DOCUMENTATION ISG-kernel

Functional description
External tool management

Short Description:
FCT-C10

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.

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.

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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 external tool management system (WZV) is a database that contains the relevant information about geometry, dynamic data, tool life etc. for each tool in a specific data record.

Before a mechanical tool change, this data record is supplied by the tool management system at the request of the CNC.

Characteristics

External means that the database is integrated outside of the CNC kernel, e.g. in the PLC. The user can manage tool data records via a graphical user interface.

Data transfer takes place between the CNC and the PLC if tool data is required in the CNC or if tool life data or changes to tool parameters need to be supplied.

Communication between the CNC and the PLC takes place in the CNC asynchronous task.

In particular, complete tool data including additional tool parameters are transferred to the CNC (PLC->CNC).

Conversely, every time new tool data is requested, the additional tool parameters and other information about the last active tool are returned to the PLC. These additional tool parameters can be used to transfer data from the NC program to the external tool management system and save them there (CNC->PLC).

Parameterisation

The presence and use of an external tool management system must be communicated to the CNC via channel parameter P-CHAN-00016.

Other properties related to communication with the tool management system can be set by additional parameters (see Section Parameters [▶ 26]).

Programming

By default, tool data is requested in the NC program using NC commands T or D (T word, D word).

Other NC commands are also provided e.g. **#TOOL PREP** or **#TOOL DATA** to permit extended communication with the tool management system.

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 Programming and tool data

Standard programming

By default, tools are identified in the NC program by means of one-part numbers. In conformity with DIN 66025, this numeric ID is programmed with the D command for calculation of new data (calculatory tool change). In conjunction with the T command, the ID defines the next tool that is to be physically changed in.

Tool change

The T number primarily serves as technological information, i.e. it reaches the interface to the PLC through the NC channel. The T command itself does not initiate a tool change. In conformity with DIN 66025, physical insertion of the new tool in the work spindle is triggered with the machine function M06.

Separate specification of the two commands "T with tool number" and M06 can be used to take preparatory measures after the T command, e.g. in the tool magazine (P-CHAN-00087), before the tool is actually physically inserted in the work spindle with M06.

External tool administration

To calculate new tool data, data must be requested over an additional interface from an (external) user-supplied tool management system (e.g. in the PLC) and must contain the D command.

The tool management system has special manufacturer-specific algorithms to define the tool to be changed based on the tool ID.

T with D

If the corresponding channel-specific parameter is defined (P-CHAN-00014), execution of the D command is also implicitly triggered with the T command.

Influence on the NC program run

During communication with the tool management system, previous motion blocks may be processed with a delay due to waiting times caused by execution of the T command. This can be avoided by setting the channel parameter P-CHAN-00106.

Tool identification (TOOL-ID)

In the NC program, every tool is identified by means of a unique number.

In the tool management system, tool data is identified by a three-part number referred to below as the tool ID. This is specified in the PLC by the following structure CNC_TOOL_ID:

NC_TOOL_ID structure in the PLC

basic DINT;

sister : DINT;

variant : DINT;

sister_valid : BOOL;

variant_valid : BOOL;

The basic tool number (basic) describes the tool type and the sister tool number (sister) defines an example of this tool type. The variant number (variant) is purely for data processing purposes. Therefore, diverse records can be used for a tool.

Tool ID = basic tool no. + sister tool no. + variant number

T command and D command

The mathematical expressions when specifying T and D commands must always be interpreted as the basic tool number (basic). Therefore, the tool management system still has the same degree of freedom as before when it comes to selecting a tool record.

T<*basic*> or **D**<*basic*>

#TOOL PREP #TOOL DATA

It must be considered that only the tool type is defined in the tool ID sent and that several tools of the same type (sister tools) may be ready for use in the tool magazine. In other words, the T or D command in the NC program may not be able to identify individual tools correctly.

This is why, as an alternative, the tool ID can be programmed by means of plaintext commands. The preparatory technology command for a physical tool change in #TOOL PREP corresponds to the T command and the request for new tool data in #TOOL DATA corresponds to the D command.

Announcing a tool change (T)

#TOOL PREP [<*basic*> [**,** <*sister*> [**,** <*variant*>]] **]**

Requesting new tool data (D)

#TOOL DATA [<*basic*> [**,** <*sister*> [**,** <*variant*>]] **]**

What is essential is to specify the basic tool number (**basic**). In addition, you can optionally program **sister** for the sister tool number and **variant** for the variant. Zero is inserted if sister or variant is not programmed (comma follows comma or close parentheses follows comma).

Tool description

A tool is described for the CNC by the data structure CNC_TOOL_DESC:

Excerpt from the structure CNC_TOOL_DESC in PLC

(* Variable name	Variable type	Reference *)
tool_id	: CNC_TOOL_ID;	
laenge	: DINT;	(* P-TOOL-00003 *)
radius	: DINT;	(* P-TOOL-00004 *)
ax_versatz	: ARRAY [1..32] OF DINT;	(* P-TOOL-00006 *)
kopf_versatz	: ARRAY [1..28] OF DINT;	(* P-TOOL-00009 *)
mass_einheit	: UINT;	(* P-TOOL-00008 *)
typ	: UINT;	(* P-TOOL-00001 *)
srk_lage	: UINT;	(* P-TOOL-00002 *)
kin_id	: UINT;	(* P-TOOL-00011 *)
log_ax_nr_spdl	: UINT;	(* P-TOOL-00012 *)
tool_fixed	: BOOL;	(* P-TOOL-00010 *)
valid	: BOOL;	(* P-TOOL-00005 *)
res	: ARRAY [1..4] OF BYTE;	
param	: ARRAY [1..60] OF LREAL;	
vb_min	: LREAL;	(* P-TOOL-00013 *)
vb_max	: LREAL;	(* P-TOOL-00014 *)
a_max	: LREAL;	(* P-TOOL-00015 *)

The meanings of individual data items are described in greater detail in [TOOL].

