DOCUMENTATION ISG-kernel

Functional description
Collision avoidance through lift function

Short Description:
FCT-A11

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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

➢ 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

When positioning operations are executed in the XY plane, the Z axis is lifted as far above the workpiece as possible to avoid collision with cut-out parts between cutting operations (G01/G02/G03, M04 laser on, M05 laser off). This is called Smart Collision Guard. The CNC automatically calculates motion of the Z axis between contour elements.

Properties

The user can specify a maximum lifting distance to lift the Z axis. Lifting/lowering is executed automatically and across blocks so that the path feedrate in the XY plane is reduced as little as possible and the Z axis reaches the specified target height at the start of the next machining contour.

The path motion is normally not affected by the lifting/lowering motion, i.e. the Z axis can be attached and detached without feed stop (on the path). The Z axis moves with jerk limiting.

The Smart Collision Guard is available in 2 methods.

- Advanced Lifting
- Lifting

Notice

This document uses the terms lift axis and Z axis synonymously.

Parameterisation

Neither of the two methods is activated in the basic setting.

In order to use the recommended Advanced Lifting method, the start-up list parameters described in the section "Parameterisation" [▸ 9], P-STUP-00060 and P-STUP-00070 are assigned the value **FCT_LIFT_UP_TIME**. In addition, the channel parameter P-CHAN-00345 “enable_time_based_lift“ must be set to 1.

For lifting, the P-STUP-00060 parameter must be assigned the value **FCT_LIFT_UP** . Do not set the channel parameter P-CHAN-00345 "enable_time_based_lift".

Programming

The lift range is defined by the two commands Z[LIFT_START...] and Z[LIFT_END]. The lift axis is automatically moved by the lift function in the intermediate motion blocks.

Notice

This function is an additional option requiring a license.

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

Release Note

This functionality has been available since CNC Build V2.11.2800.

Lifting minimises the risk of tool collisions, e.g. during laser cutting, with workpiece parts that are already cut out.

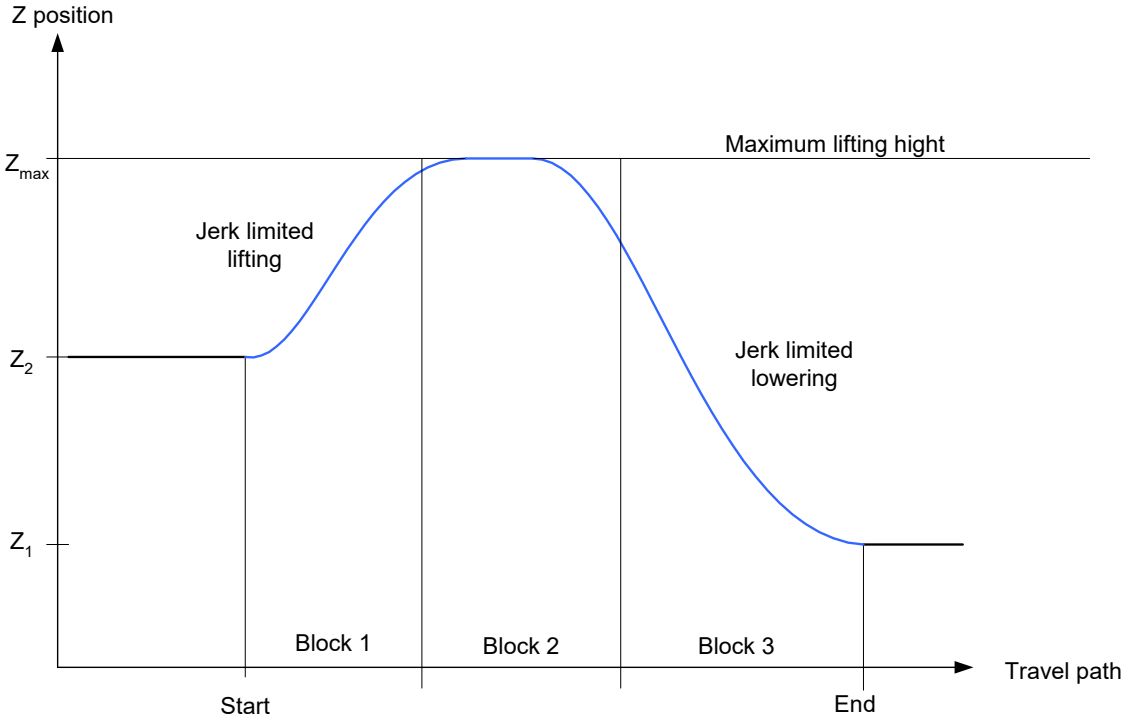

Fig. 1: Description of lifting in 3 NC blocks

A comparison table of the two methods is contained in the section Differences between Advanced Lifting and Lifting. [▸ 20]

2.1 Advanced Lifting

This method is recommended.

Reason:

- Advanced Lifting permits a greater lifting height to be reached.
- It increases collision protection.
- Advanced Lifting has no negative impact on lifting height caused by changes in feed rate or path override.
- Conventional lifting may result in Z axis overload.

Exception: A Type 3 slope is used or less computing time is required for technical reasons.

2.1.1 Advanced Lifting properties

The target position and position limiting are specified at the start of the lifting motion.

If the start or target position of the lift axis is outside the programmed maximum lifting height, the maximum height is increased, e.g. for lifting to the maximum of the start and target positions. Therefore, any Max/Min limiting of the position has no effect.

If a height difference [POS] was programmed for the lifting motion and the lift axis dynamics are not sufficient to reach the required height in the time defined by the path feed rate, the path feed rate is reduced automatically. In extreme cases (e.g. if the motion path = 0), the path axes stop and the lift axis is linearly positioned at the target position.

Waiting conditions (M functions with synchronisation, G04, M00, etc.) are possible during lifting/lowering. With Advanced Lifting the lift axis moves on to target height.

Notice

The Advanced Lifting function requires slope type 'TRAPEZ', [#SLOPE [TYPE=TRAPEZ], (or TYPE=STEP) (or TYPE = SIN²).

HSC (Type 3 slope) is not supported with Advanced Lifting.

Minimum path length

The channel parameter P-CHAN-00244 defines the minimum path length. If the path motion between lift start and lift end is shorter than the minimum path length, the lifting motion is suppressed. The programmed target position of the Z axis is approached directly.

When P-CHAN-00244 = 0 is in the default setting, the lifting motion is always executed irrespective of the real path distance.

2.1.2 Parameterisation

The channel parameter P-CHAN-00345 is switched when it is enabled to Advanced Lifting. These calculations must be carried out in the GEO real-time task of the controller.

To enable this function, the function must also be activated in the controller start-up list in the parameters P-STUP-00060 and P-STUP-00070 by the keyword **FCT_LIFT_UP_TIME**.

Automatic lifting/lowering is currently not included in the basic scope of functions (FCT_DEFAULT) and must therefore always be activated.

Further information on the start-up list parameter P-STUP-00060

The parameter P-STUP-00060 in the start-up list defines the individual functions in the contour planning. As a result, individual functions can be selected for testing, deselected for performance reasons (by not setting them) or activated as a specific function.

For Advanced Lifting the identifier **FCT_LIFT_UP_TIME** must be set.

Example

Advanced Lifting P-STUP-00060

```
configuration.channel[0].path_preparation.function FCT_DEFAULT |
FCT_LIFT_UP_TIME
```

Further information on the start-up list parameter P-STUP-00070

In the start-up list the parameter P-STUP-00070 defines the individual functions of the path interpolator. As a result, individual functions can be selected for testing, deselected for performance reasons (by not setting them) or activated as a specific function.

To activate Advanced Lifting the identifier **FCT_LIFT_UP_TIME** must be set.

