SINUMERIK 840/840C
SINUMERIK 850/880
SINUMERIK 880 GA2
Computer Link
Description of Message Frames

Planning Guide 09.95 Edition

Manufacturer Documentation

SINUMERIK 840/840C
SINUMERIK 850/880
SINUMERIK 880 GA2
Computer Link
Description of Message Frames

Planning Guide

Manufacturer Documentation

Valid for:

Control	*Software version*
SINUMERIK 840	01 and higher
SINUMERIK 840C*/*CE	01 and higher
SINUMERIK 850	02 and higher
SINUMERIK 880	03 and higher
SINUMERIK 880 GA2	01

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Other functions not described in this documentation might be executable in the control. This does not, however, represent an obligation to supply such functions with a new control or when servicing.

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Preliminary Remarks

Notes for the reader

This documentation is intended for manufacturers and users of machine tools using the computer link for SINUMERIK 840, SINUMERIK 850 or SINUMERIK 880.
It describes the message frames which are exchanged on application layer between SINUMERIK 840**/**850**/**880 and the host computer. The message frames are valid for computer link with the SINUMERIK 840, SINUMERIK 850 and SINUMERIK 880 with integrated interface module in the COM area and for SINUMERIK 850 with external interface module in the PLC area where no special reference is made in this description.

The message frame description is part of the other existing publications regarding the computer link with SINUMERIK 840**/**840C, SINUMERIK 850 and SINUMERIK 880**/**880GA2.

840**/**880 in this publication represents the following control types:

- SINUMERIK 840
- SINUMERIK 840C
- SINUMERIK 880
- SINUMERIK 880GA2

Technical information

The message frame description applies to the following computer link variants:

- SINUMERIK 840 Software version: 01 and higher
  Interface modules: CP231A, CP315, CP373 in the COM area
- SINUMERIK 840C Software version: 01 and higher
  Interface modules: CP231A, CP315, CP373 in the NC area
- SINUMERIK 850 Software version: 02 and higher
  Interface modules: CP535, CP525, CP524, AS512 in the external PLC area
- SINUMERIK 850 Software version: 04 and higher
  Interface modules: CP231A, CP315, CP373 in the COM area
- SINUMERIK 880 Software version: 03 and higher
  Interface modules: CP231A, CP315, CP373 in the COM area
- SINUMERIK 880GA2 Software version: 01 and higher
  Interface modules: CP231A, CP315, CP373 in the COM area

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1 General

- In this Description "Computer Link - Description of Message Frames " the message frames (identification, useful data and error numbers) defined for SINUMERIK 840/850/880 are explained as well as sequences. In addition, information is provided concerning the various functions and their conditions.

  This message frame description has been kept general to a large extent so that it is valid for the communication systems which can be used with SINUMERIK 840/850/880 (both for bus topology with SINEC H1 and for star topology with serial interfaces).

- The user interfaces as well as the functions are documented in the descriptions to the standard function block packages for computer link. As a rule, these Descriptions also include application examples.

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2 Structure of the Message Frames

Data exchange between the SINUMERIK and the respective node (e.g. host computer) is according to a fixed scheme.

A message frame consists of procedure (procedure header and procedure end) and the message frame data.

2.1 Procedure and protocol

The procedures DK3964R or LSV2 are used in the case of SINUMERIK 840/850/880 for the serial links (point-to-point connection).

The AS 512-protocol is used above the procedure level.

General information on the procedures and the AS 512-protocol are to be found in the Description "SINUMERIK 840/880 Computer Link".

The SINEC H1 AP1.0 protocol is used for connecting SINUMERIK 840/850/880 to the SINEC H1 bus.

2.2 Message frame data

The message frame data on application layer always consist of message frame length, identification, error number and useful data.

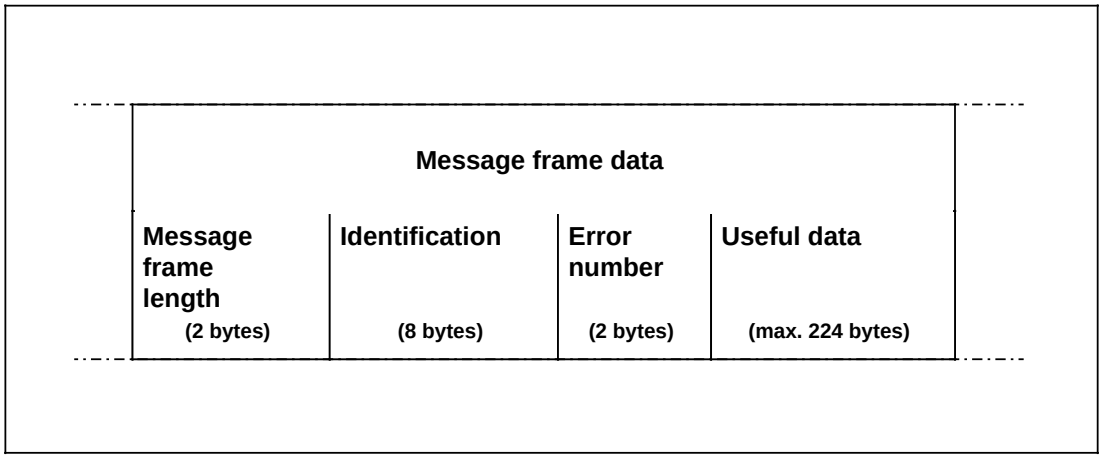


Figure 2.1 Structure of the message frame data

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2.2.1 Message frame length

The message frame length in bytes (hexadecimal format) is specified before the identification in the message frame. The message frame length is calculated by adding the number of bytes of identification and error number (always 10 bytes) + length of the useful data.

Maximum length of the message frames:

- SINUMERIK 850 with the interface modules CP535, CP525, CP524, AS512 in the external PLC area:

  The maximum useful data length is 224 bytes. Consequently, the maximum message frame length is 10 bytes + 224 bytes = 234 bytes.

- SINUMERIK 840/850/880 with the interface modules CP231A , CP315, CP373 in the COM area:

  The maximum useful data length is 244 bytes. As a result, the maximum message frame length is 10 bytes + 244 bytes = 254 bytes.

Note:

For reasons of compatibility with SINUMERIK 850 with interface modules in the external PLC area, when extending existing flexible manufacturing systems, a message frame length of 234 bytes must not be exceeded (the maximum message frame length is adjustable).
Subsequent message frames are required in the case of data sets which exceed the maximum message frame length. In the case of serial link, data sets greater than 128 bytes are automatically transmitted in two blocks depending on the interface module used. The message frame data are divided into two blocks at the interface module.

2.2.2 Identification

The message frame identification always consists of eight characters (ASCII format).