Notice
A tool can be described by way of further data which, however, is not needed to request the tool geometry from the CNC and is additionally stored only in the ?PLC.

2.1 Saving tool data

Saving tool data

In the NC program it is possible to permanently modify certain information for the current tool, i.e. save it after the tool is deselected.

This is done using what is known as additional tool parameters (V.G.WZ_AKT.P[i]). For example, these parameters can save wear data or measured values of the currently active tool during program runtime. The data is then written back to the external tool management system and saved there when a new tool record (Dxx) is selected or when a tool is deselected (D0).

If an active tool is not deselected by program end and if the channel-specific parameter (P-CHAN-00103) is set accordingly, the data of the last tool used is transferred back implicitly to the external tool management system and written there at the next program start.

T/D number

In addition, when a tool record is selected, the T and D numbers of the tool last used are transferred back to the external tool management system.

Programing Example

NC program with tool requesting

In the example below, various tool data items (life parameters and tool parameters) are written by the CNC and returned to the external tool management system.

```
%ext_wzv.nc
N10 X0 Y0 G91 G01 F1000

;enter wear for T1/D1
V.G.WZ_AKT.P[0] = 123
V.G.WZ_AKT.P[1] = 234
N40 T22 D22
N31 T2     ;-> T2 info
N32 D2     ;-> then D2 request
N33 D3 T3  ;-> first D3 request and then T3 info
N35 X11
N40 #TOOL DATA [4, 1]  ;request D in extended syntax
N50 #TOOL PREP [4]     ;request T in extended syntax
N55 X22

;use application-specific tool parameters
G90 XV.G.WZ[3].P[0]
G91
N130 X100
N140 X200
N150 T22
N160 D33
N170 X-100
N180 D0     ;deselect tool geometry
M30
```

2.2 Access to tool data in the NC program (V.G.WZ..)

V.G.WZ[j]...

The "WZ[j]" variables permit read access to the data of **any** tool. They are both available with an external tool management system (transparent access) and for use of an internal tool table (<j> then corresponds to the index of the tool (or the tool number) in the tool list [5]).

Write access is only permitted if an internal tool table is used.

WZ[j].R	Radius of the tool	Real	[mm, inch]	R/W*
WZ[j].L	Length of the tool	Real	[mm, inch]	R/W*
WZ[j].P[i]	Tool parameter where <i>: 0 … 59	Real	-	R/W*
WZ[j].V[i] or WZ[j].V.X	Offset in axis <i> or "X" of the tool where < i>: 0 … 31	Real	[mm, inch]	R/W*
WZ[j].ME	Measuring unit of radius, length and axis offsets, always supplies 0 (for [mm]) when a tool list is used, otherwise the variable has no significance	Boolean	0 , 1	R
WZ[j].OK	Validity flag of the tool; if valid, then 1	Boolean	0 , 1	R/W*
WZ[j].SPDL_AX_NR	Logical axis number of the assigned spindle	Integer	-	R/W*
WZ[j].KIN_PARAM[i]	Kinematic parameters of the tool in internal unit where < i>: 0 … 69	Real	[0.1 µm, $10^{-4}°$]	R/W*
WZ[j].KIN_ID	Kinematics ID of the tool	Integer	-	R/W*
WZ[j].TYPE	Tool type (0: Milling tool 1: Turning tool 2: Grinding tool)	Integer	-	R
WZ[j].TOOL_FIXED	Tool is alignable or fixed	Boolean	0 , 1	R/W*
WZ[j].SRK_ID	Cutter orientation of a turning tool	Integer	-	R/W*
WZ[j].S_MIN_SPEED	Minimum rotational speed (tool dynamic data)	Real	[rpm]	R/W*
WZ[j].S_MAX_SPEED	Maximum rotational speed (tool dynamic data)	Real	[rpm]	R/W*
WZ[j].S_MAX_ACC	Maximum acceleration (tool dynamic data)	Real	[°/s^2]	R/W*
WZ[j].SISTER_VALID	Validity flag of sister tool (TOOL ID)	Boolean	0 , 1	R/W*
WZ[j].SISTER	Number of valid sister tool	Integer	-	R/W*
WZ[j].VARIANT_VALID	Validity flag of variant tool (TOOL ID)	Boolean	0 , 1	R/W*
WZ[j].VARIANT	Number of valid variant tool	Integer	-	R/W*
WZ[j].GOBJECT[i].*	Access to the subelements of a specific graphical object **[as of Build V3.01.3018.00]** where <i>: 0 … 4	-	-	…
WZ[j].LINKPOINT.*	Access to the subelements of associated linkpoints **[as of Build V3.01.3018.00]**	-	-	...