Example

Advanced Lifting P-STUP-00070

```
configuration.channel[0].interpolator.function FCT_DEFAULT |
FCT_LIFT_UP_TIME
```

2.1.3 Special cases

Special case 1: POS greater than POS_LIMIT

If the specified lift axis target position is outside the limit, the limit has no effect. This means that the axis is positioned at the target position at the start of the lifting motion and not at the end. This also applies if the start position > limit.

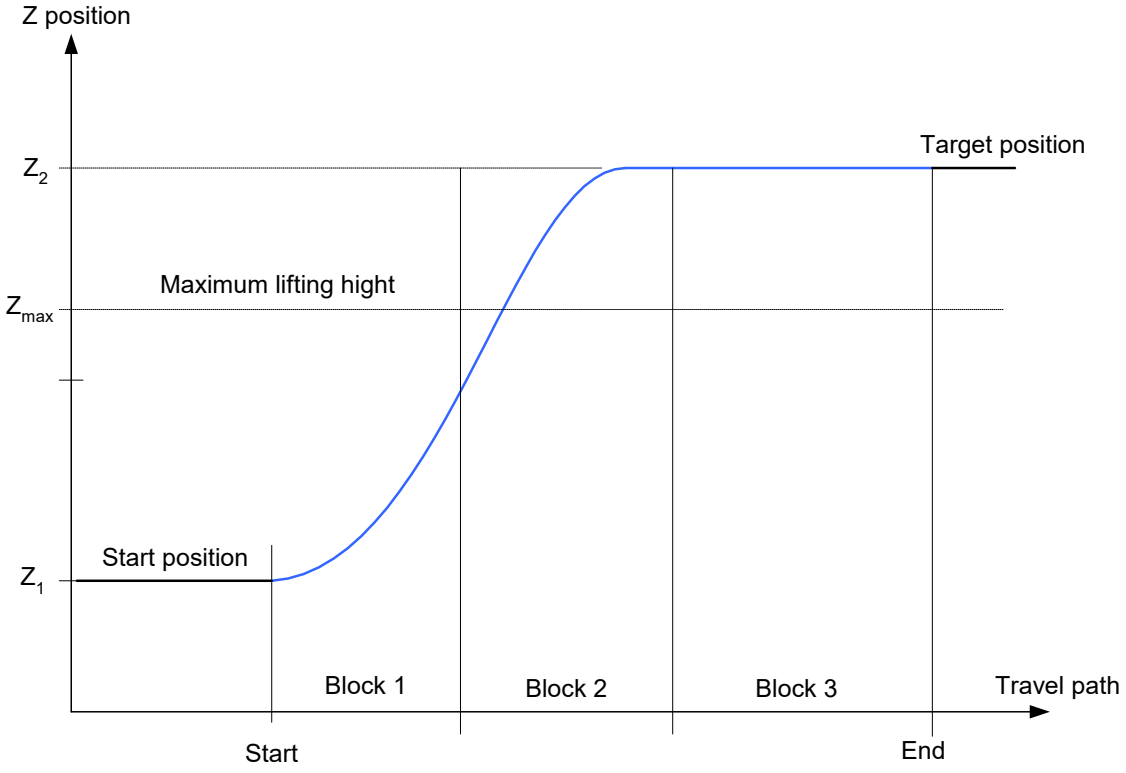

Fig. 2: Target position > limit

Programing Example

POS greater than POS_LIMIT

```
N10 Z10
N20 Z[LIFT_START POS=40 POS_LIMIT=30]
N30 X10
N40 X20
N50 X35
N60 Z[LIFT_END]
```

Special case 2: Syntax error within the lift range

Programming error within START – END

In the event of a syntax error in the NC program, the path motion is always executed up to the last correctly decoded point in the NC program. If the error location lies within a LIFT_START – LIFT_END range, the lift axis is positioned at the maximum lift height at the error location.

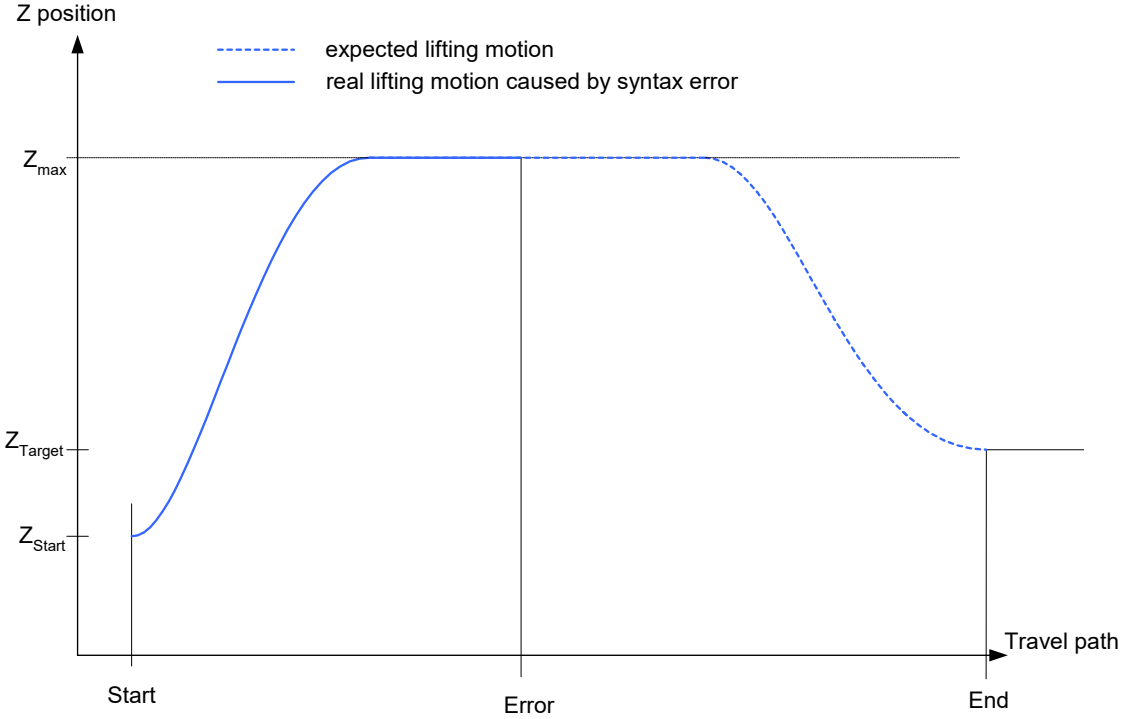

Fig. 3: Premature termination of lifting due to a syntax error

Programing Example

Syntax error within the lift range

```
N10 Z10
N20 Z[LIFT_START POS_LIMIT=30]
N30 X10
N40 X20
N50 X35
...
N100 syntax error
...
N560 X50
N570 X60
N580 X100
N600 Z[LIFT_END]
```

Special case 3: #FLUSH, #FLUSH WAIT

Flushing the channel (#FLUSH, #FLUSH WAIT) may mean that the path must be stopped if the lift axis is unable to reach the lift position in time. Otherwise, #FLUSH WAIT has no effect on the lifting profile.

2.2 Lifting

This method is only recommended if Advanced Lifting is not possible for technical reasons.

Normally, the lift axis motion is planned as an independent motion in path preparation and is then coupled to the motion of the main axes.

2.2.1 Lifting properties

The lifting motion is coupled to the path motion in this method. i.e. if the velocity of the path is changed, the LIFT motion changes to the same extent. Therefore, the same position of the path axes is identical to the position of the lift axis, regardless of the current velocity. This means that If the path motion is stopped (feed hold) or decelerated (override), the motion of the lift axis stops accordingly.

