DOCUMENTATION ISG-kernel

Functional description
Real time status information of CNC

Short Description:
FCT-C8

Documentation version: 1.06
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Preface

Legal information

This documentation was produced with utmost care. The products and scope of functions described are under continuous development. We reserve the right to revise and amend the documentation at any time and without prior notice.

No claims may be made for products which have already been delivered if such claims are based on the specifications, figures and descriptions contained in this documentation.

Personnel qualifications

This description is solely intended for skilled technicians who were trained in control, automation and drive systems and who are familiar with the applicable standards, the relevant documentation and the machining application.

It is absolutely vital to refer to this documentation, the instructions below and the explanations to carry out installation and commissioning work. Skilled technicians are under the obligation to use the documentation duly published for every installation and commissioning operation.

Skilled technicians must ensure that the application or use of the products described fulfil all safety requirements including all applicable laws, regulations, provisions and standards.

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Links below (DE)

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or (EN)

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contains further information on messages generated in the NC kernel, online help, PLC libraries, tools, etc. in addition to the current documentation.

Disclaimer

It is forbidden to make any changes to the software configuration which are not contained in the options described in this documentation.

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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

➢ 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.

Attention

Restriction or error

This icon describes restrictions or warns of errors.

Notice

Tips and other notes

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

Example

General example

Example that clarifies the text.

Programing Example

NC programming example

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

Release Note

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

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

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   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)
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

3   Description

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 $0 < D\_CoveredDistance < 1000$.
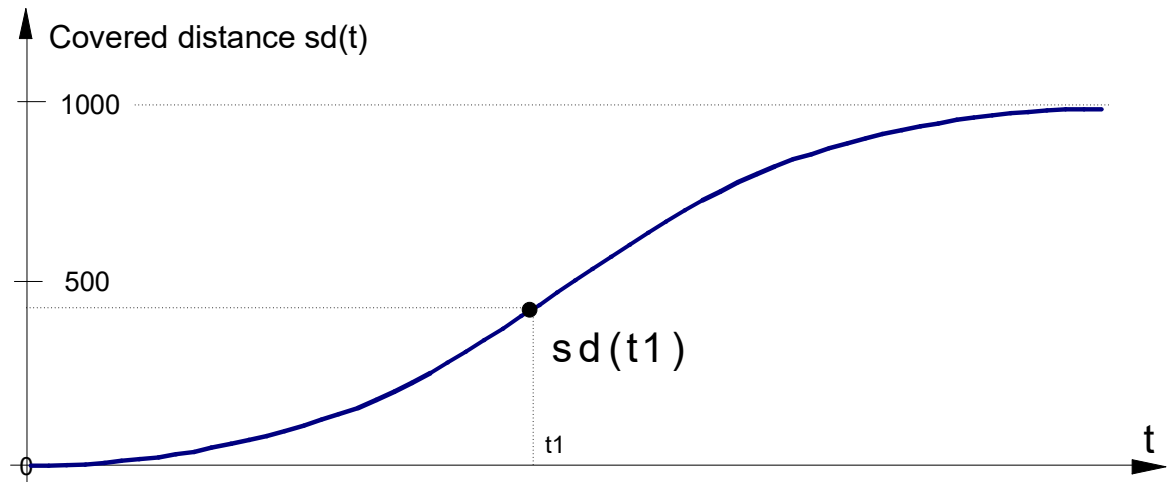
Fig. 1: Path shape block position over time of D_CoveredDistance

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. 2: Path velocity at D_ActiveFeed