S*: Write access to data of the internal tool management system as of CNC Build V3.1.3079.08

V.G.WZ_AKT...

The variables "WZ_AKT", "T_AKT" and "D_AKT" permit access to the data of the **currently selected** tool. These variables are available both for an external tool management system and for the use of an internal tool table.

T_AKT	Number of the selected tool	Integer	-	R
D_AKT	Number of the selected tool compensation record	Integer	-	R

---

i

Notice

A write access always causes the temporary change of tool data as long as this function is selected. When a new tool is selected (Dxx) or deselected (D0), the changed data are lost.

Exception:

When an external tool management system is used, the so-called additional tool data (V.G.WZ_AKT.P[i]) is adopted and saved when a new tool is selected or a tool is deselected (P-CHAN-00103).

WZ_AKT.R	Radius of the selected tool	Real	[mm, inch]	R/W
WZ_AKT.L	Length of the selected tool	Real	[mm, inch]	R/W
WZ_AKT.P[i]	Free parameters of the selected tool where <i>: 0 … 59	Real	-	R/W
WZ_AKT.V[i] or WZ_AKT.V.X	Offset in axis <i> or "X" of the selected tool where <i>: 0 … 31	Real	[mm, inch]	R/W
WZ_AKT.ME	Measuring unit of radius, length and axis offsets of the selected tool, always supplies 0 (for [mm]) when a tool list is used, otherwise the variable has no significance	Boolean	0 , 1	R
WZ_AKT.OK	Validity flag of the selected tool; is always 1 since only data of valid tools are adopted. An error message is output if invalid tools are requested	Boolean	0 , 1	R/W*
WZ_AKT.SPDL_AX_NR	Logical axis number of the assigned spindle	Integer	-	R/W*
WZ_AKT.KIN_PARAM[i]	**CAUTION**: Note on write access: Value must be programmed in internal units. Kinematic parameters of the selected tool where <i>: 0 … 69	Real	[0.1 μm, $10^{-4}°$]	R/W
WZ_AKT.KIN_ID	Kinematic ID of the selected tool	Integer	-	R/W*
WZ_AKT.TYPE	Tool type of the selected tool (0: Milling tool 1: Turning tool 2: Grinding tool)	Integer	-	R
WZ_AKT.TOOL_FIXED	Tool is alignable or fixed	Boolean	0 , 1	R/W

WZ_AKT.SRK_ID	Cutter orientation of the selected turning tool	Integer	-	R/W*
WZ_AKT.S_MIN_SPE ED	Minimum rotational speed (tool dynamic data)	Real	[rpm]	R/W*
WZ_AKT.S_MAX_SPE ED	Maximum rotational speed (tool dynamic data)	Real	[rpm]	R/W*
WZ_AKT.S_MAX_ACC	Maximum acceleration (tool dynamic data)	Real	[°/s^2]	R/W*
WZ_AKT.SIS- TER_VALID	Validity flag of sister tool (TOOL ID)	Boolean	0 , 1	R/W*
WZ_AKT.SISTER	Number of valid sister tool	Integer	-	R/W*
WZ_AKT.VARI- ANT_VALID	Validity flag of variant tool (TOOL ID)	Boolean	0 , 1	R/W*
WZ_AKT.VARIANT	Number of valid variant tool	Integer	-	R/W*
WZ_AKT.WEAR_RA- DIUS	Total radius wear with radius compensation (OTC) (sum of discrete + continuous wear)	Real	[mm, inch]	R
WZ_AKT.WEAR_RA- DIUS_CONT	Continuous radius wear with radius compensation (OTC)	Real	[mm, inch]	R
WZ_AKT.WEAR[i] or WZ_AKT.WEAR.X	Wear in axis <i> or "X" with length compensation (OTC) where < i>: 0 … 31	Real	[mm, inch]	R
WZ_AKT.WEAR_CON ST	Wear constant (OTC)	Real	[0.1 μm/ m]	R/W
WZ_AKT.GOB- JECT[i].*	Access to the subelements of a specific graphic ob- ject (see FCT-C15) **[as of V3.01.3018.00]** where < i>: 0 … 4	-	-	-
WZ_AKT.LINKPOINT.*	Access to the subelements of associated link points (see FCT-C15) **[as of V3.01.3018.00]**	-	-	-

S*: Write access to these current tool data as of CNC Build V3.1.3079.08

As an alternative to V.G.WZ_AKT.P[i], the following variables can also be used to access addi-
tional tool parameters. It is only available for an external tool management system:

V.G.WZ_INFO[i] Parameters of the selected tool L

Programing Example

NC program with tool requesting

In the example below, the CNC replaces various tools and the data is requested by the external tool management system. The request always contains the free tool parameters of the last active tool for return transfer of updated values to the PLC.

```
%ext_wzv.nc

N10 X0 Y0 G91 G01 F1000
N20 T0 D0;report back free parameters by T<?>D<?>
;with request D0

N30 T1 D1;report back free parameters by T0&D0
;with request D1

N32 V.G.WZ_AKT.P[0] = 123

N40 T2
N50 T3
N60 T4
N70 D2;report back free parameters by T1&D1
;with request D2

N080 V.G.WZ_AKT.P[0] = 1
N090 V.G.WZ_AKT.P[1] = 2
N100 V.G.WZ_AKT.P[2] = 3

M30
```

2.3   Saving tool life parameters

Tool life time/tool life distance

When tool life values are acquired, the contact time (service life) and the distance covered by the tool during contact (service distance) are calculated.