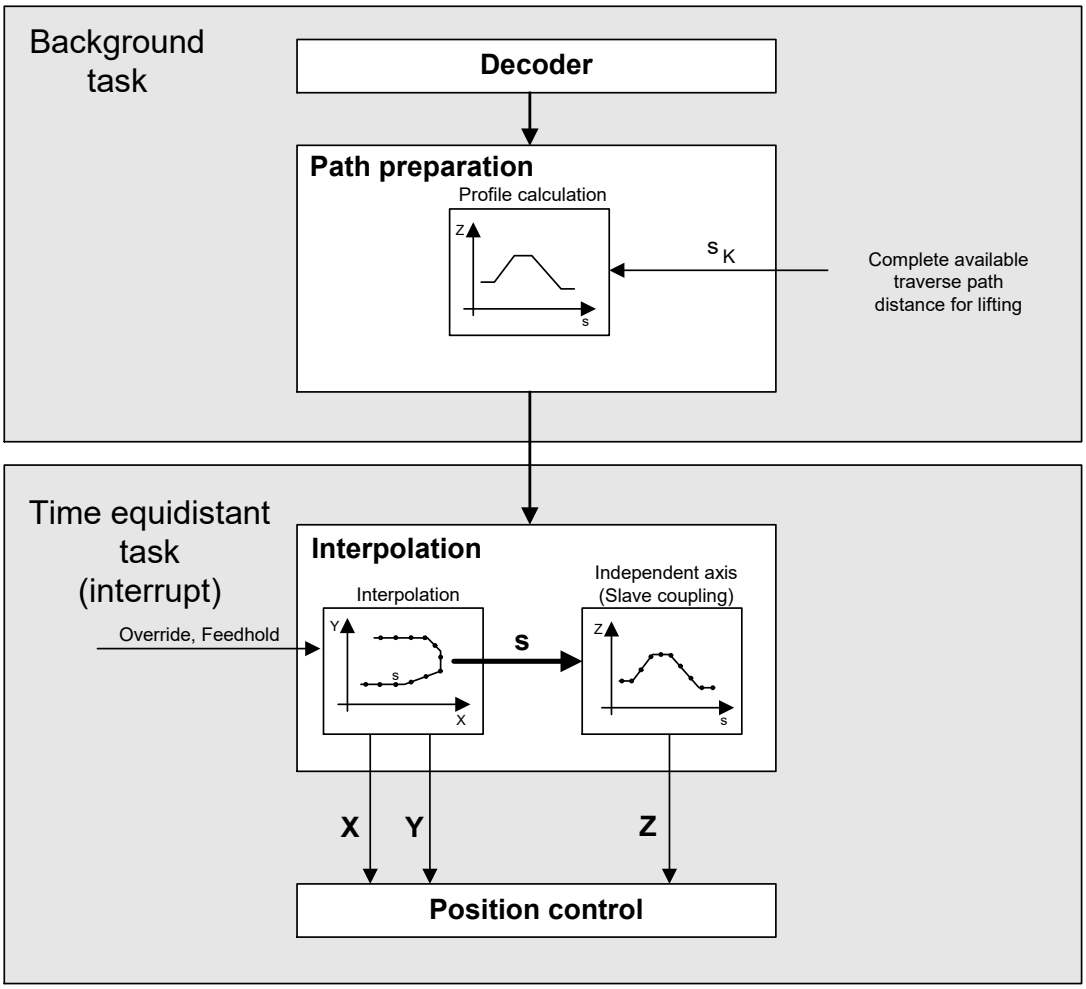

Fig. 4: Structure of planning and executing the LIFT motion

Within the LIFT range, the permitted acceleration on the path is defined so that the maximum permitted acceleration of the lift axis is not exceeded.

Waiting conditions (M functions with synchronisation, G04, M00, etc.) are possible during lifting/lowering. During the lifting motion, waiting conditions therefore lead to an interruption of the path and also of the lifting motion.

In the case of strongly bent curves (spline or polynomial contouring) or kinematic transformations, the original blocks can be further subdivided to improve planning the dynamics. This may lead to an increased number of blocks.

If there is an insufficient number of blocks (Look Ahead range)

- due to the large number of motion blocks of the path axes or
- due to the large number of technology functions (M functions),

premature lowering is avoided. Internally, a LIFT_END is added to the programmed height and a LIFT_START is then added.

At present, a maximum number of 20 CNC internal blocks (Look Ahead range) is considered between the lifting motion (START) and the lowering motion (END). A programmed motion block (G0, G1, G2, G3) normally generates an internal CNC block. Smoothing methods generate additional internal blocks.

Planning the dynamics

The lifting motion is planned so that, at constant path velocity, the lift axis is lifted and lowered again with jerk limiting at its maximum acceleration.

If the path feed rate is changed during the lifting motion (feed hold, override, etc.), this leads to additional acceleration of the lift axis. As a result, lift axis acceleration may briefly exceed its maximum limit. However, the overall acceleration due to the feed rate change on the path and the lifting motion itself always remain within the specified overload range. Therefore, the following applies to the axis:

$$|a_{active}| < a_{max} * \text{overloadfactor}$$

where

$$overloadfactor = \frac{dyn\_monitor\_a\_err}{1000} = \frac{P - AXIS - 00442}{1000}$$

Notice

Planning lift axis dynamics requires slope type 'TRAPEZ' ([#SLOPE [...]). Slope type STEP may result in Z axis overload.

Path smoothing and lifting

The LIFT function can be programmed if a smoothing method was previously activated (1st case). The LIFT axis has velocity = 0 at the start and end of the lifting motion. Therefore, smoothing is temporarily suppressed at these points.

Exception: With CONTOUR MODE (G61, G261) the lift axis in the block does not move before lifting or directly after lifting (2nd case).

1st case: Lift axis motion before/after lifting

If the lift axis is moved before lift start (block N10) or directly after lift end (block N20), the contouring of all axes at the start or end of lifting is briefly suppressed.

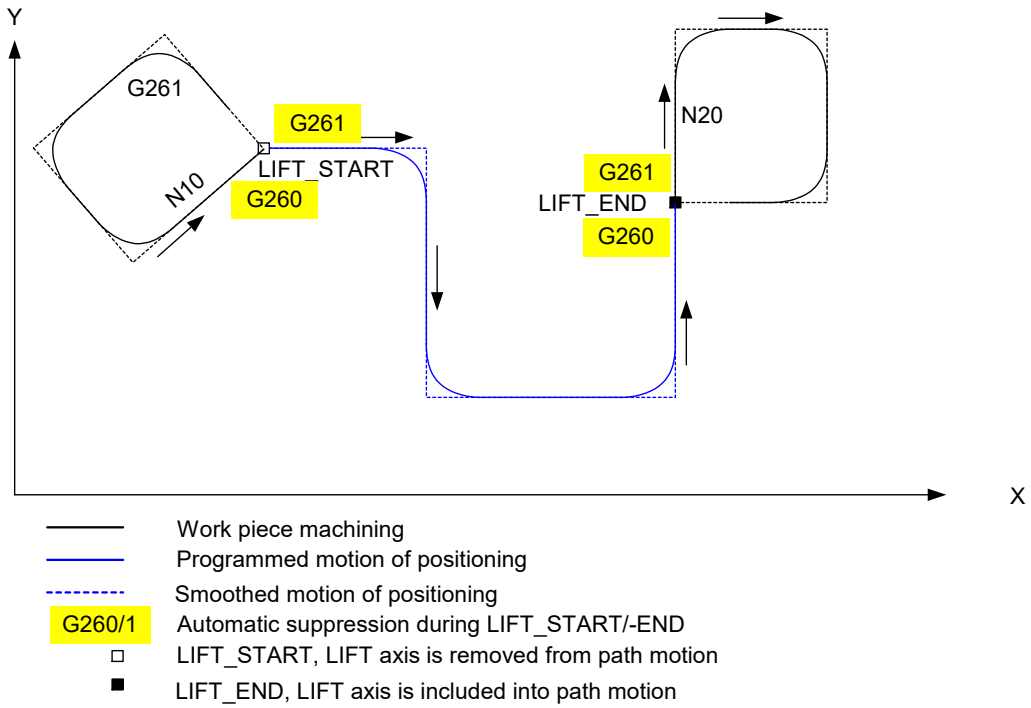

Fig. 5: Contour smoothing with automatic activation/deactivation at LIFT start/end

2nd case: No lift axis motion before/after lifting

The other axes can be smoothed if the lift axis is not moved before lift start (block N10) or directly after lift end (block N20).