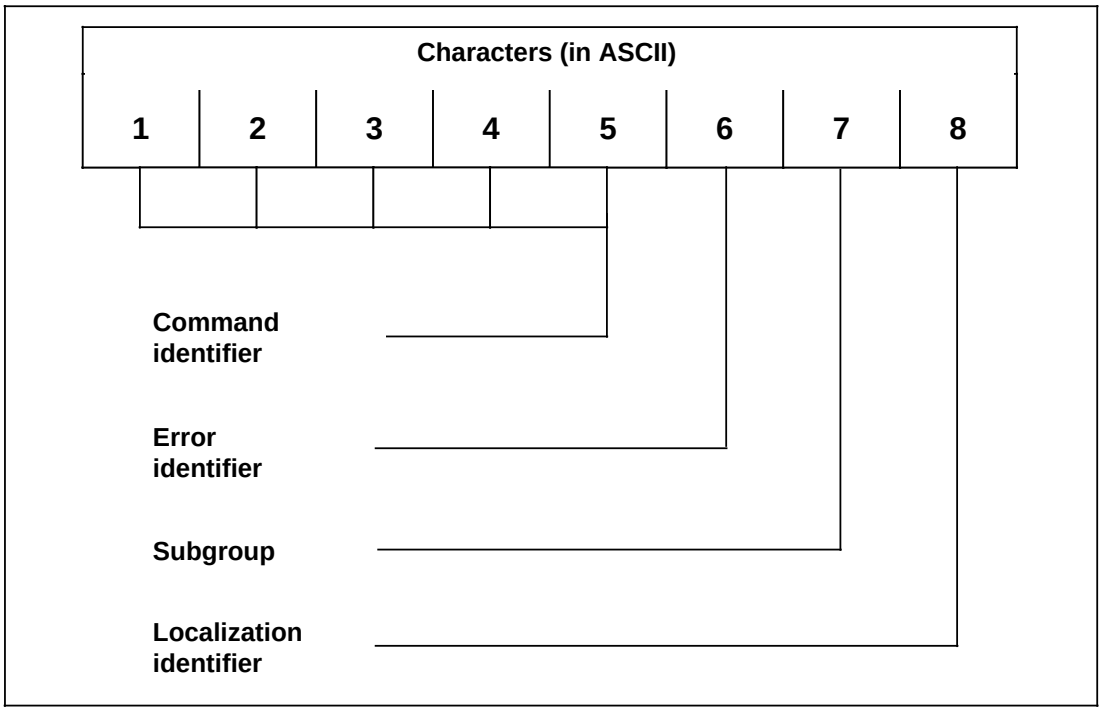


Figure 2.2 Structure of the identification

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The meaning of the characters in the message frame identification is explained below:

a) Characters 1 to 5 (command identifier)

1st character:
The first character defines the type of command

C	(Command)	=	Command call
Q	(Acknowledgement)	=	Acknowledgement of an executed job
P	(Prepare)	=	Request to prepare
R	(Receive)	=	Request to receive data
T	(Transmit)	=	Request to transmit data

b) Character 6 (error identifier)

F	(Error)	=	If a received message frame cannot be processed or contains an error, the initiating message frame is returned to the sender (host computer or PLC) with identification "F" as a 6th character.

Otherwise blank (space)

c) Character 7 (subgroup identifier)

Within a session it must be possible to distinguish clearly between the individual message frames. The 7th character of the message frame heading defines a session step with which certain message frames that occur repeatedly within a session are identified additionally. In this way, the message frame becomes unique within the session.

7th character:

A	(Beginning)	=	Beginning of a session
B	(Machining station)	=	Arrival of a pallet at the machining station
E	(End)	=	End or temporary end of a session
G	(Off)	=	Event off
K	(On)	=	Event on
M	(Machine)	=	Arrival of a pallet at the machine

Otherwise blank (space)

d) Character 8 (localization identifier)

The 8th character defines the mode group. For operating mode group = 0 the message frame applies to all mode groups. When alarms are reported, identification "P" is specified in the 8th character for PLC alarms or "N" for NC alarms.

8th character:

g	(1 ... 8, 0)	=	Number of the mode group
0		=	All mode groups
N	(NC alarms)	=	Reporting of NC alarms
P	(PLC alarms)	=	Reporting of PLC alarms

A blank (space) is used as 8th character for message frames for which the allocation to mode groups makes no sense, e.g. line monitoring (T _ OK).

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2.2.3 Error numbers

The following applies to the rejection of a message frame and the error number:

- A spaceholder for an error number (fnr) is reserved generally in all message frames. The reserved space for the error number is located behind the identification and before the actual useful data (= bytes 9 and 10). The error number requires 2 bytes.
- The format of the error number is a fixed-point word; only positive values. Range of values: 0 ... 9999 (decimal).
- In an error message frame the 6th character of the message frame identification includes the identification "F". In the case of these so-called F-message frames the error number transmitted with the message frame is located in defined data areas, where it can be evaluated if necessary. If the 6th character of the message frame identification is a blank, the error number must always be zero.
- Every message frame can be returned to the sender with the F identification as the 6th character in the identification (= message frame rejection).

  This description of message frames shows only those error messages which are activated on account of logical relationships. However, a message frame with F identification is not returned again as an error message.
- Separate error lists (range 0 ... 999) exist for the error numbers reported by the host computer and the PLC/NC respectively. In the case of the PLC/NC error messages the range 5000 ... 9999 is reserved for user error messages.

  The list of the error numbers which are transmitted by the SINUMERIK to the host computer is specified in Section 7. The error numbers which the host computer sends to the SINUMERIK are not included in this description (see Specification FMS S850/ CP535-FLR).
- In the case of the error message frames which are transmitted by the PLC to the host computer, it has to be distinguished whether the incoming message frame has been acknowledged as negative by the user or by the standard.

  If the user activates an error message frame, he must also specify the error number and the corresponding useful data. Otherwise, this is effected by the standard which always returns to the sender the useful data sent by the host computer in the error message frame.
- The error number transmitted by the host computer to the PLC in the case of negative acknowledgement (error message frame) is transferred to the user.

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2.2.4 Useful data

Most message frames also have useful data in addition to the identification (Example: NC program data for NC file transfer).

224 characters (bytes) are determined as maximum character number for the useful data in the case of SINUMERIK 850 with the interface modules CP535, CP525, CP524, AS512 in the external PLC area.

A maximum of 244 characters is possible in the case of SINUMERIK 840/850/880 with the interface modules CP231A, CP315, CP373 in the COM area.

Note:

If SINUMERIK 840/850/880 with the interface modules CP231A , CP315, CP373 in the COM area is connected to existing FMS systems, for compatibility reasons a maximum useful data length of 224 bytes must be used.

For data sets greater than the maximum message frame length, subsequent message frames must be sent until all data are transmitted (Example: Transmission of NC programs).

The following data formats are used for the useful data in the message frames.

- ASCII characters
- Fixed point number
- Binary coded decimal number (BCD number with and without decimal point)
- Binary code (bit pattern)

The fixed point and BCD numerical formats are explained in greater detail in Section 6.

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3 Overview of Functions

In the following table, all identifications of the presently agreed message frames are shown which are required with flexible manufacturing systems between SINUMERIK 840/850/880 and the node (as a rule the host computer).

The table specifies in addition to the message frame identification :

- The direction of the message frame with the aid of an arrow which always points from the transmitter to the receiver of the respective message frame.
- The type of message frames with the aid of the symbols S, K and P
  S = Standard message frame
  K = Message frame of a kernel sequence
  P = Configurable message frame (via user interface)
  The message frame types are defined in Section 4.1.
- The section in which the corresponding message frame and the corresponding useful data are described.

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Functions	Identification	Host-CNC	Messg. fr. type	Section
Message frames for operator-process communication				4.2
Pallet arrival messages				
Action: pallet delivered to machine	R _ P N _ _ M g		P	4.2.1
Response: negative acknowledgement	R _ P N _ F M g		P	
positive acknowledgement	Q _ P N _ _ M g		P	
Pallet delivered to the machining station	R _ P N _ _ B g		P	4.2.2
NC program selection Start/end message				4.2.3
Action: NC program selection with start enable	C _ C S _ _ A g		P	
Response: negative acknowledgement	C _ C S _ F A g		P	
positive acknowledgement	Q _ C S _ _ A g		P	
Report beginning of machining	R _ C S _ _ A g		P	4.2.4
Report end of machining	R _ C S _ _ E g		P	4.2.5
Remove pallet from machining station				4.2.6
Action: remove pallet	C _ P A _ _ _ g		P	
Response: negative acknowledgement	C _ P A _ F _ g		P	
positive acknowledgement	Q _ P A _ _ _ g		P	
Message frames for influencing the NC				4.2
Event message frames				4.2.8
NC alarms on	R _ A L _ _ K N		S	4.2.8.1
PLC alarms on	R _ A L _ _ K P		S	
All alarms off	R _ A L _ _ G _		S	
Operator interrupt on	R _ B U _ _ K _		S	4.2.8.2
Operator interrupt off	R _ B U _ _ G _		S	
Status message on	R _ B M _ _ K _		S	4.2.8.3
Status message off	R _ B M _ _ G _		S	
Continuation message	R _ F S _ _ _ _		S	4.2.8.4
Connection monitoring				4.2.9
Test message frame from host computer	T _ O K _ _ _ _		S	
Reply from CNC	R _ O K _ _ _ _		S	