3.3   D_StopConditions

Data type   HLI_UNS32

ST path   pMC[ChannelIdx]^.addr^.StateBahn_Data.D_StopConditions

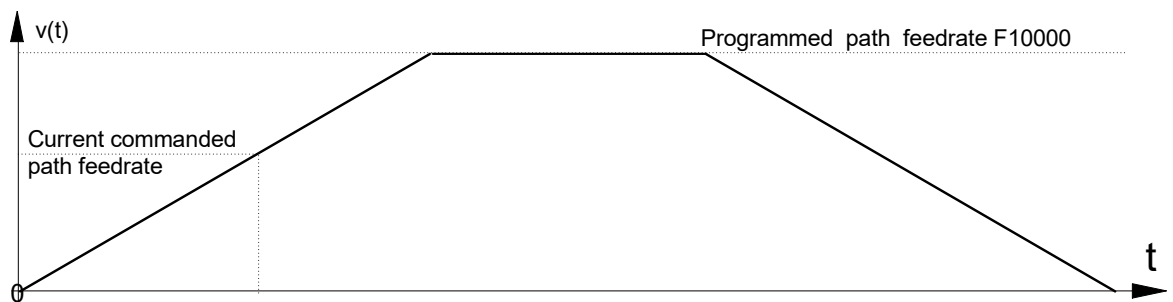In bit-encoded form, this contains the stop conditions which cause a motion stop or a program execution stop in the interpolator as a result of NC programming or a PLC command.

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

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.

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).

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

---

Programing Example

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
```

Programing Example

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
```

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.

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.

3.9   Extended status information

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.

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.
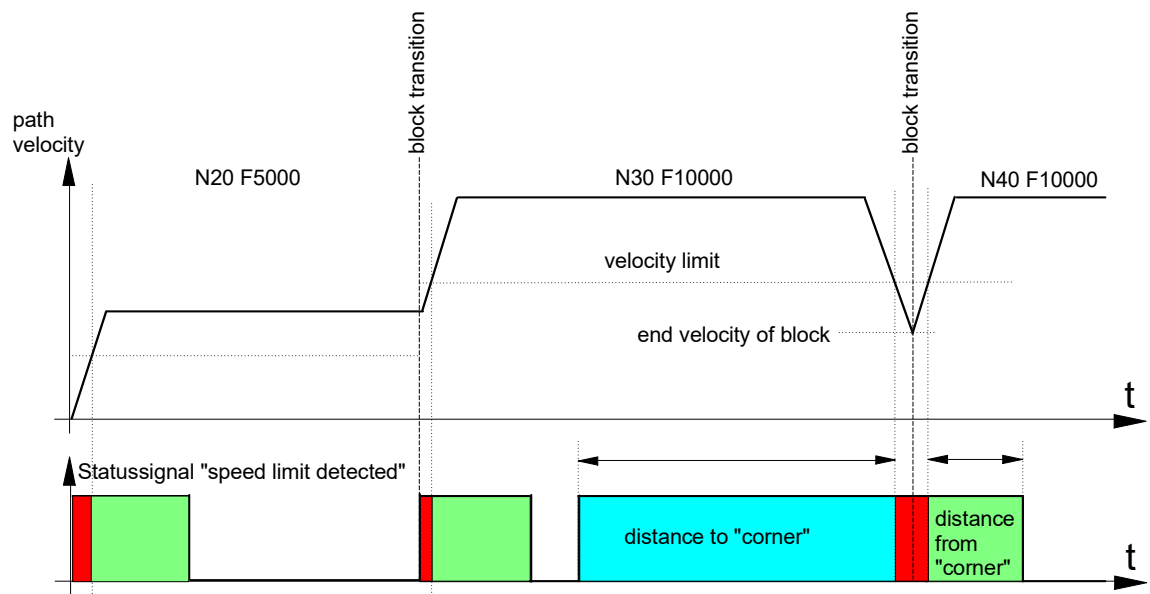

Fig. 3: F Word and status signal "speed limit detected"