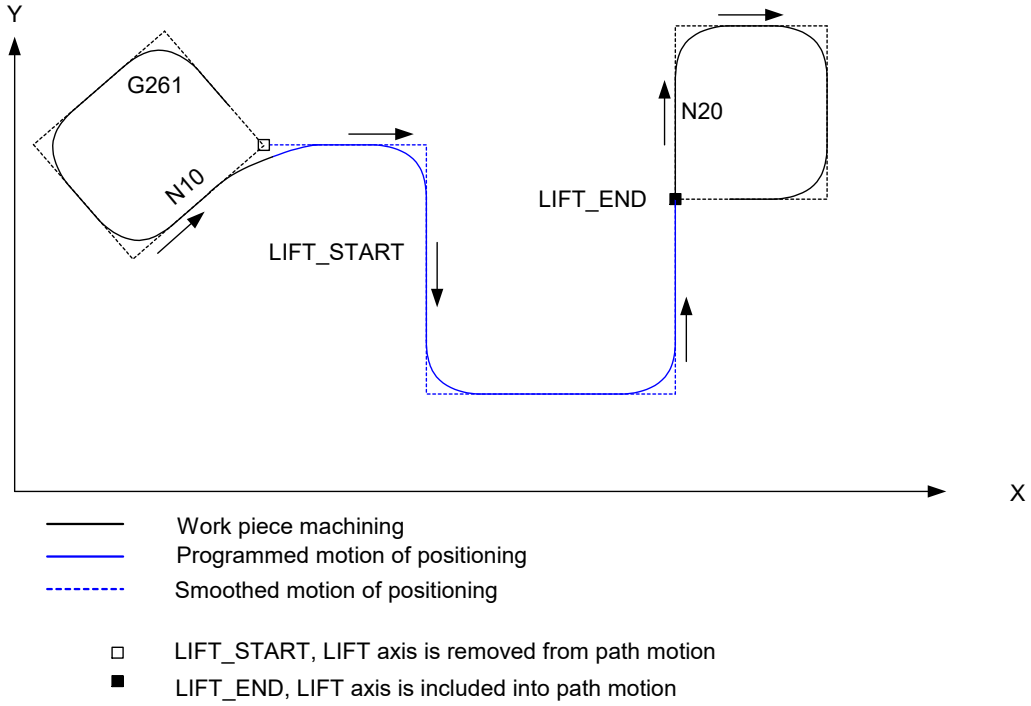

Fig. 6: Contour smoothing without lift axis movement before/after lifting

Notice

Smoothing methods may not be additionally selected or deselected between LIFT_START and LIFT_END.

2.2.2 Parameterisation

To activate lifting, the parameter P-STUP-00060 must be assigned the value **FCT_LIFT_UP** .

Example

Lifting

```
configuration.channel[0].path_preparation.function FCT_DEFAULT |
FCT_LIFT_UP
```

2.2.3 Special cases

Special case 1: Look Ahead range overflow

Large number of blocks between START – END

The Look Ahead range comprises a maximum of 20 NC blocks. Lifting is executed prematurely if the range of the motion path (Look Ahead range) considered during lifting is fully occupied due to a large number of blocks. In this case, the axis is first lifted to the specified maximum height and lowered shortly before END (see blue curve in the figure)..

Premature lifting can lead to a situation where less motion path is available for the lifting motion than the user actually assumes. As a result, path velocity may be reduced in order to execute the lifting motion and re-engagement.

Conclusion: A high number of blocks between lift start and end leads to premature lifting of the lift axis and to a possible deceleration of the path motion. For this reason Advanced Lifting is recommended.

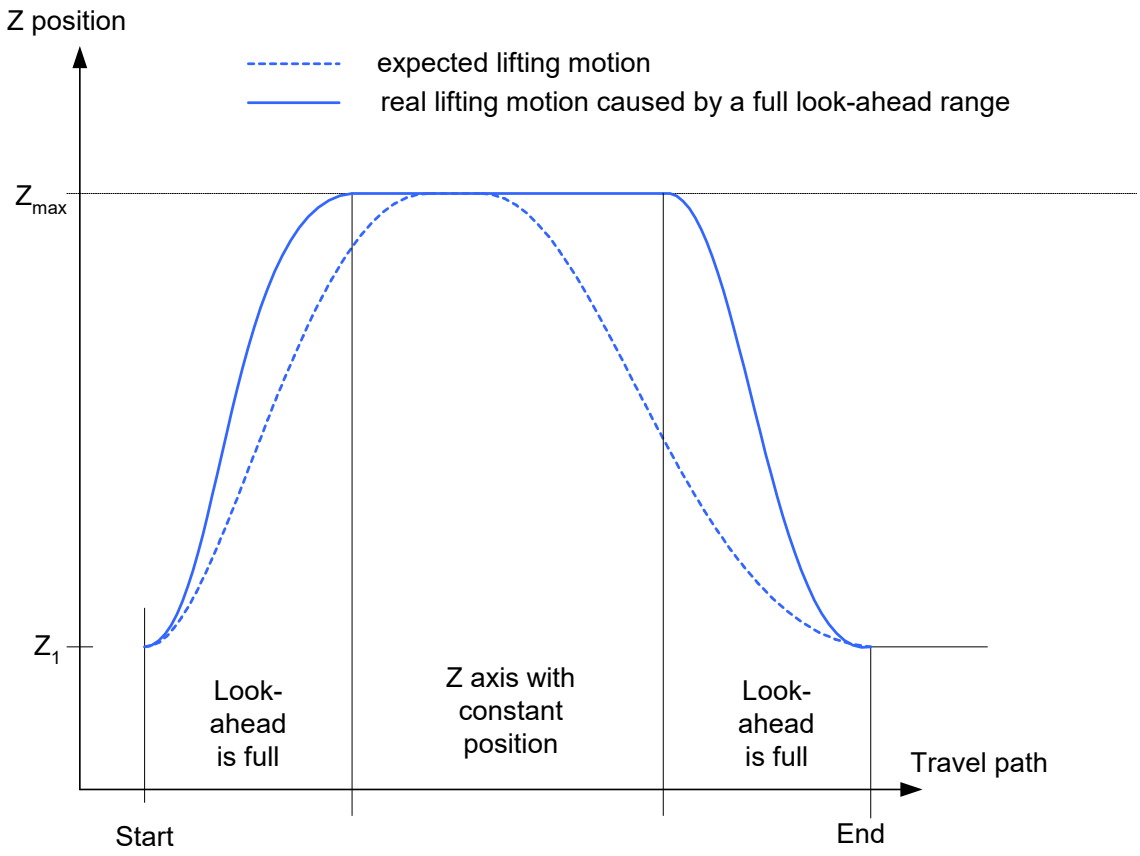

Fig. 7: Diagram of Look Ahead range overflow

Programing Example

Look Ahead range overflow

```
N10 Z10
N20 Z[LIFT_START POS_LIMIT=30]
N30 X10
N40 X20
N50 X35
...
N550 X31
N560 X32
N570 X33
N580 X34
N600 Z[LIFT_END]
```

Special case 2: Lifting and explicit flushing of the channel

LIFT and flushing the channel (#FLUSH)

During lifting, the motion blocks are first stored to enable calculation of the optimum lifting motion from LIFT start to end. With various NC commands, however, immediate execution is necessary and this is achieved implicitly by "flushing the channel".

