DOCUMENTATION ISG-kernel

Functional description
Insert stop command

Short Description:
FCT-C41

Preface

Legal information

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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.

Further information

Links below (DE)

https://www.isg-stuttgart.de/produkte/softwareprodukte/isg-kernel/dokumente-und-downloads

or (EN)

https://www.isg-stuttgart.de/en/products/softwareproducts/isg-kernel/documents-and-downloads

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

Disclaimer

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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

The function "Insert motion stops during processing" permits the insertion of CNC stop marks in the future processing of an NC program while it is being processed.

Effectiveness / possible applications

- The function can be used for processes where a stop point is not yet known before program start.
- Another application is for alternating stop points while a program is being processed.

Release Note

This function is available as of CNC Build V3.1.3105.01

Parameterisation

P-STUP-00033 [▶ 27] must be parameterised in order to use the function.

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

The function " Insert motion stops during processing" permits the insertion of CNC stop marks for the future processing of the program while a program is running. This can be used, for example, for process-controlled machining operations executed in parallel where the positions for these operations are not yet known before program start.

Stop marks are usually inserted via the PLC with the Control unit – Insert stop marks (insert command) [▸ 22]. Alternatively, stop marks can also be inserted via the NC program, see Programming [▸ 25]..

The STOP position is specified depending on the mode used. The following modes are available:
 • Mode = POSITION – STOP position dependent on an axis position
 • Mode = DISTANCE – STOP dependent on distance from program start ("dist_prog_start" control unit [▸ 27])

$$STOP = f(axis\ position\ |\ dist\_prog\_start)$$

Stop marks are represented by optional M functions. The program is continued after the M function is acknowledged in the PLC.

2.1 Properties

General properties:

- The user can insert a new stop mark while the program in running during motion or at standstill.
- The position of the STOP in the program can be preset depending on the mode used.
- A STOP is represented by a programmed/selectable stop (M00/M01) or a user-defined M function acknowledged in any way.
- A M00/M01 transfers the channel to the stop state and is exited by "Continue movement". With a user-defined, arbitrary M function, the channel does not revert to stop state but waits for the default acknowledgement from the PLC.
- If the new STOP is specified during the motion, the channel is stopped briefly, the STOP is inserted and the channel continues to the newly set STOP. If the new STOP is commanded during standstill, the new STOP is set immediately.
- A STOP can also be commanded before program start. A STOP after program end is set to the end of the program.
- Cross-program STOPs are not possible.
- STOPs can be set with a preset absolute or relative position. If STOPs have a relative preset, they can be commanded once or can be automatically commanded iteratively
- An already specified STOP can be cleared by the value 0 if a relative dimension is specified, provided the STOP is not reached. When a new STOP is specified, the current STOP is cleared and the new STOP is set.
- When a STOP inserted by the PLC is reached, it is additionally signalled by a special stop condition (stop_condition_r) . They can be read as follows:
    - by the HLI [▶ 27]
    - by the associated CNC object [▶ 29]
- The function can also be used in the backward direction.

2.1.1   DISTANCE mode

- In DISTANCE mode, the location of the STOP is specified by the "dist_prog_start" control unit [▷ 27].

- "dist_prog_start" is the absolute path travelled from program start and is monotonically increasing. This means that each program position can be uniquely identified.

- The "dist_prog_start" value can be reset with the NC command #DISTANCE PROG START CLEAR.

- Return values from the CNC to the PLC (display data) are the axis positions of the first three axes and the "dist_prog_start" at the next/current STOP.

- A STOP that is set absolute or a one-off relative STOP is cleared during forward/reverse rotation. Relative iterative STOPs are retained.

The table below shows the possible combinations of the parameter "dist_or_pos" and the parameter "rel_abs_mode" and the resulting behaviour of the CNC for DISTANCE mode (`axis_nr `= 0):

Specified dimension (rel_abs_mode)	Distance (dist_or_pos)	CNC behaviour
relative iterative (0)	=0	a possibly set STOP that is not yet reached is cleared
	<0	immediate one-off STOP at current distance
	>0	(possibly interrupt) new STOP relative to the current distance, automatic new relative STOPs after continuation of the previous STOP.
absolute (1)	=< current distance	immediate STOP at current distance
	> current distance	STOP at commanded distance
relative one-off (2)	=< 0	immediate STOP at current distance
	> 0	(possibly interrupt) and insert a STOP relative to current distance

Examples

Axis position 1
Axis position 2

Program start

PLC command

%Insert_Command_Dist

N1 X0 Y0
N5 G01 X10 Y10
N6 G00 X0 Y0

insert_command.command_w:

dist_or_pos = 40000 [0.1 µm]
rel_abs_mode = 0 (rel. rep.)
axis_nr = 0

Stop acknowledge through PLC

Processing stop

Fig. 1: Stop mark command at standstill

Axis position 1
Axis position 2

4 mm

Program start

PLC command

%Insert_Command_Dist

N1 X0 Y0
N5 G01 X10 Y10
N6 G00 X0 Y0

insert_command.command_w:

dist_or_pos = 40000 [0.1 µm]
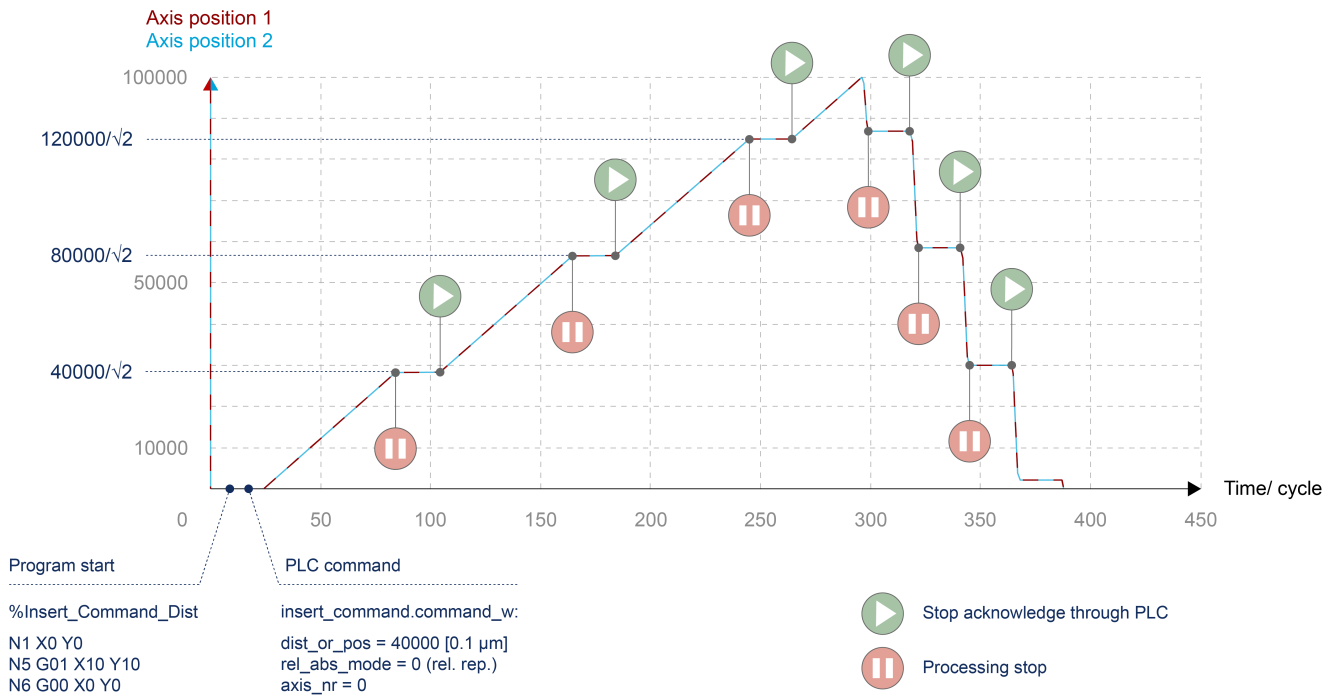rel_abs_mode = 0 (rel. rep.)
axis_nr = 0