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
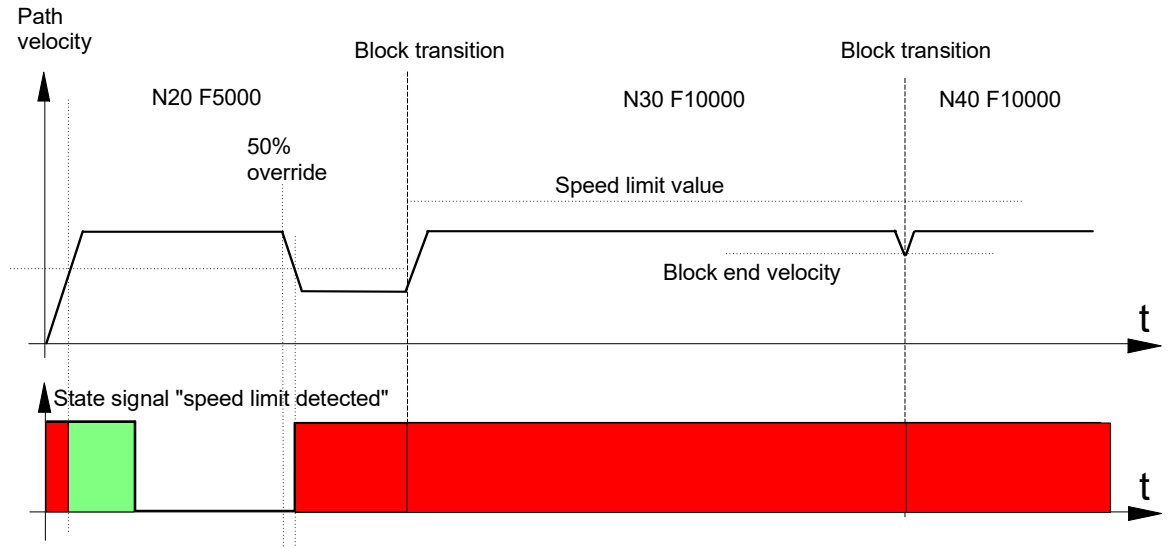signal cannot be evaluated in this case.

Fig. 4: 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.
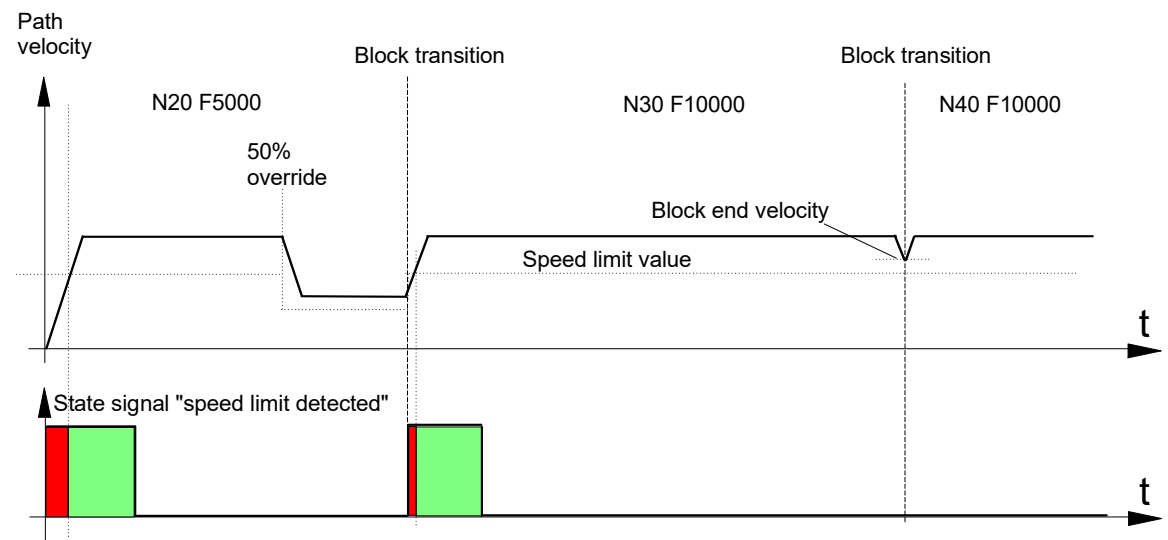

Fig. 5: Timing diagram with override weighting (f_override_weight_v_limit = 1)

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.