If channel output of the NC blocks is compelled during lifting (e.g. NC command #FLUSH), the LIFT motion is executed as if LIFT_END and again LIFT_START were programmed at this point.

Programing Example

Lifting and explicit flushing of the channel

```
N20 X40 Z2
N30 Z[LIFT_START POS=12 POS_LIMIT=40]
N40 X50
N50 X40
N60 #FLUSH
N70 X30
N80 X20
N90 Z[LIFT_END]
```

Operating principle of #FLUSH with comparable programming

```
N20 X40 Z2
N30 Z[LIFT_START POS=40 POS_LIMIT=40]
N40 X50
N50 X40
N60 Z[LIFT_END]
N60 Z[LIFT_START POS=12 POS_LIMIT=40]
N70 X30
N80 X20
N90 Z[LIFT_END]
```

2.3 Permitted functions

Permitted CNC functions that may be active when lifting is selected:

- #ROTATION ON and #CS ON: but only if the lift axis is not affected by the rotation. When the Z axis is lifted, only one coordinate system rotation about the Z axis is permitted. Otherwise, the decoder outputs the error P-ERR-21071. If #ROTATION ON/OFF is programmed within the lift range, the path preparation application outputs the error P-ERR-120606
- #TRAFO ON: If #TRAFO ON/OFF is programmed within the lift range, BAVO outputs the error P-ERR-120606.

2.4 Limitations and error response

The following limitations apply both to Lifting and Advanced Lifting.

If a programming error occurs during the lifting motion, the lifting motion is executed up to the error location and the axis stops at the specified maximum lifting height (POS_LIMIT).

If the end of the program is reached during the lifting motion without a prior, explicit LIFT_END, the lifting motion is executed as if LIFT_END was programmed at the end of the program.

Limitations during the lifting motion for both methods:

- The axis affected by lifting may not be programmed.
- Flushing the channel (#FLUSH, #FLUSH WAIT) interrupts the current lifting motion (this corresponds to implicit programming of LIFT_END followed by LIFT_START). The programmed target position of the lift axis is reached for a short time in the block in which #FLUSH was programmed.
- Channel-internal axis swapping is basically possible but the lift axis must not be affected by axis swapping. Additional path smoothing of the LIFT axis (contouring, G61/G261, G151, #SPLINE ON, #HSC ON) is not possible in the lifting range.
- During the lifting motion, tool radius compensation of the LIFT axis is not permitted, i.e. the LIFT axis may not be involved in tool radius compensation.

Limitations during the lifting motion in addition to conventional lifting:

- Path smoothing functions are temporarily suppressed at the start and end of the lifting motion. With Advanced Lifting path smoothing methods are suppressed if the lift axis is programmed directly before LIFT_START or directly after LIFT_END.
- Axis swapping leads to the end of the lifting motion.

2.5 Differences between Advanced Lifting and Lifting

Basically Advanced Lifting is recommended. It is independent of the path motion and a greater lifting height is reached. In exceptional cases it may be necessary to apply conventional lifting.

The table below provides a short comparison:

	1. Advanced Lifting	2. Lifting
Maximum lifting height (is reached faster)	high	medium
Collision protection	high	lower
Computing time (real-time task)	high	very low
Path override changes	Limited increase possible	Z axis overload (=lift axis) possible
Feed rate change	No limitation	Z axis overload (=lift axis) possible
HSC slope (Type 3)	not possible	can call an implicitly called subroutine at program end.
Maximum lift profile length	unlimited	Number of NC blocks is limited

With Advanced Lifting profile planning must be executed in the real-time task of the controller This method therefore requires much more real-time computing time than the lifting method calculated in the path preparation task.

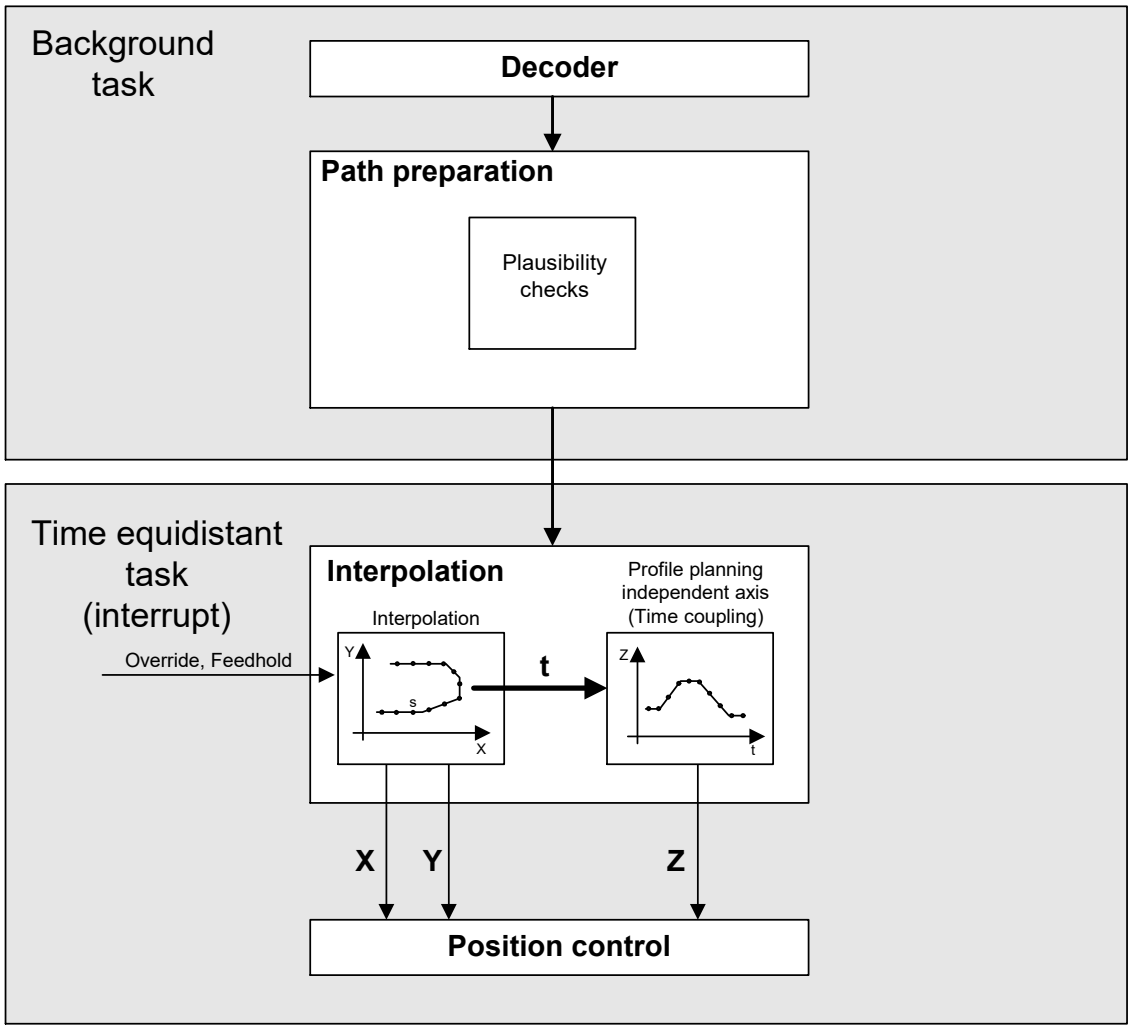

Fig. 8: Structure of the planning and processing of the lifting motion with time-based coupling