Stop acknowledge through PLC
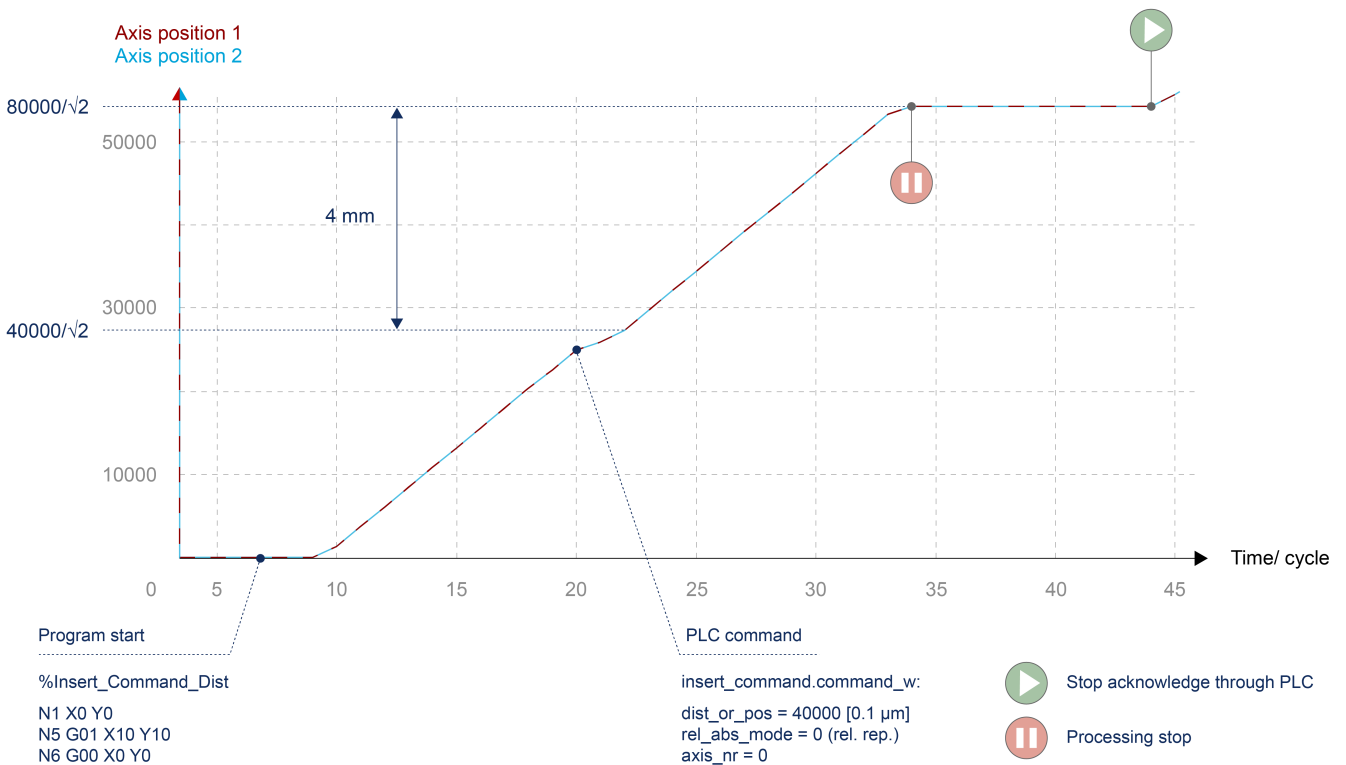
Processing stop

Fig. 2: Stop mark command on motion

2.1.2   POSITION mode

- In POSITION mode, any axis position can be specified. When this axis position is reached for the first time, the system stops. This means that if the same axis position is passed again, it is not stopped again.
- Modulo axes are handled as follows.
  - Absolute position: The specified axis position is shifted to the modulo range. A maximum of one revolution can be moved as a result.
  - Relative position: The commanded axis position describes the path to be traversed to the next stop point. Therefore, more than one revolution can be moved to the next STOP.
- Return values from the CNC to the PLC (display data) are the axis positions of the commanded axes and the "dist_prog_start" at the next/current STOP..
- A STOP that is set is cleared with forward/backward rotation by a PLC command (backward_motion control unit). This means that a STOP in backward direction must only be commanded after the revolution.

The table below shows the possible combinations of the parameter "dist_or_pos" and the parameter "rel_abs_mode" and the resulting behaviour of the CNC for POSITION mode (`axis_nr `> 0):

Specified dimension (rel_abs_mode)	Distance (dist_or_pos)	CNC behaviour
relative iterative (0)	= 0	a possibly set STOP that is not yet reached is cleared
	<> 0	STOP relative to the current axis position (or interrupt point), automatic new relative STOPs when STOP is reached.
absolute (1)	= current axis position	STOP at current axis position
	<> current axis position	STOP the next time the axis position is reached
relative one-off (2)	= 0	STOP at current axis position (or interrupt point)
	<> 0	One-off STOP relative to current axis position (or interrupt point)

Examples

Axis position 1
Axis position 2

Program start

%Insert_Command_Pos

N1 X0 Y0
N5 G01 X10 Y10
N6 G00 X0 Y0

PLC command

insert_command.command_w:

dist_or_pos = 40000 [0.1 µm]
rel_abs_mode = 0 (rel. rep.)
axis_nr = 1

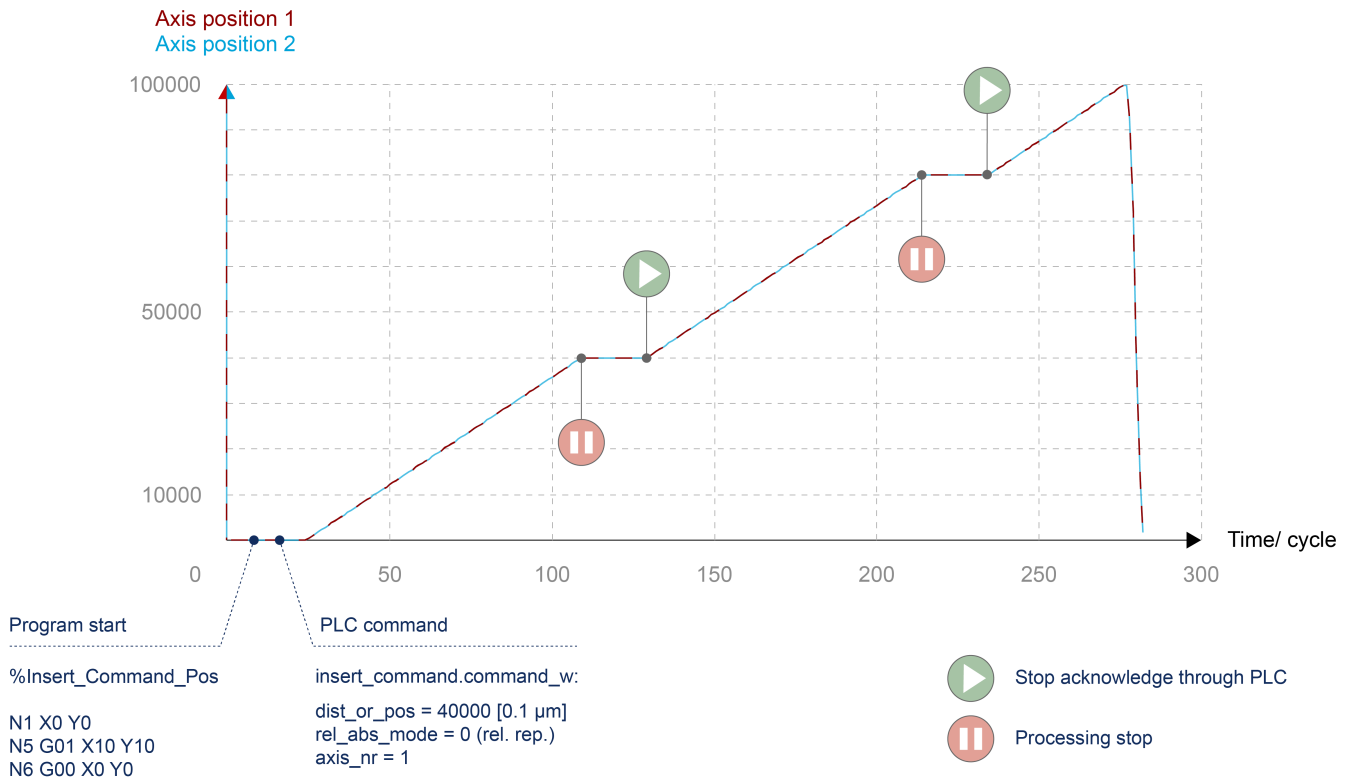Stop acknowledge through PLC

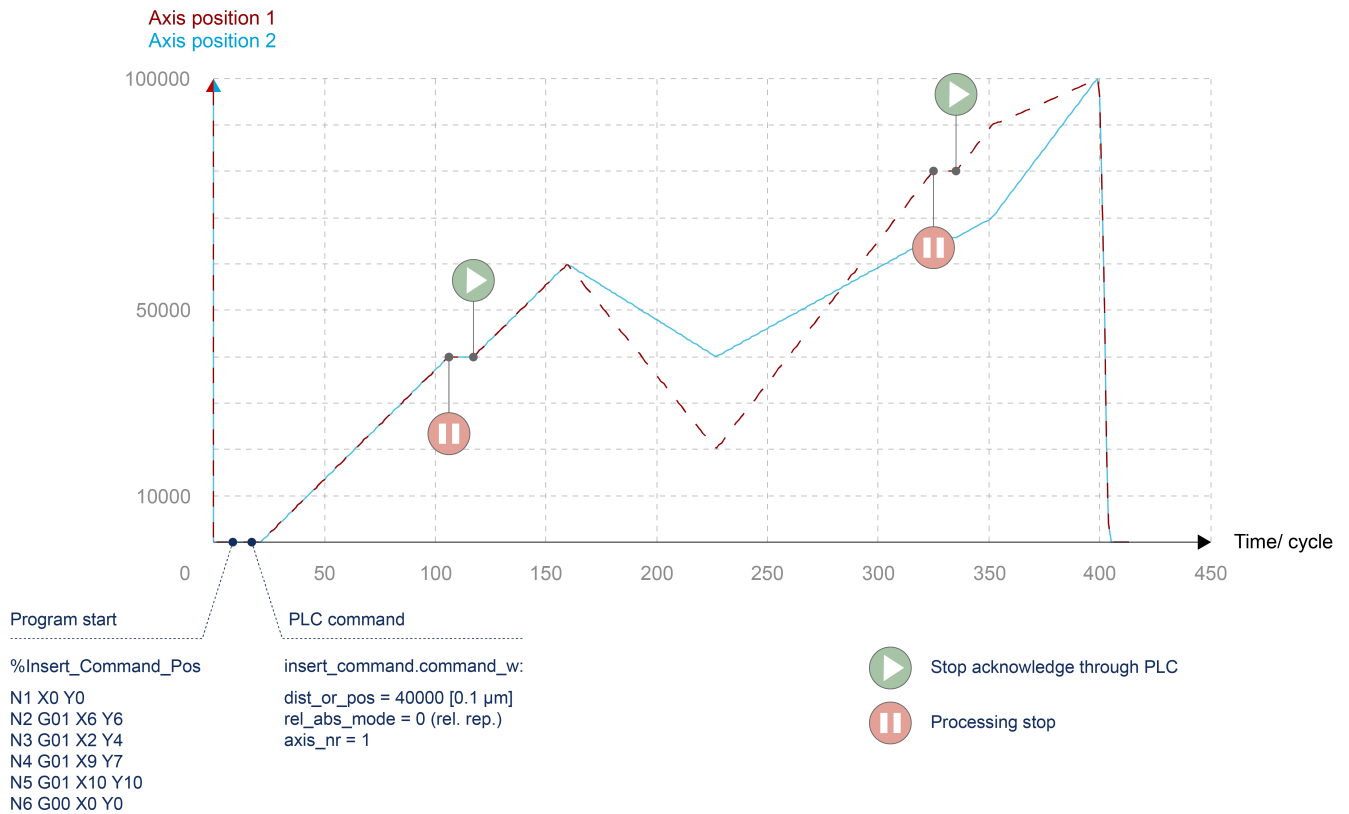Processing stop

Fig. 3: Stop mark command at standstill:

Fig. 4: STOP mark command at standstill with axis position reached multiple times
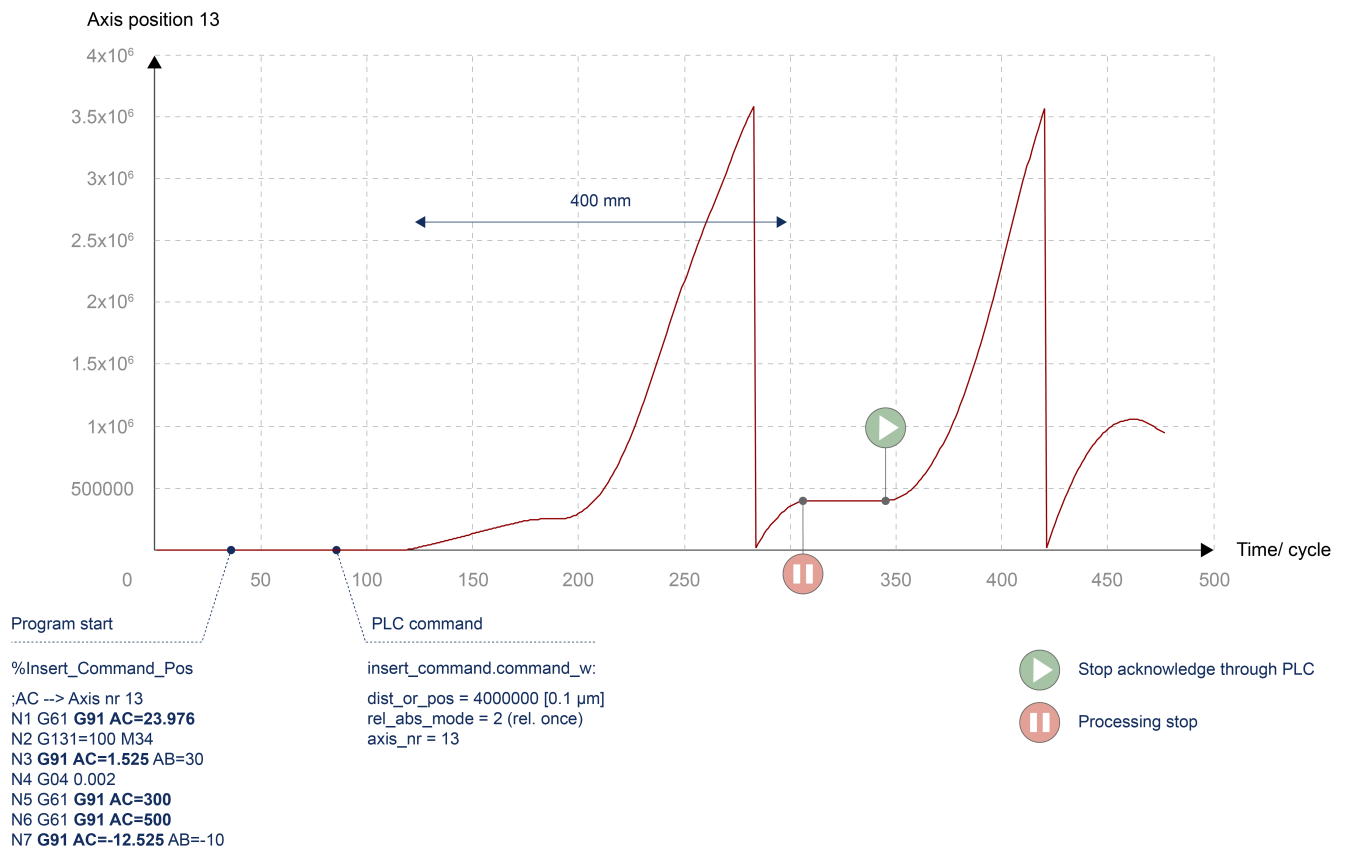
Fig. 5: STOP mark command with relative position specified for a modulo axis