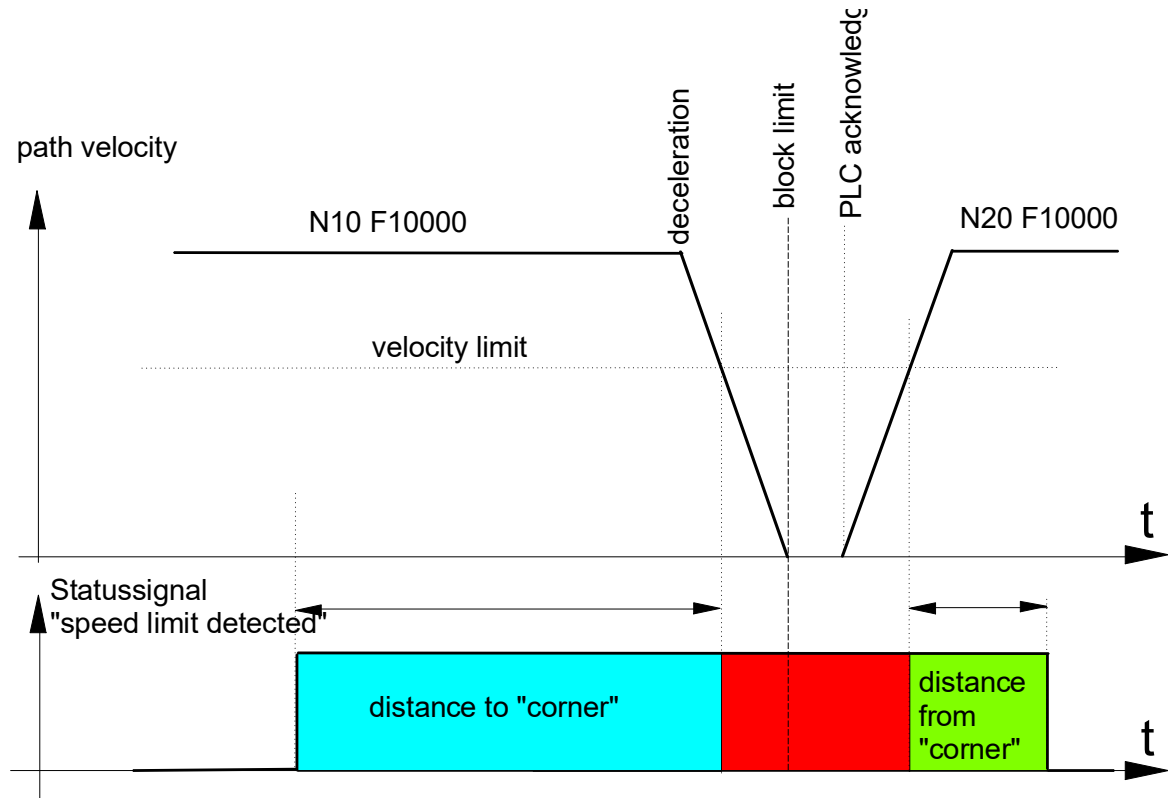## Waiting for PLC acknowledgement

Fig. 6: 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.