Compared with Lifting, Advanced Lifting achieves greater lifting heights:

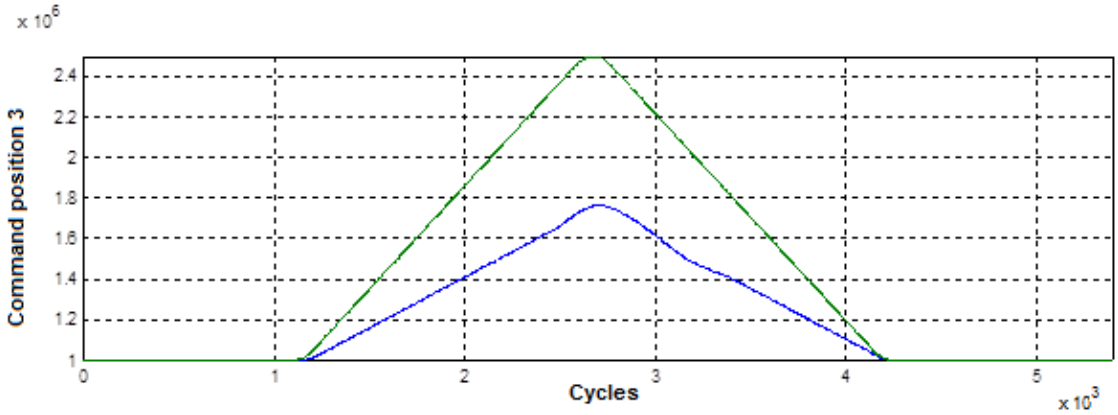

Fig. 9: Comparison of lifting heights reachable with Advanced Lifting (green curve) vs Lifting (blue curve)

In the lowering motion the path velocity override is limited to the value which was active at the start of the lowering motion.

In the upward motion of the lift axis a higher path override may no longer be accepted, otherwise the lift axis would not be able to reach the target position at the end of the lowering motion any more.

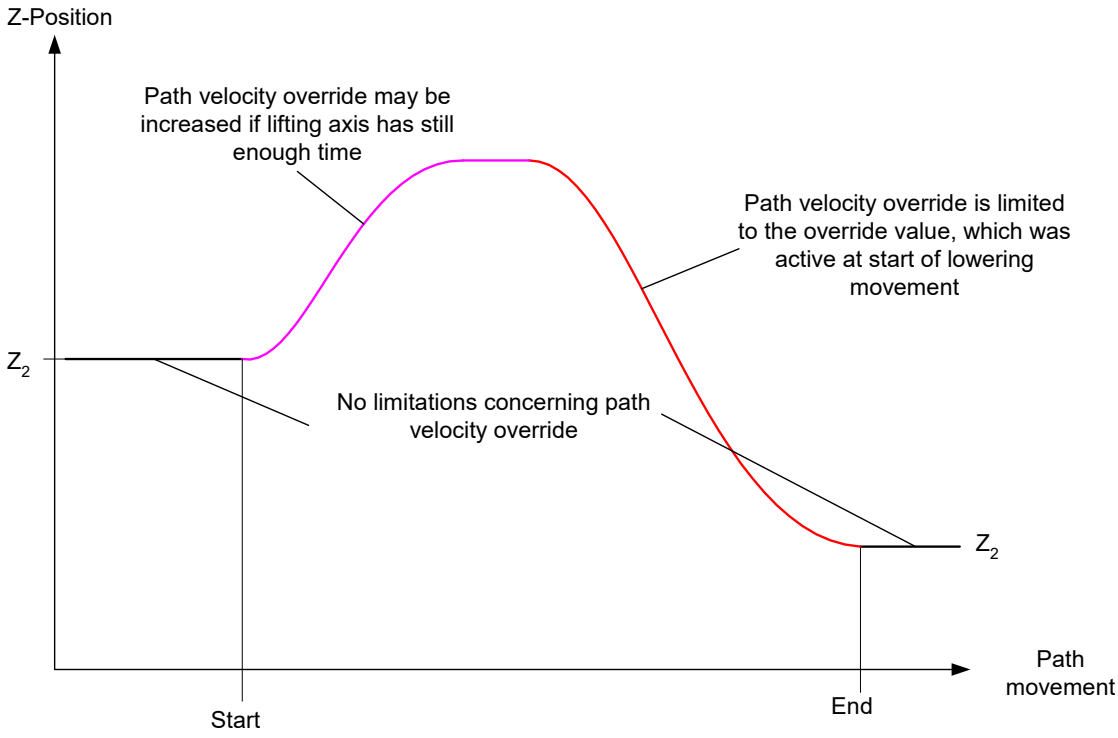

Fig. 10: Path velocity override with Advanced Lifting

2.6 Display data - status display

As of CNC Build V2.11.2810.01 it is possible to display the status of the lift function.

This is possible via CNC objects as well as via the HLI. The following data is available:

- HLI:
  - lift_active [▸ 33]
  - lift_suppressed [▸ 33]
- or as associated CNC objects
  - lift_active [▸ 32]
  - lift_suppressed [▸ 32]

A distinction is made between the status "Lift function is active" and the status "Lift movement is suppressed". Suppression of the lift movement always occurs when the programmed minimum path distance P-CHAN-00244 [▸ 31] is not reached. An active lift function is associated with execution of a lift movement.

Advanced Lifting is a special case where both the status for an active lift function and the status for suppressing a lift movement are set at the same time.

This case occurs when the actual lifting of the axis is suppressed because the path distance is too small, but at the same time a target position of the Z axis is programmed. To reach the target position, the lift function is still active in the background.

3 Programming

Cross-block lifting/lowering

Programming is based on the syntax for independent axes. The corresponding parameters can be programmed at the start of lifting/lowering. These are non-modal parameters, i.e. if required they are reset for every start.

`Syntax:`

<axis_name> **[LIFT_START** [**DOWN**] [**G90** | **G91**] [**POS**=..] **POS_LIMIT**=.. **]**

<axis_name>	Lift axis name
LIFT_START	Identifier for the start of the (cross-block) independent lifting motion of the axis. Must always be programmed as the first keyword.
DOWN	The axis motion direction can be inverted via DOWN, i.e. the motion is in the direction of the negative software limit switch. If nothing is specified, the default direction is in the direction of the positive software limit switch.
G90 / G91	Absolute/relative dimension; the default dimension is G90. G91 is non-modal and is only active for the lifting/lowering motion.
POS=..	Target position of the lift axis after the lifting motion in [mm, inch]. The current command position of the axis (see V.A.ABS.*<axis name>*) is the default.
POS_LIMIT=..	Maximum lifting height or lowering depth in [mm, inch]

`Syntax:`

<axis_name> **[LIFT_END]**

<axis_name>	Lift axis name
LIFT_END	Identifier for the end of the (cross-block) independent lifting motion of the axis.

Programing Example

Cross-block lifting/lowering

```
N10 X10 Y20 Z30     ;Cut with laser
N20 M5              ;Laser off
N30 Z[LIFT_START POS=12 POS_LIMIT=100]     ;Lift Z axis
N30 G01 X.. Y..
N40 G02 X.. Y..
N50 G03 X.. Y..
N60 G01 X.. Y..
N70 Z[LIFT_END]     ;Absolutely lower Z axis to target 12 mm
N80 M4              ;Laser on
N90 X20 Y20 ...

N10 X10 Y20 Z30
N30 Z[LIFT_START POS=12 POS_LIMIT=100] ;Lift Z axis
N40 G01 X.. Y..
N50 G01 X.. Y..
N60 Z[LIFT_END]     ;Absolutely lower Z axis to target 12 mm
N70 X100

alternative programming
N110 X10 Y20 Z30
N140 G01 X.. Y.. Z[LIFT_START POS=12 POS_LIMIT=100]
N150 G01 X.. Y.. Z[LIFT_END]
N170 X100
```

Lifting/lowering in an NC block

Programming is based on the syntax for independent axes. The corresponding parameters can be programmed at the start of lifting/lowering. These are non-modal parameters, i.e. if required they are reset for every start.