Axis position 13

%Insert_Command_Pos

;AC --> Axis nr 13
N1 G61 **G91 AC=23.976**
N2 G131=100 M34
N3 **G91 AC=1.525** AB=30
N4 G04 0.002
N5 G61 **G91 AC=300**
N6 G61 **G91 AC=500**
N7 **G91 AC=-12.525** AB=-10

insert_command.command_w:

dist_or_pos = 4000000 [0.1 μm]
rel_abs_mode = 1 (abs.)
axis_nr = 13

▶ Stop acknowledge through PLC
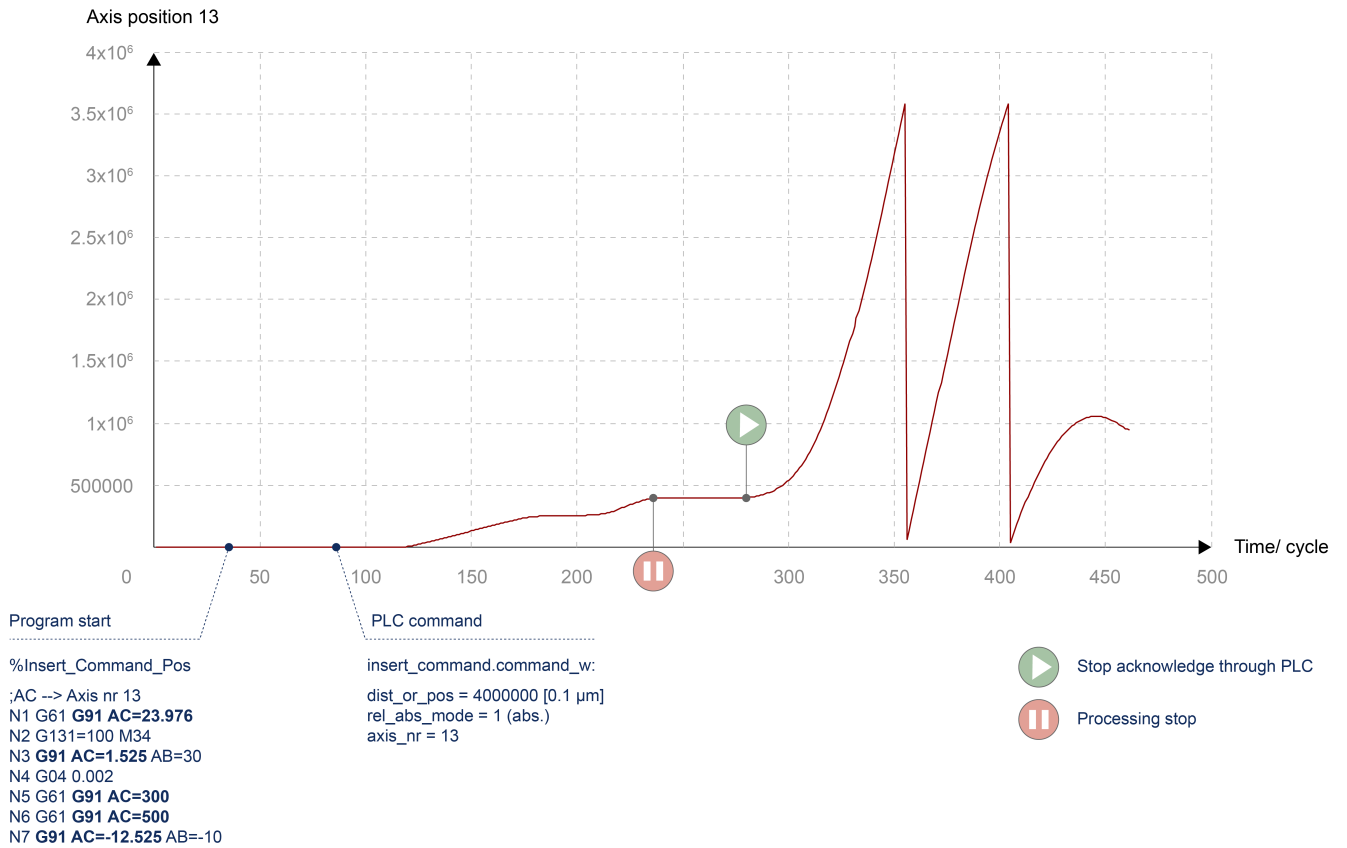
⏸ Processing stop

Fig. 6: STOP mark command with absolute position specified for a modulo axis

Axis position 13

Program start

PLC command

%Insert_Command_Pos

;AC --> Axis nr 13
N1 G61 **G91 AC=23.976**
N2 G131=100 M34
N3 **G91 AC=1.525** AB=30
N4 G04 0.002
N5 G61 **G91 AC=300**
N6 G61 **G91 AC=500**
N7 **G91 AC=-12.525** AB=-10

insert_command.command_w:

dist_or_pos = 2000000 [0.1 µm]
rel_abs_mode = 0 (rel. rep.)
axis_nr = 13

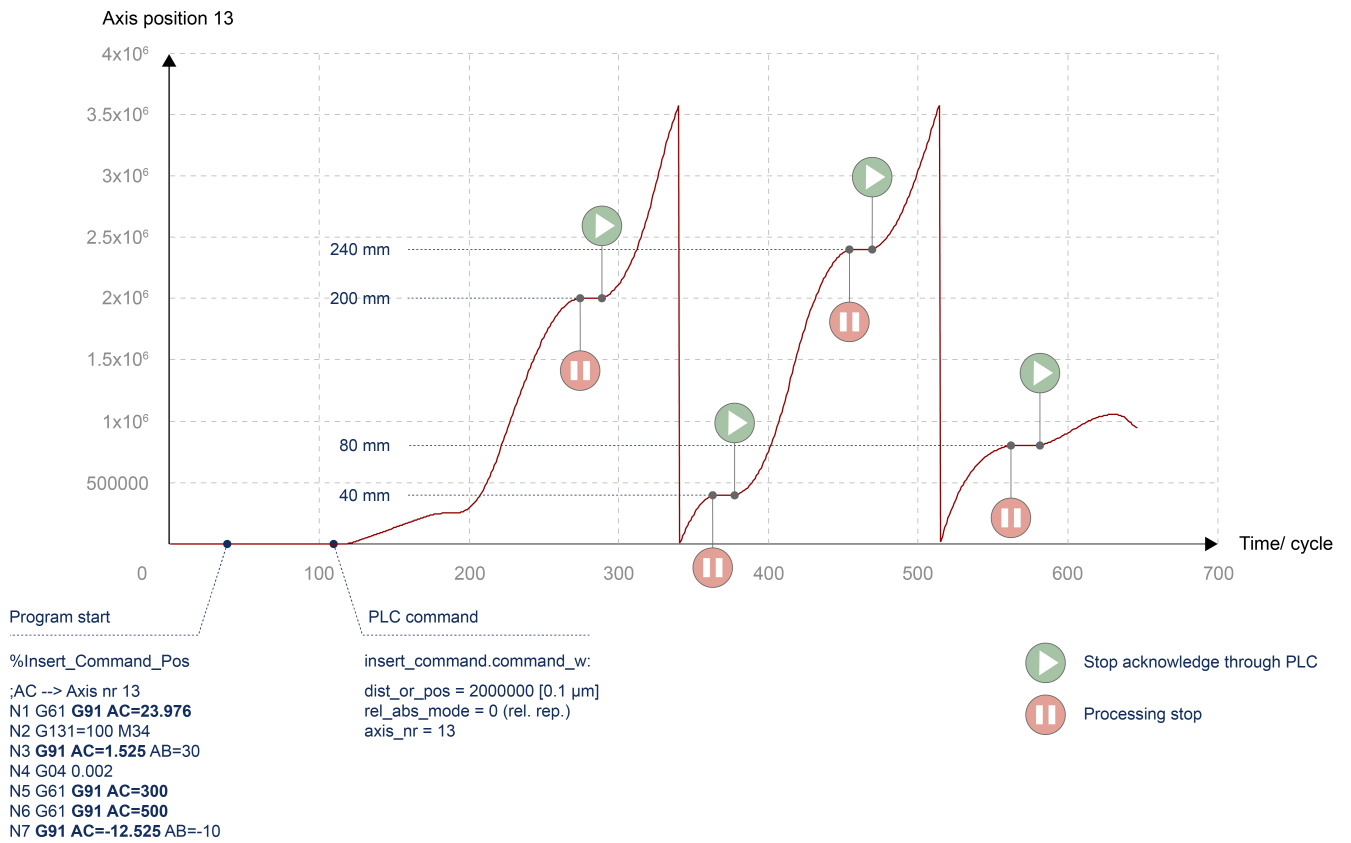▷ Stop acknowledge through PLC

⏸ Processing stop

Fig. 7: STOP mark command with relative iterative position specified for a modulo axis

2.1.3 Combination of functions "Insert motion stops during processing" and real-time loops

When combining the "Insert motion stops during machining" function with "Distance" mode and the real-time loops function when using the "MODULO" option, the following special features must be considered:

- An absolute commanded stop is only possible within the current loop or after exiting the loop.
- A relative one-time stop in a future loop that is not reached by a premature exit is rejected.