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Functions	Identification	Host-CNC	Messg. fr. type	Section
Host computer mode switchover				4.2.10
by host computer	C _ M O _ _ _ _		S	4.2.10.2
by CNC (activate manual FMS mode)	R _ M O _ _ _ _		S	4.2.10.3
by CNC (manual FMS mode terminated)	R _ M O _ E _ _		S	4.2.10.3
Computer link cold restart by CNC				4.2.11
Computer link cold restart by CNC	R _ N S _ _ _ _		S	
Synchronization				4.3.1
Beginning of synchronization	T _ S Y _ _ _ _		S	
Rejection/abort from PLC (negative acknowledgement)	T _ S Y _ F _ _		S	
Transmission of status data (positive acknowledgement)	R _ S Y _ _ _ _		S	
End of synchronization message	T _ S Y _ _ E _		S	
Abort by host computer	R _ S Y _ F _ _		S	
Interrogation of " all " pallets at machine				4.3.1.3
Pallet data request	T _ S P _ _ _ g		P	
Rejection by PLC (negative acknowledgement)	T _ S P _ F _ g		P	
Pallet data transmission (positive acknowledgement)	R _ S P _ _ _ g		P	
Transmit data of the last pallet (end)	R _ S P _ _ E g		P	
Abort of the pallet data transmission by host computer	R _ S P _ F _ g		P	
End-of-work				4.3.2
Action: change end-of-work status	C _ F A _ _ _ _		S	
Response: rejection by PLC (negative acknowledgement)	C _ F A _ F _ _		S	
End-of-work status changed (positive acknowledgement)	Q _ F A _ _ _ _		S	

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Functions	Identification	Host-CNC	Messg. fr. type	Section
Tool message frames				
Report all tool magazine assignments				4.4.3.1
Tool block request	T _ T G _ _ _ _		K	
Tool block request (negative acknowledgement)	T _ T G _ F _ _		K	
Tool block transmission (positive acknowledgement)	R _ T G _ _ _ _		K	
End of session message: all available tools reported	R _ T G _ _ E _		K	
Session abort by host computer	R _ T G _ F _ _		K	
Load magazine assignments				4.4.3.2
Transmit tool data of the first cutting edge of 1st tool	R _ M B _ _ A _		K	
Acknowledgement from CNC				
negative acknowledgement	R _ M B _ F A _		K	
positive acknowledgement	T _ M B _ _ A _		K	
Transmit tool data of the next cutting edge	R _ M B _ _ _ _		K	
Acknowledgement from CNC				
negative acknowledgement	R _ M B _ F _ _		K	
positive acknowledgement	T _ M B _ _ _ _		K	
Transmit tool data of the last cutting edge of the last tool	R _ M B _ E _ _		K	
Acknowledgement from CNC				
negative acknowledgement	R _ M B _ F E _		K	
positive acknowledgement	T _ M B _ _ E _		K	
Session abort	T _ M B _ F _ _		K	
Report all tools used				4.4.4
Tool block request	T _ T Q _ _ _ _		K	
Tool block request (negative acknowledgement)	T _ T Q _ F _ _		K	
Tool block transmission (positive acknowledgement)	R _ T Q _ _ _ _		K	
End of session message: all tools used reported	R _ T Q _ _ E _		K	
Session abort by host computer	R _ T Q _ F _ _		K	

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Functions	Identification	Host-CNC	Messg. fr. type	Section
Reporting a single-edge tool				4.4.5.1
Transmit tool data of the single cutting edge	R _ T S _ _ E _		P	
Acknowledgement by host computer:				
negative acknowledgement	R _ T S _ F E _		K	
positive acknowledgement	T _ T S _ _ E _		K	
Reporting a multi-edge tool				4.4.5.2
Transmit tool data of the first cutting edge	R _ T S _ _ A _		P	
Acknowledgement by host computer:				
negative acknowledgement	R _ T S _ F E _		K	
Requests next cutting edge	T _ T S _ _ _ _		K	
Response by CNC:				
negative acknowledgement	T _ T S _ F _ _		K	
Transmit tool data of next cutting edge	R _ T S _ _ _ _		K	
Acknowledgement by host computer:				
negative acknowledgement	R _ T S _ F _ _		K	
positive acknowledgement	T _ T S _ _ _ _		K	
Response by CNC:				
negative acknowledgement	T _ T S _ F _ _		K	
Transmit tool data of last cutting edge	R _ T S _ _ E _		K	
Acknowledgement by host computer:				
negative acknowledgement	R _ T S _ F E _		K	
positive acknowledgement	T _ T S _ _ E _		K	
Reporting a tool (only 1st cutting edge)				4.4.5.3
Transmit tool data of the first cutting edge	R _ T S _ _ _ _		P	
Random loading without code carrier				4.4.6.1
Loading initiation - request tool load	T _ WB _ _ A _		P	
Rejection by host computer (negative acknowledgement)	T _ WB _ F A _		K	
Transmit tool data (positive acknowledgement)	R _ WB _ _ _ _		K	
Request tool data next cutting edge	T _ WB _ _ _ _		K	
Transmit tool data last cutting edge	R _ WB _ _ E _		K	
Acknowledgement: Receipt of tool data last cutting edge	T _ WB _ _ E _		K	
Session abort by PLC	R _ WB _ F _ _		K	
Session abort by host	T _ WB _ F _ _		K	

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Functions	Identification	Host-CNC	Messg. fr. type	Section
Random loading - report loaded tool				4.4.6.1
Tool is loaded	Q _ WB _ _ _ _		P	
Tool is not loaded	Q _ WB _ F _ _		P	
Random loading with code carrier				4.4.6.2
Transmit tool data 1st cutting edge	R _ WB C _ A _		K	
Rejection by host computer (negative acknowledgement)	R _ WB C F A _		K	
Request tool data of next cutting edge	T _ WB C _ _ _		K	
Transmit tool data next cutting edge	R _ WB C _ _ _		K	
Transmit tool data last cutting edge	R _ WB C _ E _		K	
Acknowledgement: Receipt tool data last cutting edge	T _ WB C _ E _		K	
Session abort by PLC	T _ WB C F _ _		K	
Session abort by host computer	R _ WB C F _ _		K	
Random unloading with/without code carrier				4.4.7
Unloading initiation - report tool data first cutting edge	R _ WE _ _ A _		P	
Rejection by host computer (negative acknowledgement)	R _ WE _ F A _		K	
Request tool data next cutting edge (pos. acknowledgement)	T _ WE _ _ _ _		K	
Report tool data next cutting edge	R _ WE _ _ _ _		K	
Report tool data last cutting edge	R _ WE _ _ E _		K	
Acknowledgement: Receipt of tool data last cutting edge	T _ WE _ _ E _		K	
Session abort by PLC	T _ WE _ F _ _		K	
Session abort by host computer	R _ WE _ F _ _		K	
Random unloading - Report unloaded tool				4.4.7.3
Tool is unloaded	Q _ WE _ _ _ _		P	
Tool is not unloaded	Q _ WE _ F _ _		P	