Syntax:

<axis:name> **[LIFT** [**DOWN**] [**G90** | **G91**] [**POS**=..] **POS_LIMIT**=.. **]**

<axis_name>	Lift axis name
LIFT	Identifier for the start and end of the independent lifting motion of the axis in the current NC block Must always be programmed as the first keyword.
DOWN	The axis motion direction can be inverted via DOWN, i.e. the motion is in the direction of the negative software limit switch. If nothing is specified, the default direction is in the direction of the positive software limit switch (option not available as at 10/2011).
G90 / G91	Absolute/relative dimension. The default dimension is G90. G91 is non-modal and is only active for the lifting/lowering motion.
POS=..	Target position of the lift axis after the lifting motion in [mm, inch]. The current command position of the axis (see V.A.ABS.*<axis name>*) is the default.
POS_LIMIT=..	Maximum lifting height or lowering depth in [mm, inch]

Programing Example

Lifting/lowering in an NC block

```
; single-row programming
N200 Z40
N240 X10 Y.. Z[LIFT POS=30 POS_LIMIT=300]
N250 X20 Y.. Z[LIFT POS=20 POS_LIMIT=300]
N260 X30 Y.. Z[LIFT POS=25 POS_LIMIT=300]
N270 X.. Y.. Z[LIFT POS=30 POS_LIMIT=300]
N280 X.. Y.. Z[LIFT POS=30 POS_LIMIT=300]
```

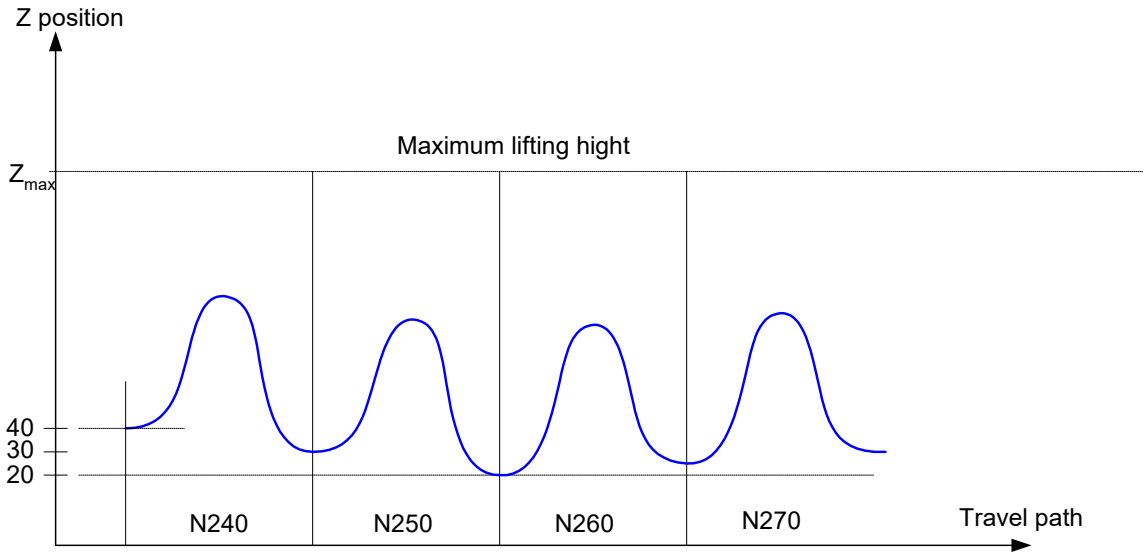

Fig. 11: Single-row lifting

Status query: Lifting/lowering active

In the NC program, the V.G. variable…

V.G.LIFT_ACTIVE

… of the Boolean type can determine whether lifting/lowering is active.

4 Parameter

4.1 Overview

ID	Parameter	Description
P-STUP-00060	function	Define functionalities in path preparation
P-STUP-00070	function	Define functionalities for decoding
P-CHAN-00244	lift_min_dist	Minimum path length for lifting motion
P-CHAN-00345	enable_time_based_lift	Switch to time-based approach for automatic lifting/lowering of an axis.
P-AXIS-00441	dyn_monitor-ing_a_warn	Output a warning in the event of a percentage excess in maximum axis acceleration Not necessary for Lifting (only for Advanced Lifting).
P-AXIS-00442	dyn_monitoring_a_err	Output an error message in the event of a percentage excess in maximum axis acceleration This maximum value is used to plan lift acceleration. This means that the following applies to the axis: $a_{act,Lift} \Leftarrow a_{max,Lift} = a_{max} * \frac{dyn\_monitor\_a\_err}{1000}$ Not necessary for Lifting (only for Advanced Lifting).

4.2 Description

4.2.1 Activate lift function

P-STUP-00060	**Defining functionalities for path preparation.**
Description	This parameter defines the individual functionalities for path preparation. The individual functions can be enabled or disabled for testing or for performance reasons.
Parameter	configuration.channel[i].path_preparation.function
Data type	STRING
Data range	See Activate lift function [▸ 27]
Dimension	----
Default value	FCT_DEFAULT
Remarks	

Path preparation function table

Flag	Description
FCT_DEFAULT	The functions FCT_FFM | FCT_PRESEGMENTATION | FCT_SPLINE | FCT_POLY | FCT_CAX | FCT_CAX_TRACK | FCT_SEGMENTATION are available.
FCT_FFM	Free-form surface mode, #HSC [OPMODE 1 CONTERR 0.01], #HSC [OP-MODE 2]
FCT_PRESEGMENTATION	Linear pre-segmentation in HSC mode
FCT_SPLINE	#HSC[], AKIMA, B-Spline, G150/G151
FCT_POLY	#CONTOUR MODE[], G61, G261/G260
FCT_CAX	C axis processing, i.e. the spindle is embedded in the NC channel.
FCT_CAX_TRACK	#CAX TRACK, tracking an axis according to the contour angle
FCT_SEGMENTATION	For dynamic segmentation of the path contour, e.g. if the curvature of a polynomial segment varies significantly.

The following functions must also be enabled:	
FCT_LIFT_UP	Automatic lifting/lowering of an axis (path-based coupling). Example: FCT_DEFAULT | FCT_LIFT_UP
FCT_EMF	Edge machining (sharp angle contours). Example: FCT_DEFAULT | FCT_EMF
FCT_EMF_POLY_OFF	Edge machining inactive with polynomials. Contrary to the setting with FCT_EMF, edge signal generation is masked when path polynomial generation is active in the channel. Polynomials are generated for smoothing G261 or when B Spline is active. The resulting geometry is then tangential. Example: FCT_DEFAULT | FCT_EMF_POLY_OFF
FCT_SYNC	Synchronisation of an axis on a path group. Example: FCT_DEFAULT | FCT_SYNC
FCT_PRECON	Optimised planning using #HSC[BSPLINE]. Example: FCT_DEFAULT | FCT_PRECON
FCT_LIFT_UP_TIME	Automatic lifting/lowering of an axis (time-based coupling). Example: FCT_DEFAULT | FCT_LIFT_UP_TIME
FCT_PTP	Dynamically optimised contouring of the complete contour. Example: FCT_DEFAULT | FCT_PTP
FCT_M_PRE_OUTPUT	Pre-output of M/H functions (microjoints). Example: FCT_DEFAULT | FCT_M_PRE_OUTPUT
FCT_SURFACE	HSC machining with Surface Optimiser Example: FCT_DEFAULT | FCT_SURFACE
FCT_SEG_CHECK	Block segmentation in combination with path-controlled offset of M functions (dwell time), see P-CHAN-00650 and Activate lift function [▸ 27] Example: FCT_DEFAULT | FCT_SEG_CHECK
FCT_NIBBLING	Activate the nibbling function Example: FCT_DEFAULT | FCT_NIBBLING
FCT_PUNCHING	Activate the punching function Example: FCT_DEFAULT | FCT_PUNCHING
FCT_VSM	Activate the velocity smoothing function Example: FCT_DEFAULT | FCT_VSM as of V3.1.3079.21