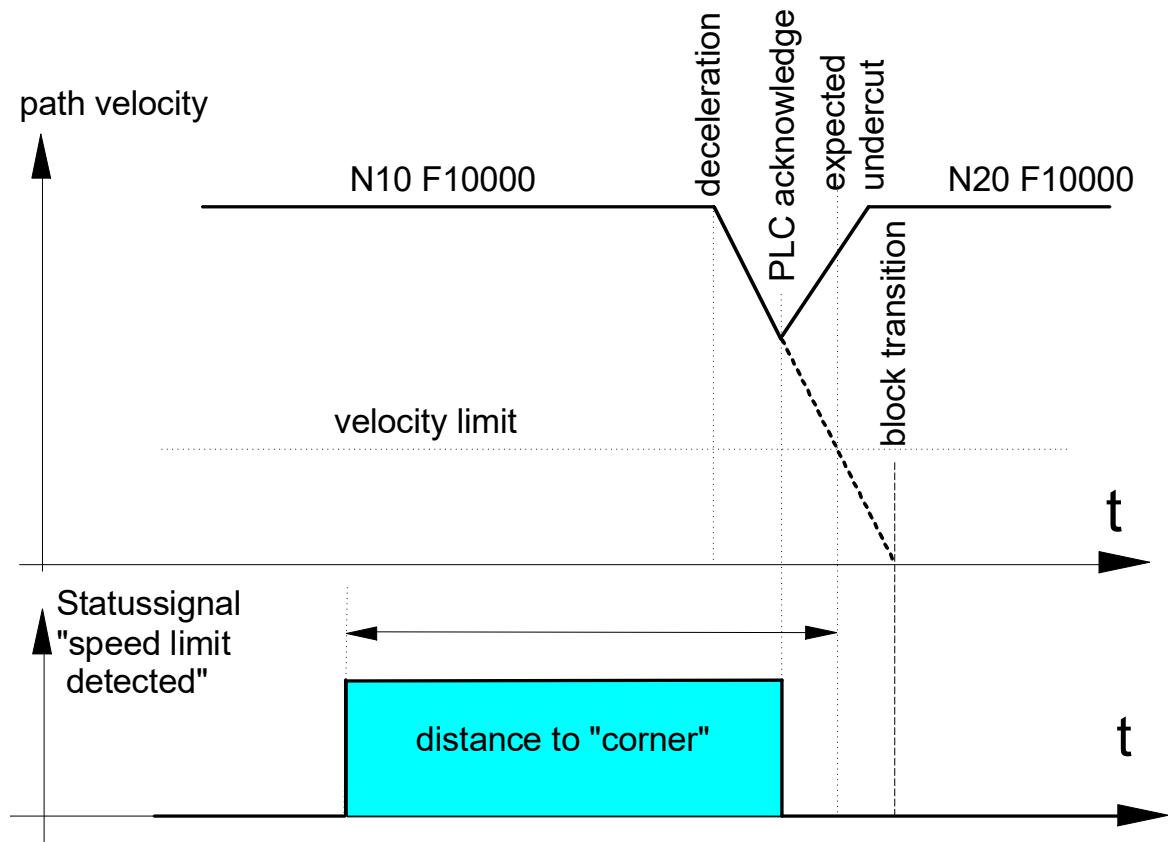**PLC acknowledgement during deceleration**

Fig. 7: A restart after PLC acknowledgement resets the "speed limit detect" status signal.

