percent of programmed speed. If current speed falls below the limit $v = v_{prog} * v\_limit/1000$, the logical signal SLD 0 ->1 is generated.
Parameter	speed_limit_look_ahead.v_limit
Data type	UNS32
Data range	0 ... MAX(UNS32)
Dimension	0.1%
Default value	0
Remarks	

P-CHAN-00155	**Weighting the speed limit via override for Speed limit Look Ahead function**
Description	This parameter controls the influence of the speed limit via the real-time feed override. In the default setting, the real-time feed override does not influence the speed limit P-CHAN-00089 (v_limit). However, if this is desirable e.g. to commission or enter contours, the parameter is set to 1. Then the parametrised speed limit value is weighted by the override value. Note that at a non-constant programmed feed, the SLD signal is activated in each acceleration phase because the speed limit at the start of the block is set to the new value.

Parameter	speed_limit_look_ahead.override_weight_v_limit
Data type	BOOLEAN
Data range	0: No weighting of P-CHAN-00089 (default). 1: Weighting of P-CHAN-00089 via override.
Dimension	----
Default value	0
Remarks	*f_override_weight_v_limit (old syntax up to V2.11.2022.13)*

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