P-STUP-00070	**Definition of interpolator functionalities**
Description	This parameter defines individual functionalities and the size of the look-ahead buffer in the interpolator, i.e. it defines the number of blocks to calculate deceleration distance and dynamic planning.
Parameter	configuration.channel[i].interpolator.function
Data type	STRING
Data range	See Activate lift function [▸ 30].
Dimension	----
Default value	FCT_IPO_DEFAULT
Remarks	

Interpolation function table

Identifier	Description
FCT_IPO_DEFAULT	FCT_LOOK_AHEAD_STANDARD
FCT_LOOK_AHEAD_LOW	30 blocks
FCT_LOOK_AHEAD_STANDARD	120 blocks
FCT_LOOK_AHEAD_HIGH	190 blocks
FCT_LOOK_AHEAD_CUSTOM	Any number of look-ahead blocks in the interval [0; 200]. Specification by parameter P-CHAN-00653.
FCT_SYNC	Synchronisation of an axis on a path group. Example: FCT_IPO_DEFAULT | FCT_SYNC
FCT_LOOK_AHEAD_OPT	The path velocity curve can be further improved for HSC machining by additional calculations. This generally reduces machining time. The additional calculations place greater demands on the controller hardware.
FCT_LIFT_UP_TIME	Automatic lifting/lowering of an axis (time-based coupling). Example: FCT_IPO_DEFAULT | FCT_LIFT_UP_TIME
FCT_SHIFT_NCBL	Path-controlled offset of M functions (dwell time). Example: FCT_IPO_DEFAULT | FCT_SHIFT_NCBL
FCT_CALC_STATE_AT_T	Calculation of path velocity at a time in the future. Function only available in combination with HSC slope and only as of V3.1.3057.0 Example: FCT_IPO_DEFAULT | FCT_CALC_STATE_AT_T
FCT_CALC_TIME	Calculation of interpolation time to next feed block (G01,G02,G03). Example: FCT_IPO_DEFAULT | FCT_CALC_TIME
FCT_CONTOUR_LAH	Contour look-ahead: advance output of motion blocks to the PLC as of V3.1.3104.07
FCT_DYN_POS_LIMIT	Dynamic limitation of axis positions

The look-ahead buffer size specified above applies as of CNC Build V2.11.2800 and higher. The following values apply as of CNC Build V2.11.20xx:

FCT_LOOK_AHEAD_LOW	30 blocks
FCT_LOOK_AHEAD_STANDARD	70 blocks
FCT_LOOK_AHEAD_HIGH	120 blocks

4.2.2 Parameters for the Lift function

P-CHAN-00244	**Minimum path length for lift movements**
Description	This parameter defines a minimum path distance for lift movement. If the main axis motion is shorter than the parameter value, no lift movement is executed.
Parameter	lift_min_dist
Data type	UNS32
Data range	0: Inactive (default). 1: Lift movements are suppressed if the main path motion is below the limit value.
Dimension	0.1µm
Default value	0
Remarks	

P-CHAN-00345	**Switch-over to time-based calculation when an axis is lifted**
Description	When an axis is lifted (see [FCT-A11 [▸ 5]]), it can be lifted or lowered automatically independent of the path motion. The CNC limits the maximum lift height so that the axis can reach the target point of the lowering movement and not influence the path motion. Normally this takes place during path preparation with a path-based coupling of the axis to the main motion path. Instead the 'enable_time_base_lift' parameter can enable a time-based consideration in the real-time GEO task of the controller. As a result, greater lifting height can be reached afterwards. However, time-based coupling requires considerably more computing power in the real-time task of the controller. The HSC slope profile and the time-based approach cannot be used at the same time.
Parameter	enable_time_based_lift
Data type	BOOLEAN
Data range	0: Path-based approach (default). 1: Time-based approach.
Dimension	----
Default value	0

Remarks	The time-based approach must also be included in the configuration data of the path preparation and interpolation function in the controller. Here, set the key word FCT_LIFT_UP_TIME in the parameters P-CHAN-00600 and P-CHAN-00650 (alternatively: P-STUP-00060 and P-STUP-00070).
	
	Parameterisation example with P-CHAN-00600 / P-CHAN-00650
	`configuration.path_preparation.function FCT_DEFAULT | FCT_LIFT_UP_TIME`
	`.interpolator.function`
	`FCT_DEFAULT | FCT_LIFT_UP_TIME`
	
	Alternatively, the function can be parameterised in the start-up list (P-STUP-00060 / P-STUP-00070).
	Example of the 1st CNC channel:
	`configuration.channel[0].path_preparation.function.`
	`FCT_DEFAULT | FCT_LIFT_UP_TIME`
	`configuration.channel[0].interpolator.function.`
	`FCT_DEFAULT | FCT_LIFT_UP_TIME`

4.2.3 CNC objects

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

Name	lift_active		
Description	This object checks the status of the lift function. It signals whether the lift function is activated.		
Task	GEO (Port 551)		
Index group	0x12130<C_{ID}>	**Index offset**	0x<A_{ID}>0095
Data type	BOOLEAN	**Length**	1
Attributes	read	**Unit**	-
Remarks			

Name	lift_suppressed		
Description	This object indicates whether a lift movement is suppressed. This is always the case when the programmed minimum path distance P-CHAN-00244 [▸ 31] is not reached.		
Task	GEO (Port 551)		
Index group	0x12130<C_{ID}>	**Index offset**	0x<A_{ID}>0094
Data type	BOOLEAN	**Length**	1
Attributes	read	**Unit**	-
Remarks	The following special case of the status display occurs when you use Advanced Lifting. If the lift movement is suppressed due to insufficient travel distance and a target position of the Z axis is programmed at the same time, the lift function is active in order to be able to approach the target position of the Z-axis. In this case, the status of the lift function lift_active [▸ 32] = TRUE and lift_suppressed= TRUE are displayed simultaneously.		

4.2.4 HLI parameters

Lift function is active	
Description	This data item indicates whether a lift function is active or not. An active lift function is associated with execution of a lift movement.
Signal flow	CNC->PLC
ST path	gpAx[axis_idx]^.ipo_state.**lift_active**
Data type	BOOL
Value range	TRUE = Lift function is active FALSE = Lift function is not active
Access	PLC is reading

Lift movement is suppressed	
Description	This data item indicates whether a lift movement is suppressed. This is always the case when the programmed minimum path distance P-CHAN-00244 [▶ 31] is not reached.
Signal flow	CNC->PLC
ST path	gpAx[axis_idx]^.ipo_state.**lift_suppressed**
Data type	BOOL
Value range	TRUE = Lift movement is suppressed FALSE = Lift movement is not suppressed.
Access	PLC is reading
Special feature	The following special case of the status display occurs when you use “Advanced Lifting”: If the lift movement is suppressed due to insufficient travel distance and a target position of the Z axis is programmed at the same time, the lift function is active in order to be able to approach the target position of the Z-axis. In this case, the status of the lift function is simultaneously displayed as “active” and “suppressed”.

5 Appendix

5.1 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/

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Keyword index

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