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Functions	Identification	Host-CNC	Messg. fr. type	Section
Loading/unloading of tool cartridges				4.4.8 4.4.8.1
Report cartridge arrival to host computer	R _ K N _ _ M _		P	
Negative acknowledgement by host computer	R _ K N _ F M _		P	
Positive acknowledgement by host computer	Q _ K N _ _ M _		P	
Transmit cartridge assignment (loading list) to CNC (1st message frame)	R _ T L _ _ _ _		K	4.4.8.2
Acknowledgement by PLC to loading list (1st message frame)	Q _ T L _ _ _ _		K	
Cartridge assignment (loading list) last message frame	R _ T L _ _ E _		K	
Acknowledgement of PLC to loading list (last message frame)	Q _ T L _ E _		K	
Transmit unloading list to CNC (1st message frame)	R _ T U _ _ _ _		K	4.4.8.3
Acknowledgement by PLC to unloading list (1st message frame)	Q _ T U _ _ _ _		K	
Unloading list last message frame	R _ T U _ _ E _		K	
Acknowledgement by PLC to unloading list (last message frame)	Q _ T U _ _ E _		K	
Enable for tool cartridge machining	C _ T E _ _ _ _		P	4.4.8.4
Negative acknowledgement by PLC	C _ T E _ F _ _		P	
PLC reports beginning of machining	Q _ T E _ _ _ _		P	

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Functions	Identification	Host-CNC	Messg. fr. type	Section
Loading/unloading of tool cartridges (continued)				
End of machining with cartridge assignments (1st message frame)	R _ T P _ _ _ _		K	4.4.8.5
Negative acknowledgement by host computer	R _ T P _ F _ _		K	
Positive acknowledgement by host computer with request for next block	Q _ T P _ _ _ _		K	
End of machining with cartridge assignments (last message frame)	R _ T P _ _ E _		K	
Negative acknowledgement by host computer	R _ T P _ F E _		K	
Positive acknowledgement by host computer to cartridge assignments (last message frame)	Q _ T P _ _ E _		K	

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Functions	Identification	Host-CNC	Messg. fr. type	Section
NC file transfer				4.5.2
Transmit NC files to CNC, request by host				
Request by host computer	P R a a a _ _ _		S	
Acknowledgement by CNC				
negative acknowledgement	P R a a a F _ _		S	
positive acknowledgement	T N a a a _ _ _		S	
Response by host computer:				
negative acknowledgement	T N a a a F _ _		S	
Transmission of the NC data	R N a a a _ _ _		S	
Acknowledgement by CNC				
negative acknowledgement	R N a a a F _ _		S	
positive acknowledgement	T N a a a _ _ _		S	
End of NC data transmission	R N a a a _ E _		S	
Acknowledgement by CNC:				
negative acknowledgement	R N a a a F E _		S	
positive acknowledgement	R E a a a _ _ _		S	
Transmit NC files to CNC, request by operator				4.5.3
Request by operator	T D a a a _ _ _		S	
Response by host computer:				
negative acknowledgement	T D a a a F _ _		S	
Request by host computer	P R a a a _ _ _		S	
Acknowledgement by CNC				
negative acknowledgement	P R a a a F _ _		S	
positive acknowledgement	T N a a a _ _ _		S	
Response by host computer:				
negative acknowledgement	T N a a a F _ _		S	
Transmission of NC data	R N a a a _ _ _		S	
Acknowledgement by CNC				
negative acknowledgement	R N a a a F _ _		S	
positive acknowledgement	T N a a a _ _ _		S	
End of NC data transmission	R N a a a _ E _		S	
Acknowledgement by CNC				
negative acknowledgement	R N a a a F E _		S	
positive acknowledgement	R E a a a _ _ _		S	

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Functions	Identification	Host-CNC	Messg. fr. type	Section
NC file transfer (continued)				4.5.4
Transmit NC files back to host computer, request by host computer				
Request by host computer	P T a a a _ _ _		S	
Response by CNC				
negative acknowledgement	P T a a a F _ _		S	
Transmit NC data back	R N a a a _ _ _		S	
Acknowledgement by host computer:				
negative acknowledgement	R N a a a F _ _		S	
positive acknowledgement	T N a a a _ _ _		S	
End of NC data retransmission	R N a a a _ E _		S	
Acknowledgement by host computer:				
negative acknowledgement	R N a a a F E _		S	
positive acknowledgement	R E a a a _ _ _		S	
Transmit NC files back to host computer, request by operator				4.5.5
Request by operator	R D a a a _ _ _		S	
Acknowledgement by host computer:				
negative acknowledgement	R D a a a F _ _		S	
positive acknowledgement	P T a a a _ _ _		S	
Response by CNC				
negative acknowledgement	P T a a a F _ _		S	
Transmit back NC data	R N a a a _ _ _		S	
Acknowledgement by host computer:				
negative acknowledgement	R N a a a F _ _		S	
positive acknowledgement	T N a a a _ _ _		S	
End of NC data retransmission	R N a a a _ E _		S	
Acknowledgement by host computer:				
negative acknowledgement	R N a a a F E _		S	
positive acknowledgement	R E a a a _ _ _		S	

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Functions	Identification	Host-CNC	Messg. fr. type	Section
NC file transfer (continued)				
Erase NC files				4.5.6
Announce erasing of NC files	P R C L F _ _ _		S	
Response by CNC				
negative acknowledgement	P R C L F F _ _		S	
Request transmission of erase data	T N C L F _ _ _		S	
Response by host computer:				
negative acknowledgement	T N C L F F _ _		S	
Transmit erase data	R N C L F _ _ _		S	
End of session	R N C L F _ E _		S	
Acknowledgement by CNC				
negative acknowledgement	R N K O M F _ _		S	
positive acknowledgement	R N K O M _ _ _		S	

Note: File transfer between SINUMERIK 840C (MMC and NCK) and the host computer with its special message frames is described in Section 4.5.9.

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Functions	Identification	Coding station-CNC	Messg. fr. type	Section
Session with pallet coding station				
Read from pallet data carrier:				4.6.1
Request pallet data reading	T _ C R _ _ _ _		P	
Response by coding station:				
negative acknowledgement	T _ C R _ F _ _		P	
Transmit pallet data	R _ C R _ _ _ _		P	
Write to pallet data carrier:				
Transmit pallet data	R _ C W_ _ _ _		P	
Response by coding station:				
negative acknowledgement	R _ C W_ F _ _		P	
Data written on carriers	T _ C W_ _ _ _		P	
Reset data carriers				
CNC aborts pending instruction	C _ C R _ _ _ _		P	
End session:				
Request session end	C _ C N _ _ _ _		P	
Response by coding station:				
negative acknowledgement	C _ C N _ F _ _		P	
Coding station ends session	Q _ C N _ _ _ _		P	
Session with tool coding station				
Read from tool data carrier:				4.6.2
Request tool data reading	T _ C B _ _ _ _		P	
Response by coding station:				
negative acknowledgement	T _ C B _ F _ _		P	
Transmit tool data	R _ C B _ _ _ _		P	
Writing to tool data carrier:				
Transmit tool data	R _ C E _ _ _ _		P	
Response by coding station:				
negative acknowledgement	R _ C R _ F _ _		P	
Data written to carriers	T _ C E _ _ _ _		P	
Delete initiation on data carrier:	R _ C L _ _ _ _		P	
positive acknowledgement	T _ C L _ _ _ _		P	
negative acknowledgement	R _ C L _ F _ _		P	

1) *Coding station*

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4 Message Frames

4.1 General

The interface between the SINUMERIK 840/850/880 and the host computer is described herein as seen from the SINUMERIK side.

The extent of the documented message frames depends on the needs of flexible manufacturing systems.

The message frames between host computer and SINUMERIK 840/850/880 described in this section are defined in such a way that they can be used for a large number of different machine types and/or machine configurations.

Therefore the message frames on the SINUMERIK side were also classified into the following three types of message frames:

- Standard message frames
- Kernel sequences
- Configurable message frames via user interface

Some message frames always require a logical acknowledgement in the form of a positive or negative response message frame. The possible acknowledgements for these message frames are documented.