> **Notice**
>
> 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.
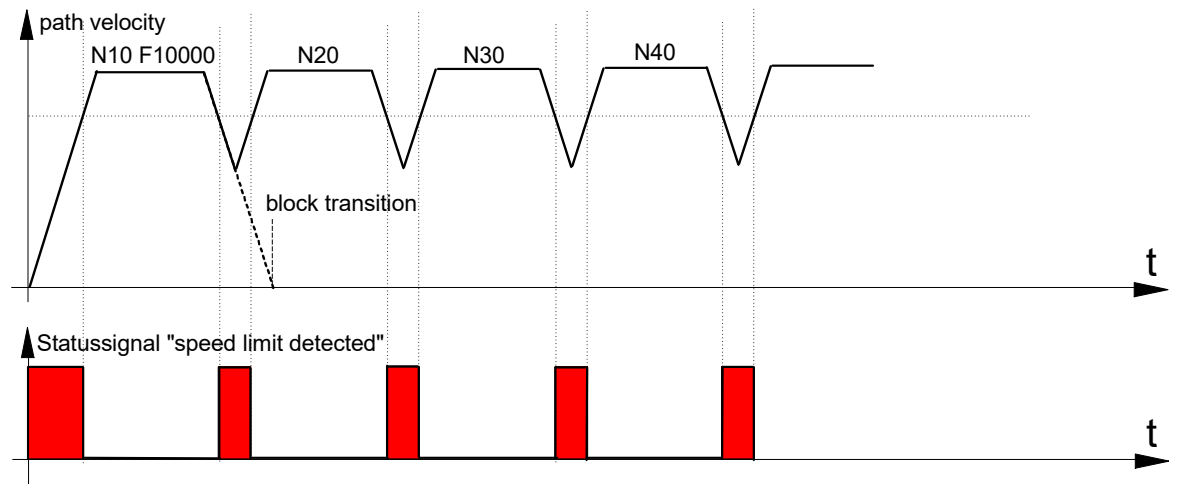

Fig. 8: Inadequate block supply results in the activation of the "speed limit detected" signal.

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
```

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

> **Programing Example**
>
> **"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.
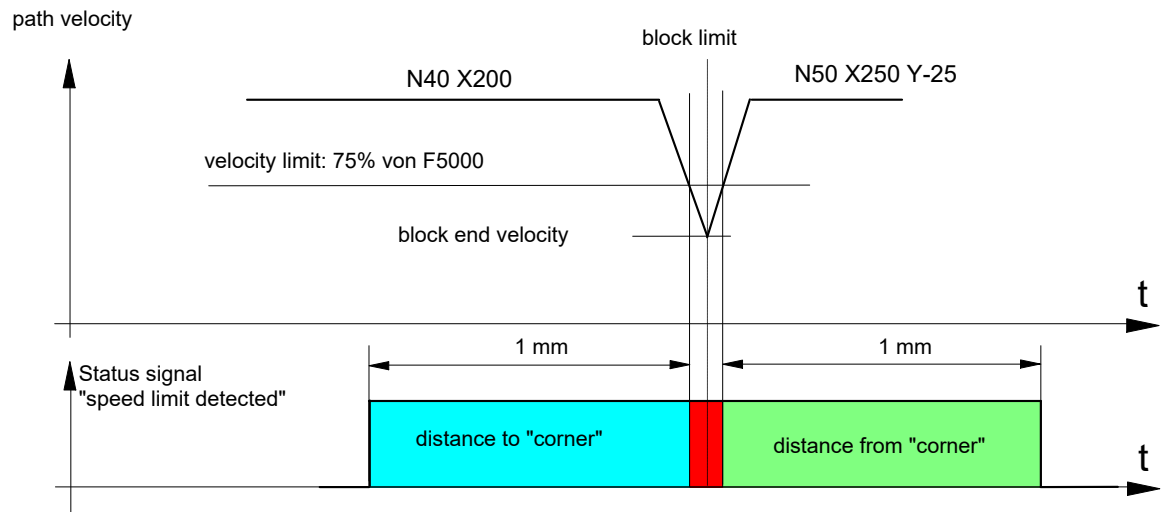
Fig. 9: F word and "speed limit detected" status signal

5 Parameter

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	over-ride_weight_v_limit	Weighting of the velocity limit value by override

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)*

6 Appendix

6.1 Suggestions, corrections and the latest documentation

Did you find any errors? Do you have any suggestions or constructive criticism? Then please contact us at documentation@isg-stuttgart.de. The latest documentation is posted in our Online Help (DE/EN):

QR code link: https://www.isg-stuttgart.de/documentation-kernel/

The link above forwards you to:

https://www.isg-stuttgart.de/fileadmin/kernel/kernel-html/index.html

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Keyword index

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