By default only travel by motion blocks is considered. Positioning by rapid traverse has no effect on tool life parameters.

The parameter P-CHAN-00255 specifies that all motions, i.e. including rapid traverses, are considered in tool life capture to permit application-specific modification of tool life capture. At the same time, use of the channel-specific control unit MCControlBoolUnit_ToolLifeSuppressCapture/tool_life_suppress_capture on the HLI can suppress tool life capture depending on the user's specific requirements. This permits the complete modification of tool life capture to the user's requirements.

The interpolator displays the data (tool ID, contact time, contact distance) after the tool is replaced.

> **i**
>
> **Notice**
>
> The service life is recorded in [s]; the service distance is recorded in [mm].

Time of storage

The interpolator automatically sends the complete tool ID, tool life and tool life distance data to the tool management system every time a tool is changed. This is announced by the T command if the parameter P-CHAN-00076 is set and this data is saved in the tool management system. By default, tool life data is sent to the tool management system even if the tool distance/tool life is set to the value 0. The parameter P-CHAN-00243 can suppress the transfer of tool life data when it has the value 0.

All parameters are set to 0 in the interpolation after tool life data is sent. After this is completed, tool life capture starts for the tool that was just replaced.

Weighting

The NC program can change the weighting the tool life values. The changeable factor is used to adapt tool life acquisition to tool use.

Weighting factors

The following two decoder variables are used to program the weighting factors of service life and service distance (access is not synchronous with real time):

Weighting of service life: V.TLM.TIME_FACT

Weighting of service distance: V.TLM.DIST_FACT

The variables are readable and writable. Both factors are 100% at program start. Both variables may be written in an NC block.

Example

Saving tool life parameters

A tool that is always in contact should be weighted with a factor of 100%. However, if material is only removed along half the motion path, a weighting factor of 0.5 can be included in the calculation.

The default value of the weighting factors of service time and service distance is 1.0.

Notice

Acquisition conditions:

If the parameter P-CHAN-00255 is not set, all motion types except for rapid traverses are considered in the tool life calculation. For example, G01, G02, G03, spline interpolation and G63 are included in the tool life calculation.

If the parameter P-CHAN-00255 is set, all motion types are considered in the tool life calculation.

Tool life acquisition is stopped at a feedrate of zero.

The weighting factors are included in the calculation.

A distinction is not made between main and tracking axes for axes participating in the motion. The path feedrate is always used to add up the distance. In the case of tracking axes programmed on their own in the block, the path covered by the tracking axis is added to the service distance. If this is not desired, the programmer can correct it by specifying the weighting factors V.TLM.TIME_FACT/DIST_FACT = 0.

Active master/slave arrangements are not taken into account.

In the event of a reset or program abort, the last updated values are also included in the tool management database.

If a tool is replaced for the first time, i.e. the work spindle was previously empty and the current T number is equal to 0, no data is sent.

2.3.1   Access to tool life parameters

Tool life time/tool life distance

In addition to the possibility of sending tool life data by an NC command to the tool management system (#TOOL LIFE READ), tool life data also can be evaluated online by CNC objects.

The factors for tool life weighting (cf V.TLM.TIME_FACT, V.TLM.DIST_FACT) can also be changed.

Display of tool life parameters in the ISG Object Browser
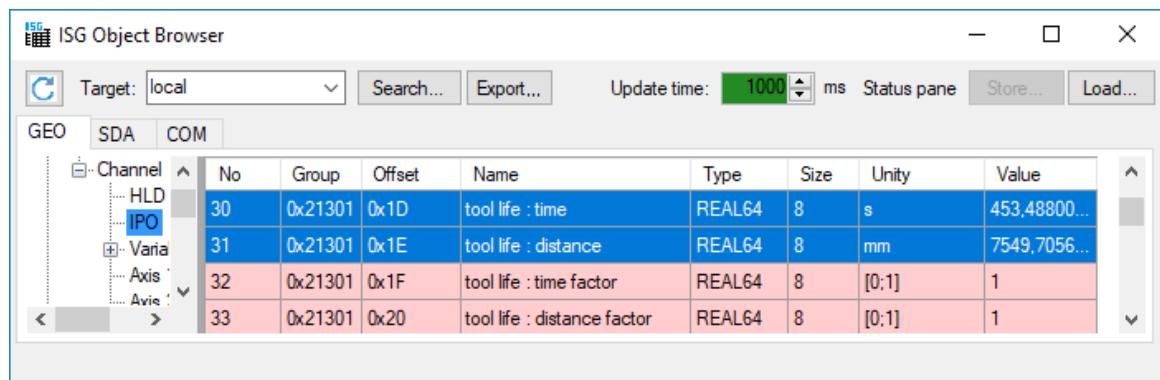
Fig. 1: ISG Object Browser – tool life