Absolute commanded stop
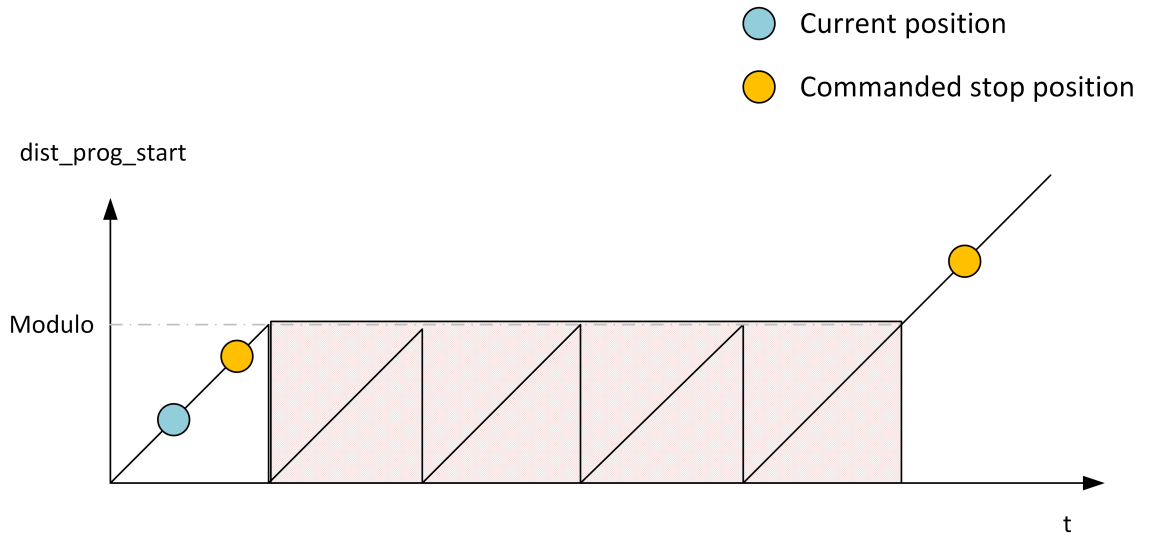

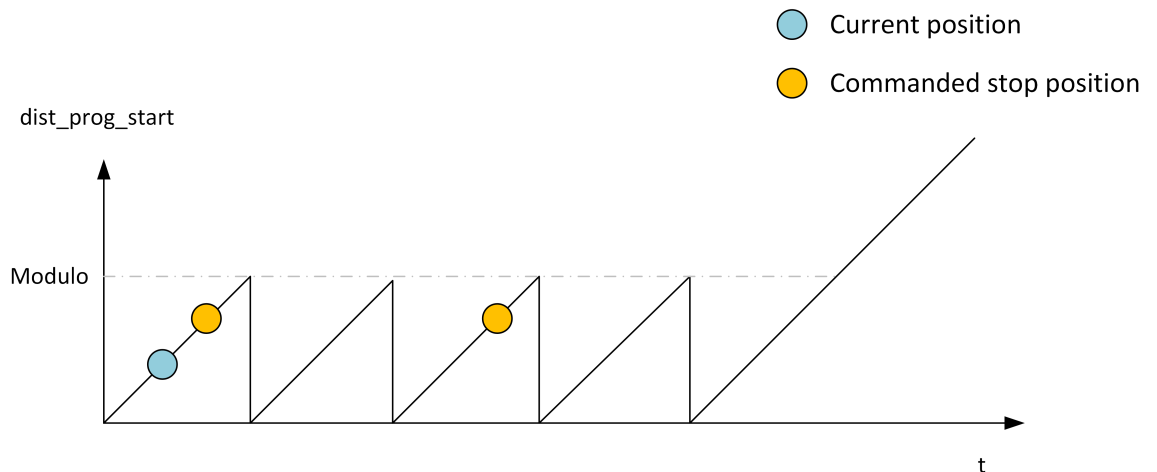**Fig. 8: Absolute commanded stop**

Relative one-time/iterative commanded stop

Fig. 9: Relative commanded stop

Difference in case of premature exit from real-time loop
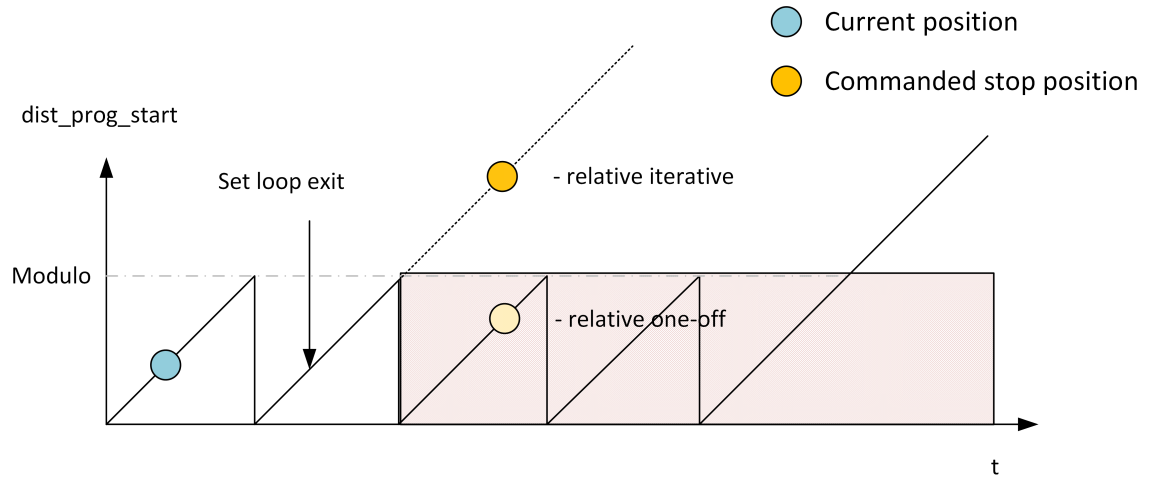

Fig. 10: Premature exit from real-time loop

2.2   Applications

2.2.1   POSITION mode application

The "Insert stop marks" function in POSITION mode can be used for machining with continuously fed material with a local offset technology process.

For example, in tube or wire machining, the workpiece length is defined by cutting at the start and end of the NC program. If a technology process is also applied, e.g. the tube is insulated by laser, this insulation process takes place at a local offset position.

In the laser insulation process, the CNC must be at a standstill. This can be achieved by inserting a STOP with the "Insert stop marks" function.

Since laser processing is locally displaced from the actual programming point, laser processing in the following program may require a STOP in the current program. This relationship is shown in the figure below. The position axis shown is intended to represent the position of the tube feed axis across programs. The position traversed then corresponds to the length of the tube produced at the end.
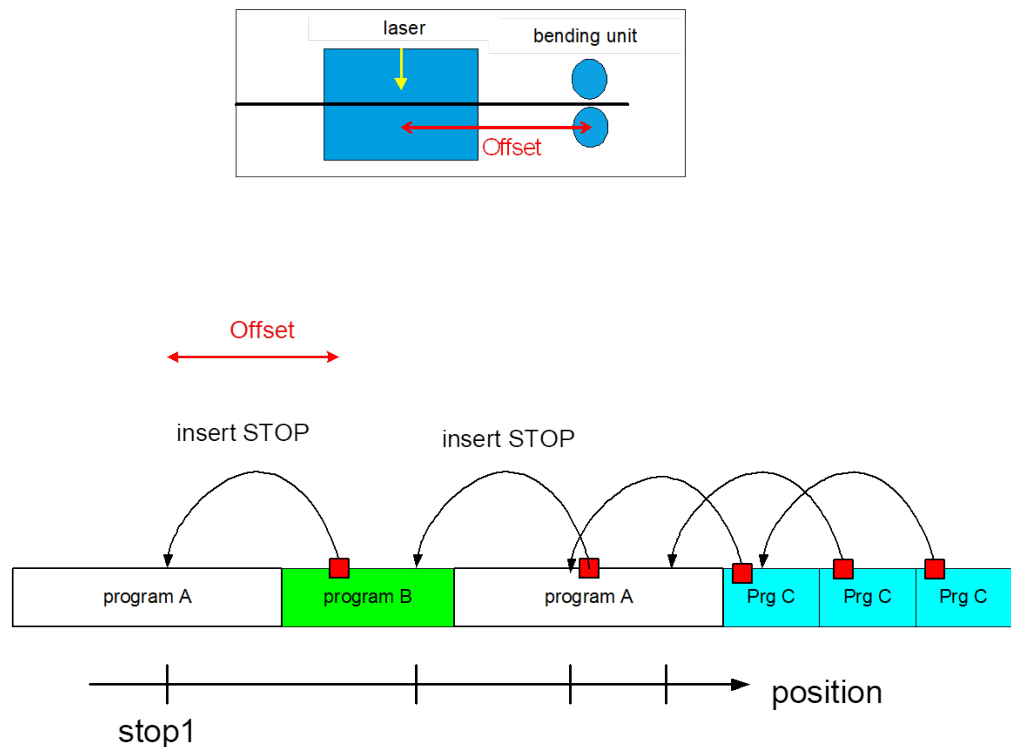

Fig. 11: POSITION mode application

If the program sequence is not defined in advance, the STOP position in the program is only known during the program run. The STOP can therefore not be implemented by NC programming.

The "Insert stop marks" function can be used to insert a STOP online during program processing as soon as the next programme is known.

2.2.2 DISTANCE mode application

In multichannel machining, where the resulting geometry is created by superimposing individual channels, it may be necessary to stop one channel while the other channel(s) continue machining.

An example of this is a machining operation with two channels working in planes perpendicular to each other.

The figure below shows the movement of the first channel superimposed by an orbiting movement about the Z axis of the second channel.
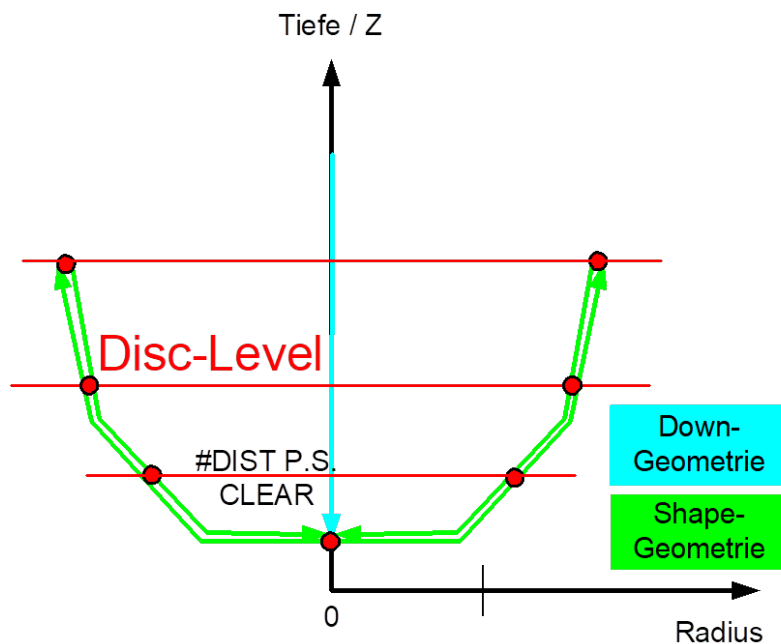

Fig. 12: DISTANCE mode application

Process-controlled, the same geometry is traversed several times with different process settings. Each process setting requires STOPs in the first channel (discs in the figure), while the second channel continues orbiting until a sufficient quality is reached.