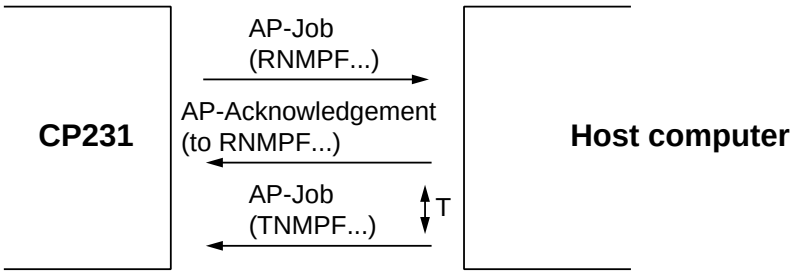
By concatenating the message frames the required sessions can be put together according to the respective requirements.

The sessions have to be agreed with the corresponding node (e.g. host computer). The session sequence is usually firmly specified by that node.

The sessions referred to in this message frame description are examples of the type required by the host computer when using SIEMENS FMS systems (i.e. the format of the useful data for the type ”p” message frames proposed here must be in compliance with the FMS system).

Note:

In order to ensure correct data transfer between the CP 231A communications processor and the host computer, the minimum time between two message frames, i.e. between AP acknowledgement and AP new job, should be approx. 30 to 50 ms.



4.1.1 Definition of message frame types

On the SINUMERIK side, the message frames are divided into three types (message frame classification) which are defined as follows:

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1. Standard message frames

Standard message frames are those message frames which are processed completely by the standard function blocks. Upon receipt of a standard message frame a signal is issued to the user interface. Some standard message frames have to be initiated via the standard interface (example: Report operator interrupt ON**/**OFF).

Examples of standard message frames are event message frames (e.g. reporting NC alarms to the host computer).

2. Kernel sequences

Kernel sequences are defined message frame sessions between host computer and PLC which are executed autonomously on the PLC side via the standard function blocks. Since the kernel sequences are processed by the standard, these sessions are fixed and cannot be changed by the PLC user program.

The message frames of the kernel sequences are a subset of standard message frames.

Some kernel sequences are initiated via the user interface "output". If a message frame is acknowledged within a kernel sequence with an error, this results always in the kernel sequence being aborted.

Entering of tool data into the corresponding NC and PLC tool memories during "Random loading" is an example of a kernel sequence.

3. Configurable message frames

Configurable message frames are those message frames, the data and information of which must be further processed in the PLC user program in the case of incoming message frames or which have to be supplied by PLC user programs in the case of message frames to be sent.

For SINUMERIK 850 with the CP535, CP525, CP524 interface modules in the PLC area, the standard program organizes the exchange of the message frame data between the input and/or output buffers and the user interfaces in the case of the configurable message frames.

For SINUMERIK 840**/**850**/**880 with the CP231A, CP315, CP373 interface modules in the COM area, the configurable message frames are transported to and from the user interface by means of the computer link basis software.

In the case of incoming message frames, the corresponding "Input" user interface is occupied by the user interface and the useful data are transmitted into the specified data areas.

The "Output" user interface initiates transmission of a message frame. The data to be included has to be provided in specified data areas.

In this message frame description, several configurable message frames frequently required for flexible manufacturing systems are defined including their useful data.

In addition, the user can define his own project-specific message frames. In this case, the command lists for input and output have to be supplemented accordingly.

In order to avoid overlapping between the project-specific user message frames and any additional new standard message frames it is recommended to use for these message frames X, Y or Z (ASCII characters) as the first character in the identification. For later extensions of the standard message frames X, Y or Z are not used as the first character in the identification.

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In this message frame description the respective type of the message frame is identified by a symbol. The following symbols are used:

S ... Standard message frame
K ... Message frame of a kernel sequence
P ... Configurable message frame via user interface

The direction specification **"Input"** and **"Output"** used in this description always refers to the SINUMERIK. Thus:

Input = Message frame from host computer to SINUMERIK
Output = Message frame of SINUMERIK to host computer

4.1.2 Remarks on the representation of message frames

The message frames are represented here as follodghws:

1. Identification
   Mnemonic with 8 ASCII characters in all cases, a blank being represented by the underscore "_".
2. Error number (fnr)
   2 bytes, format = 1 fixed point word
3. Useful data
   The useful data are enclosed in parentheses [<...useful data...>]. These parentheses are only used to facilitate representation and do not form part of the message frame as such.

   Mnemonic notation is also used for the useful data, the meaning of which is explained in each case.

   There are different data formats for useful data. It has been attempted by means of the mnemonic notation to distinguish ASCII and other formats (fixed point, BCD).

   The following applies to the representation of data formats

   ASCII: Mnemonic always consists of the same letters, the number of the letters indicating the number of ASCII characters.
   e.g. pppp = pallet number
   Data format = ASCII, 4 characters
   or
   k = parameter for subsequent machining
   Data format = ASCII, 1 character

   Fixed point**/**BCD: Mnemonic consists of different letters
   e.g. pnr = NC program number
   Data word fixed point, 1 word
   or
   tnr = tool ident. number
   Data format BCD, 8 decades

The direction of the message frame is represented with the aid of an arrow which always points from the transmitter to the receiver of the message frame.

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Furthermore, the classification is specified for each message frame (message frame type), where:

S ... Standard message frame
K ... Message frame of a kernel sequence
P ... Configurable message frame via user interface

The procedure and/or protocol-dependent acknowledgement message frames (with SINEC AP1.0 the PDU acknowledgement; with 3964R the response message frame) are not shown here for reasons of simplicity. This also applies to the message frame length included in the transmission of each message frame.

4.2 Message frames for operator-process communication and influencing the NC

The sequences for operator-process communication are made up exclusively of configurable message frames. The data exchange between host computer and PLC user program is thus effected via the input and output user interfaces. Evaluation and initiation of the message frames has to be done by the PLC user program.

Other sessions can run during the operator-process communication as required, e.g. tool sessions or loading of NC programs.

All sessions can be interrupted or aborted completely by status or alarm messages.

4.2.1 Pallet arrival at machine message

Function	Host CNC	M.fr.type
1. Message from PLC (= action): Pallet (workpiece carrier) has been delivered to machine	R _ P N _ _ M g fnr [<pppp>] <—	P
2. Response from host:		
a) negative acknowledgement by host with error message, e .g. pallet is at wrong machine	R _ P N _ F M g fnr [<pppp>] —>	P
b) positive acknowledgement by host in response to pallet arrival at machine message	Q _ P N _ _ M g fnr [<pppp>] —>	P

Comments on useful data:

pppp : Pallet number (4 bytes, ASCII)

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Conditions for "pallet arrival at machine message" :

- "Pallet arrival at machine message" must be initiated via the user interface. The message must be issued irrespective of whether a specific input station (bring station, loading station) is available or whether the input station is identical to the machining station.
- The message frame R _ PN _ _ Mg is transmitted by the CNC to the host with each FMS mode.
- If there are several intermediate stations between the input station and the machining station, the message frame R _ PN _ _ Mg should be initiated for transmission to the host computer only on arrival at the input station.
- On arrival of a pallet at the machine, the pallet is assigned in the CNC to a mode group. This mode group is reported to the host computer with the message frame "Pallet arrival message " (g in the case of identification = mode group). This mode group reported by the CNC is always included in the transmission between host computer and CNC as part of the operator-process communication.
- In the case of negative acknowledgement, the "Pallet arrival at machine message" must be reinitiated if required, since the host computer may have ignored the message. Otherwise, this would have resulted in an interruption of automatic manufacturing.

4.2.2 Pallet arrival at machining station message

Function	Host CNC	M.fr.type
1. Message from PLC Next pallet to be processed has been delivered to machining station	R _ P N _ _ B g fnr [<pppp>] <———	P

Comments on useful data:

pppp : Pallet number (4 bytes, ASCII)

Conditions for "Pallet arrival at the machining station message" :

- "Pallet arrival at the machining station message" has to be initiated by the user via the user interface. The message frame is transmitted to the host computer in every FMS mode.
- The message frame "Pallet arrival at the machining station message" should not be initiated if a subsequent operation has to be performed next (i.e. the pallet remains on machining station after machining has ended).