CNC objects for tool life data detection

Name	tool life : distance		
Description	This CNC object specifies the tool life of the currently active tool.		
Task	GEO (Port 551)		
Index group	0x12130<C_{ID}>	Index offset	0x1E
Data type	REAL64	Length/byte	8
Attributes	read	Unit	[mm]
Remarks			

Name	tool life : distance factor		
Description	This CNC object defines and reads the life distance weighting.		
Task	GEO (Port 551)		
Index group	0x12130<C_{ID}>	Index offset	0x20
Data type	REAL64	Length/byte	8
Attributes	read/ write	Unit	[s]
Remarks			

Name	tool life : time		
Description	This CNC object specifies the tool life time of the currently active tool.		
Task	GEO (Port 551)		
Index group	0x12130<C_{ID}>	Index offset	0x1D
Data type	REAL64	Length/byte	8
Attributes	read	Unit	[s]
Remarks			

Name	tool life : time factor		
Description	This CNC object defines and reads the tool life time weighting.		
Task	GEO (Port 551)		
Index group	0x12130<C_{ID}>	Index offset	0x1F
Data type	REAL64	Length/byte	8
Attributes	read/ write	Unit	[-]
Remarks	Range [0;1]		

Name	tool life : tool id		
Description	This CNC object reads the index of the current tool for tool life time detection.		
Task	GEO (Port 551)		
Index group	0x12130<C_{ID}>	Index offset	0x1C
Data type	UNS32	Length/byte	4
Attributes	read	Unit	[-]
Remarks			

3   Communication with ext. tool management system (PLC)

CNC channel identification

Every request contains a unique job number. On a multichannel CNC machine, the channel number [1; max] of the CNC channel which initiated the request is encoded. The response must always contain the job number.

This unique job number is also referred to as "invoke id" (ADSRDWRTIND.INVOKEID, 32 bits).

3.1   Tool data (D or #TOOL DATA)

Tool geometry

With every D<i> or #TOOL DATA the CNC requests tool data during NC program decoding.

When the new tool is requested, the D number, T number and the freely usable P parameter of the currently replaced tool are also included. This permits the PLC to detect which tool is to be replaced. Wear can be entered in the NC program by the P parameter, for example, and can be returned to the PLC in the tool change.

The following data (CNC_TOOL_REQUEST_IN) is transferred in the request from the CNC to the PLC:

id: CNC_TOOL_ID; (tool id of requested tool)

act_t_nr : DINT; (actual t number in nc kernel)

act_d_nr : CNC_TOOL_ID; (actual tool id in nc kernel)

param : ARRAY[1..60] OF LREAL;

log_ax_nr_tool_length: UINT; (spindle axis for tool length compensation)

The PLC returns the complete tool record (CNC_TOOL_DESC).
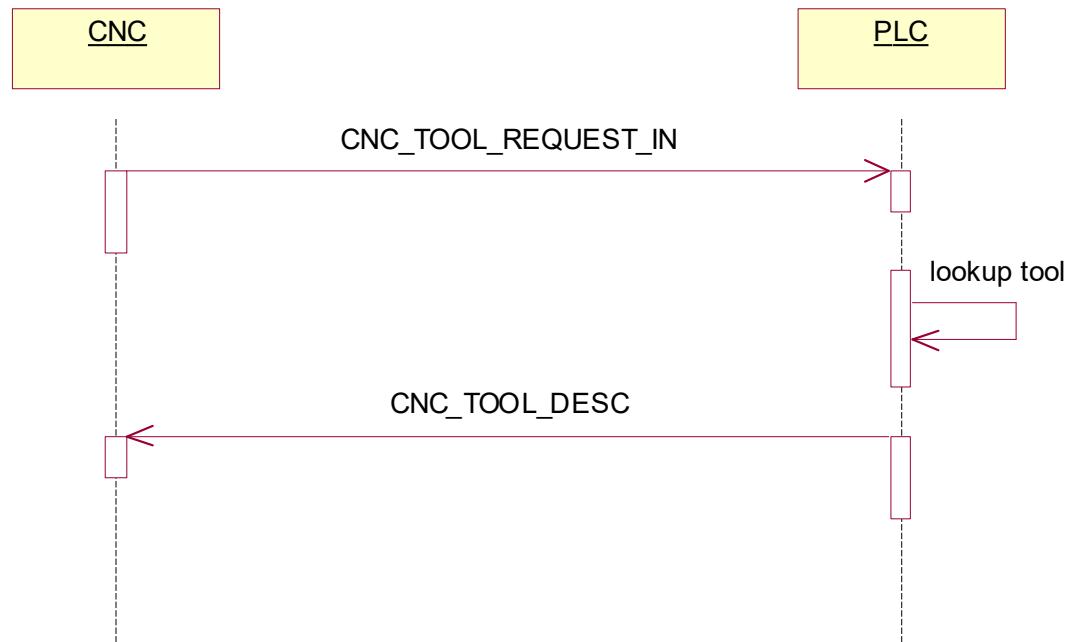
Fig. 2: Requesting tool data from the PLC