The "Insert stop marks" function offers the option to set the discs for the current process setting at the start of each process setting marking the start of the program. Due to the 2D motion of the channel, equidistant discs can be inserted in the program using the distance traversed.

2.3 Combination of functions "Insert motion stops during processing" and real-time loops

When combining the "Insert motion stops during machining" function with "Distance" mode and the real-time loops function when using the "MODULO" option, the following special features must be considered:

• An absolute commanded stop is only possible within the current loop or after exiting the loop.

• A relative one-time stop in a future loop that is not reached by a premature exit is rejected.

Absolute commanded stop

○ Current position

● Commanded stop position

dist_prog_start

Modulo

t

Fig. 13: Absolute commanded stop

Relative one-time/iterative commanded stop

○ Current position

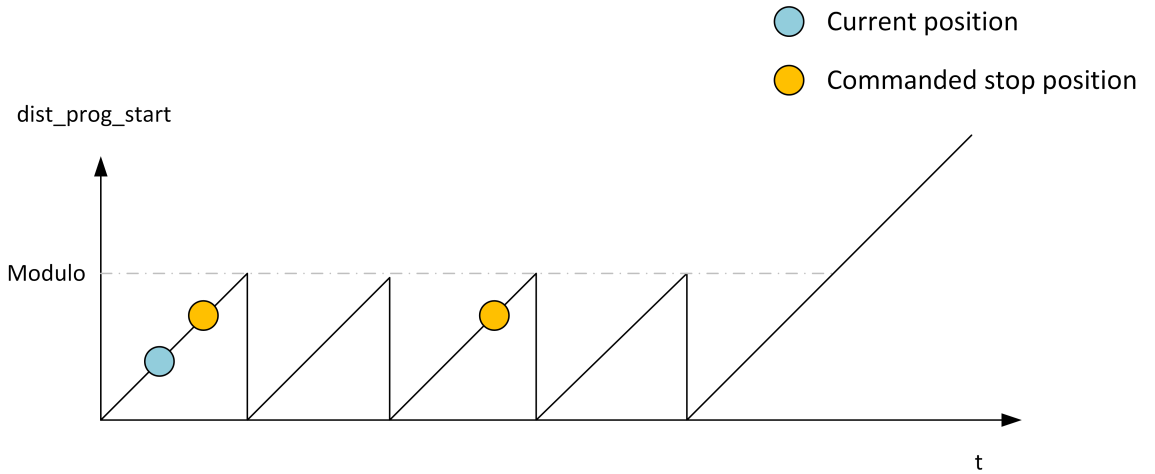● Commanded stop position

dist_prog_start

Modulo

t

Fig. 14: Relative commanded stop

Difference in case of premature exit from real-time loop
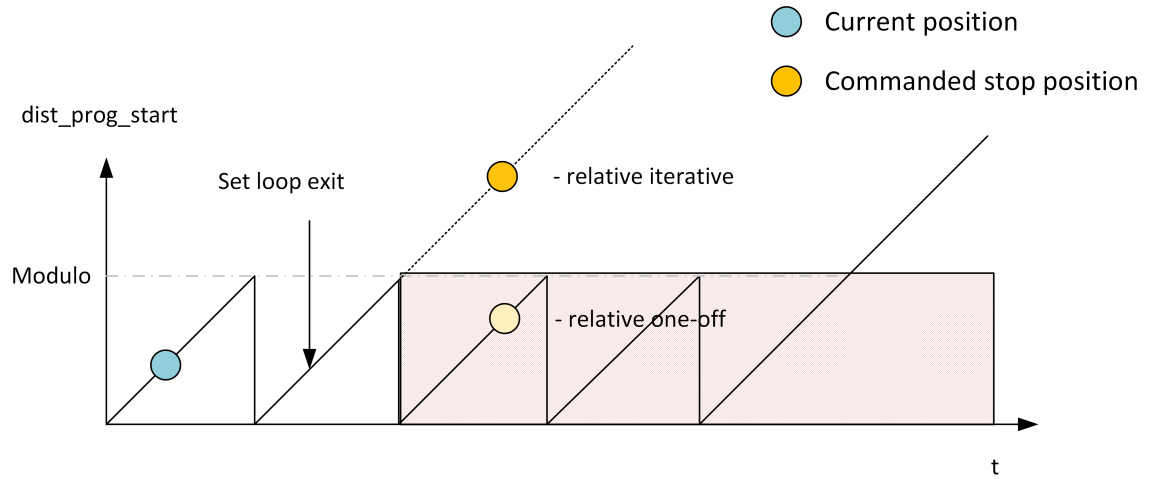
Fig. 15: Premature exit from real-time loop

3 PLC interface

3.1 Control unit – Insert stop marks (insert command)

Insert stop marks	
Description	During runtime, the PLC can use this control unit to set stop points in the future NC program. The control unit must then be enabled by enable_w = TRUE.
	The PLC signals a new assignment of command_2 by setting **command_semaphor_rw** to TRUE.
	The CNC sets the command_semaphor_rw to FALSE after the command_w data is read.
Data type	MC_CONTROL_INSERT_CMD_UNIT
ST path	gpCh[*channel_idx*]^. bahn_mc_control.**insert_cmd**
Command data	
ST element	**.command_w**
Data type	HLI_INSERT_CMD_COMMAND [▶ 23]
Access	PLC writes command_w
Return values	
ST element	**.state_r**
Data type	HLI_INSERT_CMD_STATE [▶ 24]
Access	PLC reads
Activation	
ST element	**.enable_w**
Data type	BOOL
Access	PLC writes
Value range	[TRUE/FALSE] ; TRUE: CU enabled in PLC
Flow control of commanded value	
ST element	**.semaphor_rw**
Data type	BOOL
Value range	[TRUE, FALSE]
Special features	**Consumption data item**
Access	TRUE : PLC triggers on new request
	FALSE : CNC has read new request

3.2   User data

Command data – Insert command	
Description	Control data for inserted STOP command
ST path	gpCh[*channel_idx*]^.bahn_mc_control.insert_cmd.**command_w**
ST name	HLI_INSERT_CMD_COMMAND
ST element	**.dist_or_pos**
Data type	LREAL
Description/special features	Relative/absolute distance or axis position at which the stop is to be inserted. [0.1 µm] The default setting is DISTANCE mode, the POSITION mode is active at a value of ".axis_nr" > 0
ST element	**.rel_abs_mode**
Data type	UINT
Description/special features	Value = 0 for relative distance with automatic insertion of a new stop when the current stop is reached Value = 1 for one-off insertion at the absolute distance Value = 2 for one-off insertion at the relative distance
ST element	**.axis_nr**
Data type	UINT
Description/special features	Value = 0 for DISTANCE mode Value > 0 for POSITION mode: Stop is inserted at the commanded axis position of the axis with the logical axis number = ".axis_nr".
ST element	**.m_function_nr**
Data type	UINT
Description/special features	Number of the inserted M function • Value = 0 for M00 programmed stop • Value = 1 for M01 optional stop (enabled/disabled with m01_stop_enable CU) • Value > 1 for M<m_function_nr> with MVS_SVS synchronisation
ST element	**.add_nr**
Data type	DINT
Description/special features	Optional additional value of the M function; it is specified as a negative or positive integer.