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4.2.3 NC program selection with start enable

Function	Host CNC	M.fr. type
1. NC program selection and start enable by host	C _ C S _ _ A g fnr [<pppp pnr k rrrrr>] ——————————————————>	P
2. Response from PLC a) negative acknowledgement with error message, if program start is not permissible or not possible	C _ C S _ F A g fnr [<pppp>] <——————————————————	P
b) positive acknowledgement to start enable	Q _ C S _ _ A g fnr [<pppp>] <——————————————————	P

Comments on useful data:

pppp : Pallet number (4 bytes, ASCII)
pnr : NC program number (four-digit, 1 fixed point word)
k : Parameter for subsequent machining (1 byte, ASCII)
= I: Identical machining station for subsequent operation, i.e. the workpiece pallet remains on the machining station after end of machining if the pallet has been machined properly.
= U: Different machining station for subsequent operation i.e. the workpiece pallet should be removed automatically from the machining station after end of machining.
rrrrr : Reserve (5 bytes, ASCII)

Conditions for NC program selection with start enable:

- The host computer sends e.g. the program selection, after
  a) the CNC has reported to the host the arrival of the pallet at the machine and any required data sessions (e.g. load NC programs) have been ended
  or
  b) the CNC has reported to the host the number of the pallet which is on the machining station and any required data sessions (e.g. load NC programs) have been ended
  or
  c) the CNC has reported the machining end for the pallet and a subsequent operation has to be executed on the same machine and any required data sessions have been ended.

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- On receipt of the start enable, the user must check various conditions in her/his PLC user program; e.g. FMS mode = normal mode and NC mode = automatic; etc.

  The start enable has to be acknowledged positively when the test result is positive (initiation in the PLC user program).

  The start enable should also be acknowledged positively and stored if an alarm (NC/PLC) or an operator interrupt exist.

  A negative acknowledgement message frame with the corresponding error number has to be sent to the host computer when the result is negative. The start enable previously given by the host computer should be cancelled if an error occurs.

  The following conditions are to be checked by the PLC user program when using Siemens FMS and an error message frame with the corresponding error number should be initiated, if required:

  fnr = 5000 : FMS mode is not normal mode
  (i.e. no host computer material flow control mode)
  fnr = 5001 : Mode group is not in automatic mode
  fnr = 5002 : Reported pallet number is incorrect or not known

4.2.4 Report beginning of machining

Function	Host CNC	M.fr.type
1. Message from PLC Beginning of machining for pallet (workpiece carrier) is reported after the NC program for the corresponding workpiece pallet has been started	R _ C S _ _ A g fnr [<pppp zs>] <———————————————	P

Comments on useful data:

pppp: Pallet number (4 bytes, ASCII)
zs: Status identifier for beginning of machining; signalled to PLC (1 word fixed-point)
= 0: Start of program for machining normal
0: Start of program for machining not possible

Conditions:

- Message frame "report beginning of machining" has to be initiated in the PLC user program. It should be sent to the host computer only if the machining has been started due to the message frame "NC program selection and start enable" (interlocking in the PLC user program).
- If a program start is not possible the message frame should be transmitted with zs 0 to the host computer and the given start enable should be cancelled.

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4.2.5 Report end of machining

Function	Host CNC	M.fr.type
1. Message from PLC Report end of machining of an operation for pallet (workpiece carrier) to host	R _ C S _ _ E g fnr [<pppp fz k r*>] <——————————————————— *= jj data (additional data for user)	P

Comments on useful data:

pppp: Pallet number (4 bytes, ASCII)
fz: Production status to control the material flow (1 fixed point word)
0=Machined without error
1=Reject
2=Rework
3=Unfinished
4=Repetition
k: Machining for subsequent machining (1 byte, ASCII)
r: Reserve (1 byte, ASCII)
*: Additional end of machining data for user (jj data)
length can be programmed
jj: Format identification for end of machining data (2 bytes, ASCII)
(programmable data part; see also Section 4.3.1.5)
jj 01 = format identification for standard end of machining data
*when jj = 01 *: = 01 hhhh yyyy zzzz nnnn uuuu ssss ....*
hhhh: Stopping place name of output buffer (4 bytes, ASCII)
hhhh= 0000 if not used or pppp not shifted out
yyyy: Number of good parts (4 bytes, ASCII)
zzzz: Number of reject parts (4 bytes, ASCII)
nnnn: Number of rework parts (4 bytes, ASCII)
uuuu: Number of unfinished parts (4 bytes, ASCII)
ssss: Total operation time (4 bytes, ASCII)
(period in which metal was cut on the machine referred to a single operation)
....: Programmable user part (maximum of 54 bytes)

Conditions for "Report end of machining":

- Initiation for transmitting the message frame "Report end of machining " to host takes place in the PLC user program. Previously the useful data to be included in the transmission of the message frame must have been entered at the user interface accordingly.
- Message frame "Report end of machining " should be sent to the host computer only if machining has been started as a result of the message frame "NC program selection and start enable" (interlocking by PLC user program).

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4.2.6 Remove pallet from machining station

Function	Host CNC	M.fr.type
1. Command from host computer: Remove pallet from machining station in order to prevent a machining operation or a subsequent operation	C _ P A _ _ _ g fnr [<pppp hhhh>] ——————————————————>	P
2. Acknowledgement from PLC		
a) negative acknowledgement: e.g. machining of the pallet already in progress	C _ P A _ F _ g fnr [<pppp hhhh>] <——————————————————	P
b) positive acknowledgement: Pallet (workpiece carrier) has been moved from the machining station to the output station hhhh	Q _ P A _ _ _ g fnr [<pppp hhhh>] <——————————————————	P

Comments on useful data:

pppp: Pallet number (4 bytes, ASCII)
hhhh: Stopping place name of the output station from which the pallet is to be or has been removed (4 bytes, ASCII)

Conditions for "Remove pallet from machining station":

- The host computer no longer wishes an operation and/or subsequent operation to be performed on this machine (e.g. no tools are available in the machine for this operation any more) and therefore remove the workpiece pallet from the machining station.
- The message frame "Remove pallet from machining station" can be sent by the host computer before "NC program selection and start enable":
  a) before the first operation on this machine
  b) before subsequent operations on this machine
- The acknowledgement message frame (positive or negative) has to be generated in the PLC user program.
- If the host specifies with the C _ PA _ _ _ g message frame hhhh = 0000 as stopping place name, the user must specify hhhh in the positive acknowledgement.

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4.2.7 Examples for operator-process communication

The operator-process communications shown in the following are examples for sessions as required by the host when using Siemens FMS systems.

The normal sequence in the session is specified without error message frames.