Programing Example

Tool manager in the PLC program
Tool data

```
RInd: ADSRDWRTIND;
RRes : ADSRDWRTRES;

Rind;

IF RInd.VALID THEN

(* initialise response *)
RRes.NETID := '';
RRes.PORT := RInd.PORT;
RRes.INVOKEID := RInd.INVOKEID;

(* sender channel no. is coded in the invoke id *)
cnc_channel_nr := RInd.INVOKEID;
cnc_channel_nr := cnc_channel_nr AND 16#00FFFFFF;


(* CNC requests tool geometry data due to D<i> *)
IF RInd.IDXGRP = ADS_IGRP_TOOL_DESC_READ THEN

(* Tool data request from CNC *)
pToolReq := RInd.DATAADDR;
BasicToolId := pToolReq^.id.basic;
SpindleID:= pToolReq^.log_ax_nr_tool_length;

IF BasicToolId <= MAX_TOOLS THEN
(* transmit tool data in the response *)
RRes.LEN := SIZEOF(tool[1].cnc.tool_desc);
RRes.DATAADDR := ADR(tool[BasicToolId].cnc.tool_desc);
RRes.RESULT := ADS_RDWRT_IND_NO_ERROR;
ELSE
(* Tool not present *)
RRes.LEN := 0;
RRes.DATAADDR := 0;
RRes.RESULT := WZV_TOOL_ID_BASIC_INVALID;
END_IF
```

Programing Example

Tool request

```
%main
N10 X1200
N11 S2[D1] (request tool D1 for spindle S2
N20 S2[D2 REV=1 M4] (request tool D2 for spindle S2
N30 D3 S100 M3 (request tool D3 for spindle S
N40 X0
N50 M30
```

3.2 Tool change (T or #TOOL PREP)

3.2.1 Initialisation

Data format

There is often a real tool in the spindle when the control unit is restarted. The PLC has the option of directly communicating this tool to the CNC. The number of this tool can be read in the NC program by the variable V.G.T_AKT and can then be used in the NC channel for the correct selection of the real tool.

Example
PLC view

```
bWrite: BOOL := FALSE;
ToolWrite        : ADSWRITE;
ToolNo: DINT   := 4711;

IF bWrite = TRUE THEN
        bWrite := FALSE;
        ToolWrite(Write := FALSE);
        ToolWrite.NETID := '';
        ToolWrite.PORT := ADS_PORT_TASK_SDA;
        ToolWrite.IDXGRP := ADS_IGRP_DECODER_OF_CHANNEL + 1;
        ToolWrite.IDXOFFS := ADS_IOFFS_ACTUAL_T_NUMBER;
        ToolWrite.SrcAddr := ADR(ToolNr);
        ToolWrite.LEN := SIZEOF(ToolNr);
        ToolWrite(Write := TRUE);
END_IF
ToolWrite();
```

3.2.2   Information to PLC

Tool change

With every programmed T<i> or #TOOL PREP, the CNC communicates the tool number to the PLC during NC program decoding, provided this function is activated in the channel parameter list (P-CHAN-00087).

This advance information can be used by the external tool management system to prepare a tool change (cleaning the tool, turning the disk changer, etc.) to save time.

The following data (CNC_TOOL_ID) is transferred in the request from the CNC to the PLC; the T number is entered in the basic element:

```
basic           : DINT;
sister          : DINT;
variant         : DINT;
sister_valid    : BOOL;
variant_valid   : BOOL;
```

The PLC must acknowledge receipt by returning the identical message.
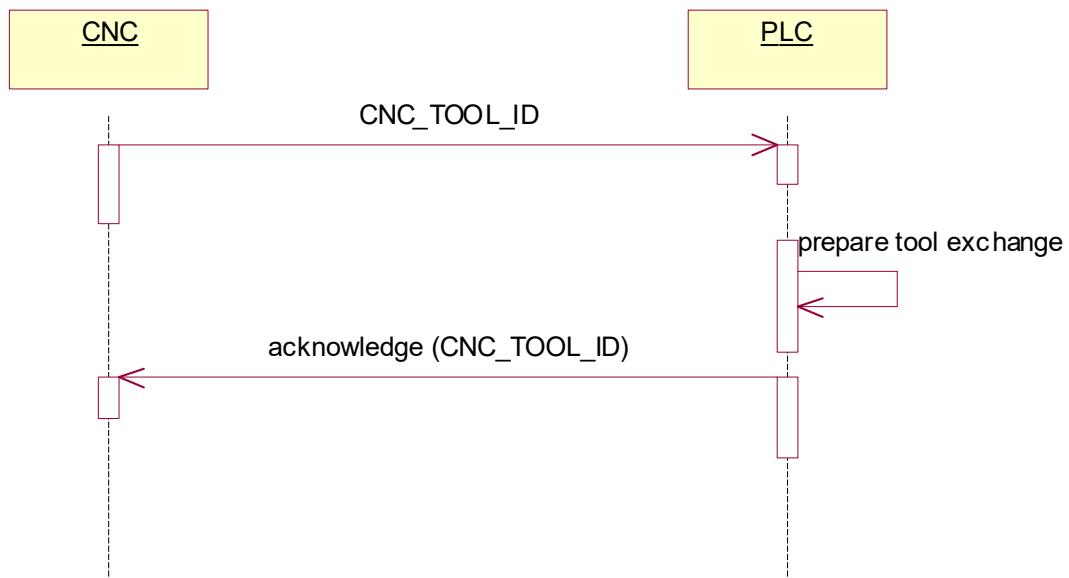