Status data – Insert command	
Description	Status data of the insert command control unit
ST path	gpCh[*channel_idx*]^.bahn_mc_control.insert_cmd.**state_r**
ST name	HLI_INSERT_CMD_STATE
ST element	**.distance_of_next_stop**
Data type	LREAL
Description	Absolute distance (dist_prog_start) of the feed axes (#FGROUP) at the next stop [0.1 µm] Value >= 0 : Stop found, axis positions correct Value = -1 : Stop still not found in the NC program
ST element	**.position_at_next_stop[*idx*]**
Data type	ARRAY[0..HLI_CS_AXIS_MAXIDX] OF DINT
Description	When • command_w.axis_nr = 0, the axis positions X, Y, Z are assigned accordingly at the next stop in the PCS [0.1 µm] • command_w.axis_nr > 0; .position_at_next_stop[0] contains the axis position of the commanded axis at the next stop position_at_next_stop[1]=0 and position_at_next_stop[2]=0
ST element	**.state**
Data type	DINT
Description	Status if the current command_w. • Value =0: no stop commanded • Value=1: Stop commanded but not yet reached

4   Programming

The NC command #INSERT CMD can be used to specify stop marks via the NC program.

The "AXNR" parameter is used to set the mode.

- AXNR = 0 – DISTANCE mode (default)
- AXNR !=0 – POSITION mode

Syntax:
#INSERT CMD [ON | OFF] [AXNR=.. **MNR**=.. **ADDR**=.. **DIST**=.. [**ABS** | **REL** | **REL_ONCE**] **]**

ON	Insert stop marks is enabled
OFF	Insert stop marks is disabled. This results in a stop at the program position.
AXNR=..	Logical axis number
	Stop is inserted at the commanded axis position of the axis with this logical axis number.
	Note: Mode is defined by specifying the logical axis number.
	AXNR = 0 – DISTANCE mode is used
	AXNR !=0 – POSITION mode is used
	Default value = 0
MNR=..	Number of the inserted M function
	• Value = 0 for M00 programmed stop (default)
	• Value = 1 for M01 optional stop (enabled/disabled with m01_stop_enable CU)
	• Value > 1 for M<m_function_nr> with MVS_SVS synchronisation
ADDR=..	Optional additional value of the M function; it is specified as a negative or positive integer.
DIST=..	Relative/absolute distance or axis position in [0.1µm] at which the stop is to be inserted. Dependent on the mode used
ABS	One-off insertion at the absolute distance
REL	for relative distance with automatic insertion of a new stop when the current stop is reached.
REL_ONCE	One-off insertion at the relative distance.

> **ℹ Notice**
>
> **The distance specification ABS/REL or REL_ONCE are mutually exclusive.**
>
> When you use simultaneous programming within an #INSERT CMD instruction, the error is output with ID 22130.

The default assignment of the NC command is:

#INSERT CMD [MNR=0 DIST=0 REL AX=0]

If M function < 2 is specified, the command for continuing machining must be given by the "Continue motion" control unit after the STOP is reached.

If M function is specified >= 2, the default acknowledgement of the M function is sufficient.

The bit in the stop conditions [▶ 28] is displayed on the HLI when an inserted stop is reached.

The combination of the parameters DIST=0 and REL=1 clears the previously set STOP irrespective of the parameters MNR and AXNR,

The current distance can be reset with #DISTANCE PROG START CLEAR.

5   Parameter

Start-up parameters

P-STUP-00033	Memory size for backward motion
Description	This parameter defines the memory size in bytes used for backward motion on the path. During start-up, the NC checks whether the required minimum size is available. If this is not the case, a warning is output and the memory size is set to the required minimum value. If the size is set to 0, the "forward/ backward motion on the path" function is not available. The maximum size is only limited by the resources available on the PC.
Parameter	fb_storage_size[i] where i = 0 to 11 (maximum number of channels: 12, application-specific)
Data type	UNS32
Data range	0 ... MAX(UNS32)
Dimension	----
Default value	0
Remarks	

Other PLC parameters

Currently covered path in the NC program (PCS)	
Description	Reads the current distance covered in the NC program since program start or since the last # DISTANCE PROG START CLEAR NC command. The calculation is based on the current position in the current NC block.
Signal flow	CNC → PLC
ST path	gpCh[*channel_idx*]^.bahn_state.**dist_prog_start**
Data type	UDINT (* LREAL)
Unit	0.1 µm
Access	PLC is reading
Special features	* As of CNC Build V3.1.3104.01 the data element is provided in LREAL forma.

Stop condition	
Description	Displays the condition why the current motion was stopped.
Signal flow	CNC → PLC
ST path	gpCh[*channel_idx*]^.bahn_state.**stop_conditions_r**
Data type	DINT
Value range	See Value range of stop conditions [▶ 28] with explanations.
Access	PLC is reading

Value range of stop conditions

Constant in PLC	Value	Explanation
HLI_SC_FEEDHOLD	0x0001	Path feed stop
HLI_SC_VFG	0x0002	No axis-specific feed enable.
HLI_SC_SINGLE_BLOCK	0x0004	Single step mode active.
HLI_SC_M00_OR_M01	0x0010	M00 (programmed stop), M01 (optional stop) is active.
HLI_SC_PLC_ACKNOWLEDGE	0x0020	Stop occurs due to waiting for an acknowledgement from the SPS. This may occur as a result of the output of M or H technology functions but is not restricted to them alone.
HLI_SC_OVERRIDE_ZERO	0x0040	Override = 0.
HLI_SC_OVERRIDE_RAPID_ZERO	0x0080	Override = 0 with rapid traverse blocks
HLI_SC_DELAY_TIME	0x0200	Dwell time.
HLI_SC_CHANNEL_SYNC	0x0800	Channel synchronisation is active.
HLI_SC_IPO_INPUT_EMPTY	0x1000	Input FIFO of the interpolation is empty.
HLI_SC_IPO_INPUT_DISABLED	0x2000	Input of function blocks (e.g. motion blocks etc.) disabled.
HLI_SC_WAIT_FOR_AXES	0x8000	Stop occurs due to waiting until a commanded axis swap is completed.
HLI_SC_CHANNEL_ERROR	0x00010000	An error occurred in the channel.
HLI_SC_WAIT_TECHNO_ACK	0x00020000	Waiting for acknowledgement of M/H/ST technology functions.
HLI_SC_W_C_AFTER_COLLISION	0x00040000	After a detected collision, waiting for motion resumption.
HLI_SC_SLOPE_SUPPLY_PROBLEM	0x00080000	Block supply problem (only occurs in conjunction with HSC slope).

HLI_SC_BACK_INTERPOLATION	0x00100000	Back interpolation after tracking mode is active.
HLI_SC_STOP_REVERSIBLE	0x00200000	Stop since M00 (programmed stop) is active. However, the NC program can be processed backwards despite M00 (available as of V3.1.3039.01).
HLI_SC_BREAKPOINT_STOP	0x00400000	Stop after a breakpoint (stop point) is reached; available as of V3.1.3039.01.
HLI_SC_M0_STOP	0x02000000	Stop after an M00 function is reached
HLI_SC_M1_STOP	0x04000000	Stop after an M01 function is reached
HLI_SC_INSERT_STOP_AT_DIST	0x08000000	Stop after an M function inserted by the Control Unit "Inserting stop marks" is reached.
HLI_SC_DEC_SYN_CHAN_EMPTY	0x10000000	Decoder is waiting for synchronisation. NC channel has no jobs.

CNC objects

Name	bahn_state.stop_conditions_r		
Description	Displays the condition why the current motion was stopped. The value read can be seen in the table [▷ 28].		
Task	GEO (Port 551)		
Index group	0x12330<C_{ID}>	Index offset	0x30
Data type	UNS32	Length	4
Attributes	read	Unit	[-]
Remarks	Alternatively, the stop condition can also be read by the HLI [▷ 27].		

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:

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Keyword index