4.2.7.1 Example - machining without subsequent operation

Function	Host CNC	M.fr. type
1. Action: PLC sends "Pallet arrival at machine message" to host computer	R _ P N _ _ M g fnr [<pppp*>] <———	P
Response: Host computer acknowledges positively to "Pallet arrival at machine message"	Q _ P N _ _ M g fnr [<pppp>] ———>	P
2. Transmit NC files to CNC (if necessary) host controls the data sessions required for the pallet operation	(poss. transmission of NC programs) 1) (<———>)	S
3. PLC sends "Pallet arrival at the machining station message" to the host computer	R _ P N _ _ B g fnr [<pppp>] <———	P
4. Action: Host computer gives "NC program selection with start enable"(k = U, if no subsequent operation for pallet) 2)	C _ C S _ _ A g fnr [<pppp pnr k rrrrr>] ———>	P
Response: PLC acknowledges start enable positively	Q _ C S _ _ A g fnr [<pppp>] <———	P
5. PLC reports beginning of machining for pallet (zs = 0 , if program has been started)	R _ C S _ _ A g fnr [<pppp zs>] <———	P
	Workpiece being machined	
6. PLC reports end of machining to host computer (end of an operation for the pallet)	R _ C S _ _ E g fnr [<pppp zs>] <———	P

1) *NC file transfer can take place at any time in the session*

2) *The host computer can also transmit "NC program selection with start enable" to the PLC, before the PLC has reported "Pallet arrival at machining station message".*

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4.2.7.2 Example - machining with subsequent operation

Function	Host CNC	M.fr. type
1. Action: PLC sends "Pallet arrival at machine message" to host	R_P N__ M g fnr [<pppp*>] <———	P
Response: Host computer acknowledges positively to "pallet arrival at machine message"	Q_ P N_ _ M g fnr [<pppp>] ———>	P
2. Transmit NC files to NC (if necessary) Host computer controls the data sessions required for the operation of the pallet	(poss. transmission of NC programs) 1) (<———>)	S
3. PLC sends "Pallet arrival at the machining station message" to host	R_ P N_ _ B g fnr [<pppp>] <———	P
4. Action: 2) Host computer gives "NC program selection with start enable "(k = I, identical machining station for subsequent operation)	C_ C S_ _ A g fnr [<pppp pnr k rrrrr>] ———>	P
Response: PLC acknowledges start enable positively	Q_ C S_ _ A g fnr [<pppp>] <———	P
5. PLC reports beginning of machining for pallet (zs = 0 , if program has started)	R_ C S_ _ A g fnr [<pppp zs>] <——— Workpiece being machined	P
6. PLC reports end of machining to host (the pallet remains on the machining station for the subsequent operation)	R_ C S_ _ E g fnr [<pppp fz k r *>] <———	S
7. Host computer controls the data sessions necessary for the subsequent operation	(poss. transmission of NC programs) (<———>)	P
8. Action: Host gives "NC program selection with start enable" for subsequent operation (k=U, since last operation)	C_ C S_ _ A g fnr [<pppp pnr k rrrrr>] ———>	P
Response: PLC acknowledges start enable positively	Q_ C S_ _ A g fnr [<pppp>] <———	P
9. PLC reports beginning of machining for subsequent operation to pallet (with fnr = 0)	R_ C S_ _ A g fnr [<pppp zs>] <——— Workpiece being machined (subsequent operation)	P
10. PLC reports end of machining to host (the pallet exits from the machining station, since no further subsequent operation is intended)	R_ C S_ _ E g fnr [<pppp fz k r *>] <———	P

1) *NC file transfer can take place at any time in the session*

2) *The host computer can also transmit "NC program selection with start enable " to the PLC before the PLC has reported "Pallet arrival at machining station message".*

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4.2.8 Event message frames

In addition to the message frames for handling the operator-process communication, so-called event message frames are defined to describe events at the machine.

A distinction is made between events which

a) cause a brief interruption of manufacturing due to a fault (so-called NC or PLC alarms)

b) cause an organizational interruption of manufacturing generally due to an action of the machine operator (so-called operator interrupts)

c) contain an operating event without direct effect on the current production process (so-called PLC status messages).

The above-mentioned event types result in different responses at the machine and also in the host computer and are therefore distinguished in the message frames as well.

The end of an interruption in the FMS production, caused by a NC/PLC alarm message or an operator interrupt message, has to be communicated to the host computer with a "Continuation message "sent by the PLC.

All these event message frames are standard message frames.

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4.2.8.1 Report NC/PLC alarms on and off

Function	Host CNC	M.fr.type
1. Message from PLC Alarms on message on NC and PLC alarms on in separate message frames . . . Alarms are eliminated by the machine operator . . .	R _ A L _ _ K a fnr [<ms anr1..anr10>] <—————————————————— +— N=NC alarm +— P=PLC alarm	S
2. Message from PLC alarms off message is sent by PLC if no alarm (NC and PLC alarm) is on (common message frame) (ms always 0)	R _ A L _ _ G _ fnr [<ms >] <——————————————————	S

Comments on useful data:

ms: Identification for machine stoppage (1 fixed point word)
0 = no machine stoppage
1 = alarms cause machine stoppage

anr1...anr10 : Alarm numbers (10 words, format: fixed point word)
: With the message frame R _ AL _ _ Ka, 10 alarm numbers are always included in the transmission.
: Alarm no. 0 = no alarm

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Remarks on alarm messages:

Definition:

Alarm messages are message frames from the PLC which report to the host computer a fault condition of the complete machine. These malfunctions lead with few exceptions (e.g. V.24 interface during the loading of MPF, SPF etc.) to stoppage of the complete machine. Stoppage means that either a current machining operation is interrupted or no machining operation can begin. A distinction is made between NC and PLC alarms.

The alarm numbers of the NC alarms are determined by the SINUMERIK 850 system. The PLC user can freely assign a part of the PLC alarm numbers himself; the remaining part has already been reserved by standard functions.

Conditions for alarm message:

- NC and PLC alarms in "on" condition is reported in separate message frames.
- The message "Alarms on" is sent by the PLC on its own initiative if a NC or PLC alarm exists (irrespective of whether the alarm leads to a stoppage or not).
- With the message frame "Alarms on" 10 alarm numbers are always reported, both for NC and for PLC alarms.

  If there are fewer than 10 NC or PLC alarms, the alarm numbers which are not used are preset with 0.

  Example: There are 2 NC alarms. In addition to these two existing alarm numbers the alarm number 0 is transmitted eight times.
- The alarm numbers are not transmitted according to their appearance in time.
- In the case of NC alarms it is possible that a subsequent message frame is transmitted.

  Example:
  Message frame 1: Alarm message with NC alarms which do **not** interrupt the machining operation
  Message frame 2: Subsequent message frame for alarm message where the machining operation is interrupted.
- In certain cases not all existing NC/PLC alarms are transmitted. First alarms are always reported, irrespective of whether they lead to machining stoppage or not. Further alarms which do not lead to stoppage are not reported to the host.

  Additional alarms which cause a stoppage are reported, however, provided no stoppage had previously been indicated.

  By means of PLC MD 7001 bit 3 ”Alarm message frame on stack change”, it is possible to set the condition whereby on occuring the PLC alarms are reported with message frame R_AL_KP (i.e. always the first 10 active PLC alarms).
- The message frame "Alarms off" is sent by the PLC if no alarm (NC or PLC) exists, irrespective of whether the alarms have led to a stoppage or not. If machining has previously been interrupted it is not automatically continued with the message "Alarms off ". In this case the host expects an additional continuation message.

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4.2.8.2 Report operator interrupts on and off

Function	Host CNC	M. fr. type
1. Message from the PLC Operator interrupt on Example: Safety door open . . Operator interrupts are eliminated by the machine operator . .	R _ B U _ _ K _ fnr [<mf unr>] <————	S
2. Message from the PLC Operator interrupt off Example: Safety door closed	R _ B U _ _ G _ fnr [<mf unr>] <————	S

Comments on useful data:

mf: Identification for material flow interrupt
0 = material flow not interrupted
1 = material flow is interrupted (1 fixed point word)

unr: Operator interrupt number
Only one operator interrupt number is transmitted for each message frame
(1 fixed point word)

Notes on operator interrupt messages

Definition:

Operator interrupts are message frames from the PLC which report to the host the beginning (event on) and end (event off) of a machine operator intervention. These interventions are reported to the host only if they lead to the stoppage of the complete machine.

Stoppage means that either a current machining is interrupted or it cannot be started.

Operator interrupts are organizational machining interrupts.
Example: Safety door open = operator interrupt on
Safety door closed = operator interrupt off

Conditions:

- Message frame is reported by the PLC on its own initiative.
- Initiation of the message and specification of the data mf und unr takes place via defined interfaces in the PLC user program.
- Each operator interrupt "on" and "off" is reported with a separate message frame.
- An identification is transmitted with the message frame which indicates whether the entire material flow is interrupted by the reported operator interrupt or not (provided by the user). Transport jobs for this machine can be prevented by the host, depending on this identification.