Fig. 3: Advance information about tool change to the PLC

Programing Example

Tool manager in the PLC program
Tool information

```
...

(* CNC communicates tool change T<i> (during program decoding) *)
ELSIF RInd.IDXGRP = ADS_IGRP_TOOL_INFO_WRITE THEN

(* CNC writes tool life data *)
pTid := RInd.DATAADDR;
BasicToolId := pTid^.basic;

IF BasicToolId <= MAX_TOOLS THEN
(* save actual requested tool T<nr> *)

(* Tool id in valid range *)
RRes.LEN := SIZEOF(pTid^);
RRes.DATAADDR := pTid;
RRes.RESULT := ADS_RDWRT_IND_NO_ERROR;

ELSE
(* no data transmitted in the response *)
RRes.LEN := 0;
RRes.DATAADDR := 0;
RRes.RESULT := WZV_TOOL_ID_BASIC_INVALID;
END_IF
ELSE
```

3.3 Tool life data

Tool life time, tool life distance

With every programmed T<i> or #TOOL PREP and if P-CHAN-00076 is set, the complete tool ID, tool life time and tool life distance are sent automatically by the CNC to the PLC.

The transferred data can be saved and further processed in the PLC. The PLC must acknowledge receipt by returning a blank message.

The following data is transferred by the CNC to the PLC:

CNC_TOOL_DATA_IN   (Tool life data sent from CNC)

|	
tool_id	: CNC_TOOL_ID; (Tool id from CNC)
time_used	: LREAL; (Usage time of tool in seconds)
dist_used	: LREAL; (Usage distance in mm)
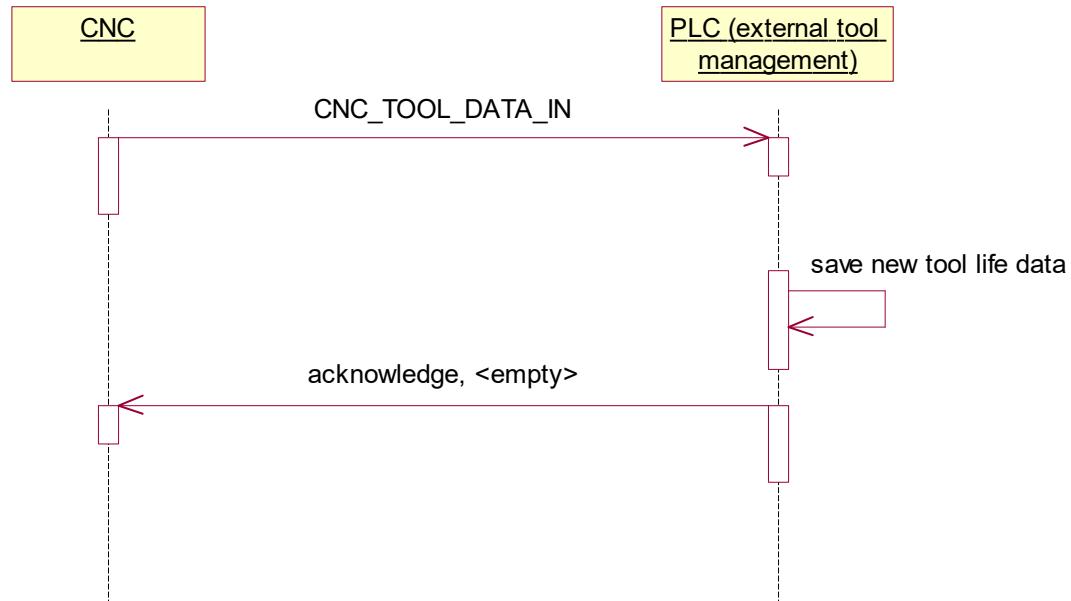
Fig. 4: Transferring tool life parameters to the PLC

Programing Example

Tool manager in the PLC program

```
...

(* CNC updates tool life data after selecting
a different tool T<i> *)
ELSIF RInd.IDXGRP = ADS_IGRP_TOOL_LIFE_DATA_WRITE THEN

(* CNC writes tool life data *)
pToolLife := RInd.DATAADDR;
BasicToolId := pToolLife^.tool_id.basic;

(* no data transmitted in the response *)
RRes.LEN := 0;
RRes.DATAADDR := 0;

IF BasicToolId <= MAX_TOOLS THEN
(* update tool life data *)
tool[BasicToolId].cnc.tool_life.dist_used := tool[Ba-
sicToolId].cnc.tool_life.dist_used
+ pToolLife^.dist_used;
tool[BasicToolId].cnc.tool_life.time_used := tool[Ba-
sicToolId].cnc.tool_life.time_used
+ pToolLife^.time_used;

(* Check validity of response*)
RRes.RESULT := ADS_RDWRT_IND_NO_ERROR;
ELSE
RRes.RESULT := WZV_TOOL_ID_BASIC_INVALID;
END_IF
```

4 Parameter

Parameterisation

The user can configure communication between the CNC and the external tool management system by making settings in the channel parameter listCHAN].

> **Attention**
>
> The parameters are set for specific channels. The settings can be made in the default list if they affect all channels.

4.1 Overview

ID	Parameter	Description
P-CHAN-00014	einrechnen_mit_t	Implicit execution of the D command in the event of T programming
P-CHAN-00016	ext_wzv_vorhanden	External tool administration available in the system
P-CHAN-00076	tool_life_to_wzv	Send tool life quantities of a tool to the tool administration
P-CHAN-00087	t_info_to_wzv	Prepare a tool change in the magazine
P-CHAN-00103	d_clear_to_wzv	Save tool data on program start
P-CHAN-00106	t_with_implicit_flush	Release motion blocks when T is selected.
P-CHAN-00255	tool_life_cap-ture_all_movements	Record all movements for tool life recording.
P-CHAN-00243	tool_life_to_wzv_sup-press_zero	Suppress output of tool life data parameters 0.

ID	Parameter	Description
P-CHAN-00014	einrechnen_mit_t	Implicit execution of the D command in the event of T programming
P-CHAN-00016	ext_wzv_vorhanden	External tool administration available in the system
P-CHAN-00087	t_info_to_wzv	Prepare a tool change in the magazine
P-CHAN-00106	t_with_implicit_flush	Release motion blocks when T is selected.

4.2   Description of channel parameters

P-CHAN-00014	Implicit execution of D word with T
Description	If a T command is programmed, the D command is implicitly executed with the same number as the T command. This mechanism can be selected both for a list-based internal and for an external tool management. This parameter has no effect on the programming of #TOOL PREP (corresponds to the T command). Afterwards, a #TOOL DATA must always be programmed.
Parameter	einrechnen_mit_t
Data type	BOOLEAN
Data range	0/1
Dimension	----
Default value	0
Remarks	Parameterisation example: The parameter 'einrechnen_mit_t' is assigned the value 1. The programming of 'T80' then corresponds to the programming command 'T80 D80'. *einrechnen_mit_t 1*

P-CHAN-00016	Tool data is requested from an external tool management
Description	If the system works with external tool management (e.g. integrated in PLC), this parameter is set to 1.
Parameter	ext_wzv_vorhanden
Data type	BOOLEAN
Data range	0/1
Dimension	----
Default value	0
Remarks	Parameterisation example: The system works with an external tool management. *ext_wzv_vorhanden 1*

P-CHAN-00076	Send tool life data to external tool management
Description	If an external tool management system is used, only tool data are requested from it by default. This parameter must also be set to send the tool life data of a tool determined in the NC kernel to the external tool management.
Parameter	tool_life_to_wzv
Data type	BOOLEAN
Data range	0/1
Dimension	----
Default value	0
Remarks	

P-CHAN-00087	Information of the external tool management in case of a T function
Description	Programming a T function generates a message which is sent to the external tool management to prepare the magazine for a tool change.
	Assignment is only executed if an external tool management is used ((P-CHAN-00016).
Parameter	t_info_to_wzv
Data type	BOOLEAN
Data range	0/1
Dimension	----
Default value	0
Remarks	Parameterisation example: If a T function is programmed, the external tool management prepares a tool change.
	t_info_to_wzv 1

P-CHAN-00103	Save and delete tool data in an external tool management
Description	Tool data of the current tool (e.g. wear parameters) can be modified via variable access (V.G.WZ_AKT...) in the NC program.
	For saving, this data is written back to external tool management each time a new tool is selected. If a tool was programmed in the previous NC program, D0 (tool deselection) is implicitly requested at <u>Program restart</u>. With this request the data of the tool last used is transmitted back at the same time to external tool management. This ensures that no modified tool data is lost.
	This saving by implicitly initiating a D0 at program start can be achieved by setting the parameter to 1. The assignment only makes sense if an external tool management function is used (P-CHAN-00016).
Parameter	d_clear_to_wzv
Data type	BOOLEAN
Data range	0/1
Dimension	----
Default value	0
Remarks	On reset, no implicit D0 is initiated. This means that the data of the tool last used is only saved on the next program start.

P-CHAN-00106	**Enabling motion blocks during T selection**
Description	By setting the parameter to 1, all motion blocks up to the T word are executed. This is an implicit '#FLUSH CONTINUE' initiated by the T word[PROG// Flushing NC channel].
	Assignment only makes sense if an external tool management is used (P-CHAN-00016).
Parameter	t_with_implicit_flush
Data type	BOOLEAN
Data range	0/1
Dimension	----
Default value	0
Remarks	

P-CHAN-00255	**Tool life data recording for rapid traverse motions**
Description	With tool life data recording, no rapid traverse motions G00 are recorded by default. This parameter achieves that rapid traverse motions are also considered for tool life data recording.
Parameter	tool_life_capture_all_movements
Data type	BOOLEAN
Data range	0: Rapid traverse motions G00 are not included in tool life data recording (default).
	1: Rapid traverse motions G00 are also included in tool life data recording.
Dimension	----
Default value	0
Remarks	

P-CHAN-00243	**Suppress output of tool life parameters 0**
Description	When parameter P-CHAN-00076 is set, the tool life data is sent to the external tool management on every tool change, even if this is zero.
	This parameter can be set if no tool life data is sent in the event that service distance and service life = zero .
Parameter	tool_life_to_wzv_suppress_zero
Data type	BOOLEAN
Data range	0/1
Dimension	----
Default value	0
Remarks	This parameter is available as of CNC Build V2.11.2802.00 and higher.

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/

The link above forwards you to:

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Keyword index

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