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4.2.8.3 Report PLC status messages on and off

Function	Host CNC	M. fr. type
1. Message from PLC Status message on	R_ B M_ _ K _ fnr [<ms bnr>] <———————————	S
2. Message from PLC Status message off	R_ B M_ _ G _ fnr [<ms bnr>] <———————————	S

Comments on useful data:

ms: Identification for machine stoppage (1 fixed point word)
Since, by definition, PLC status messages do not lead to machine stoppage, ms is always 0 here.

bnr: Status message number
One status message number is transmitted for each message frame to the host.
(1 fixed point word)

Notes on PLC status messages:

Definition:

PLC status messages provide the operator with information and do not lead to machining stoppage. These messages have no influence on the interactive communication between host and PLC and they are provided for logging purposes only.

Conditions:

- The user stores in a defined data area the status messages which have occurred and initiates the transmission to the host; only the status messages which have newly occurred should be sent.

  The transmission of the message frame to the host is done by the standard function blocks.

- Each PLC status message "on" is reported with a separate message frame.

- The status message number can be determined by the user as follows:
  1) a number is assigned to the status message bit (in a list)
     or
  2) the status message buffer is read out

  The user must compare the old/new status message number.

- Status message off must be implemented correspondingly by the user.

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4.2.8.4 Continuation message (end of a job stoppage)

Function	Host	CNC	M. fr. type
1. Message from the PLC Continue machining operation which has been interrupted on account of an NC/PLC alarm or an operator interrupt	R _ F S _ _ _ _ fnr <———————————		S

Comments:

This message frame reports the end of a job stoppage which has been caused as a result of an NC or PLC alarm message or an operator interrupt message. The user must initiate the continuation message via a defined interface. The transmission of the continuation message is done by the standard function blocks.

Example of a job stoppage:

1. Current NC part program is interrupted
2. Opening of the safety door, while no workpiece is being machined (operator interrupt)

Condition for continuation message:

- Interrupt cause has been eliminated by the operator
- Operator has acknowledged continuation of machining (e.g.

Example (referring to above-mentioned fault examples):

Re 1 For example, condition for continuation of the interrupted NC part program at the point of interruption has been satisfied and "Program interrupted " has been reset.

Re 2 Permit the safety door to be closed and automatic resumption of job.

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4.2.9 Connection monitoring

Function	Host	CNC	M. fr. type
1. Message from the host: Connection test	T _ O K _ _ _ _ fnr	—————————————>	S
2. Reply from CNC Acknowledgement of the connection monitoring by standard	R _ O K _ _ _ _ fnr	<—————————————	S

Comments:

The host transmits the message frame T _ OK _ _ _ _ cyclically to the CNC in order to test the connection between host and CNC.

The CNC replies with the message frame "Acknowledgement for connection monitoring". If the response is not sent within the programmable time or if the host notices errors at the procedure level, even at the time of the message frame output, the fault is reported and the machine is defined by the host as being "undefined ". The FMS mode can only be continued by means of synchronization.

4.2.10 FMS mode switchover

4.2.10.1 General information to FMS mode

Different NC modes of operation are defined for operating the machine controls on their own. FMS modes or machine statuses are also required for machines which are integrated in an FMS system. The machine statuses must be managed by the CNC by interactive communication with the host. The host and the CNC must always be synchronous with regard to the mode that has been set.

With the exception of "Manual mode", the FMS mode is determined by the host (or its operator) and the machine control is informed by the message frame.

The following FMS modes are defined for this interface:

- Normal mode
- Special mode
- Maintenance mode
- Manual mode

The host can change over as desired between normal, special and maintenance mode. It subsequently executes a synchronization, when resetting to the normal mode.

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Definition of FMS modes:

a) Normal mode

A machine is in normal mode if it is subjected to the automatic material flow of the host. The machine is supplied with workpieces, equipped with tools and, where appropriate, provided with operator input, only in the scope of computer-controlled order processing. Operations which disturb or interrupt the automatic manufacturing flow (e.g. NC data transfer on the initiative of the machine operator), must be locked by the PLC (PLC user program) or enabled only explicitly (e.g. for eliminating a fault).

b) Special mode

In the special mode, a machine is not subjected to the automatic material flow, i.e. it is not used for the computer-controlled order processing. Nevertheless, certain functions and interactive communications take place between host and machine within a limited scope.

As a rule the special mode is used for testing NC programs or for manual production of workpieces separately from the orders which are processed and managed by the computer.

The special mode is initiated by an operator command to the host.

The special mode is switched off and the machine is reduced to the automatic material flow by means of operator-system communication on the host as well.
Reducing is only executed if all material has passed through the machine.

c) Maintenance mode

This mode allows the machine to be temporarily made available for execution of maintenance work. The same functions as in special mode are permissible.
The two modes differ only for statistical purposes and in the switchover message frame.

d) Manual mode

If the host is down for a lengthy period it is generally necessary for economical or deadline reasons to continue manufacturing with the machines in the manual mode. The operating functions required for this (e.g. NC start) should be enabled by a selector switch managed by the PLC user program. Manual manufacturing means, however, that the production orders are no longer relevant or up to date, when the host restarts. Furthermore, the transaction data in the host no longer correspond to reality.

If the computer interface is switched off by the operator on the machine by means of the selector switch, this machine state change must be reported spontaneously to the host.

Switching back to normal mode is performed in conjunction with a synchronization. The same conditions apply as for returning from the maintenance and special modes.

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4.2.10.2 FMS mode switchover by host

Function	Host CNC	M. fr. type
1. Message from the host: FMS mode switchover (activated by the host operator as a result of system input)	C _ M O _ _ _ _ fnr [<m>] ——————————————————>	S

Comments on useful data:

m: FMS mode (1 byte, ASCII)
= N: Normal mode
= S: Special mode
= W: Maintenance mode

Conditions for FMS mode switchover:

- Operator-process communications are processed by the host only in normal mode. In other modes the host returns the message frame with identification F (negative acknowledgement).
- When switching over to normal mode or in the cyclic mode, the user should ensure that the following conditions apply :
  – NC mode = automatic (AUT)
  – No dry run
  – No single block
  – Feed override position not = 0 (possibly = 100%)
  – Possible other user-specific conditions

  The above-mentioned conditions are checked in the PLC user program.
- Manual mode (M) cannot be selected or deselected by the host (see Section 4.2.10.3).

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4.2.10.3 Activate FMS mode by CNC

Function	Host CNC	M. fr. type
1. Message from CNC: Changeover to FMS mode (activation by machine operator)	R_ MO_ _ _ _ fnr [<M>] <———	S
2. Message from CNC: Manual mode ended (activation by machine operator)	R_ MO_ _ E_ fnr [<M>] <———	S

Comments on useful data:

M: Manual mode (1 byte, ASCII)

Conditions:

- This message frame clears the computer link between machine (CNC) and host.
- Activation is effected by corresponding machine operator command. No further message frames are sent by the CNC during the manual mode to the host and all incoming message frames are ignored (including synchronization message frames).
- The machine operator must change over the "manual mode" to end this mode.
  The end of the "manual mode" is reported to the host via a message frame.
  Further continuation of the host mode is determined by the host computer which, as a rule, initiates synchronization.

4.2.11 Computer link restart message frame from PLC

Function	Host CNC	M. fr. type
CNC initiates cold restart of the computer link in order to notify the computer of CNC initial state	R_ NS_ _ _ _ fnr [<M>] <———	S

Comments:

Message frame is automatically transmitted by the CNC in the case of
- Manual warm restart
- Automatic warm restart
- Cold restart

Conditions:

- With a computer link established via an AS512 interface module with SINUMERIK 850 the first message frame is transmitted **twice** in succession.

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4.3 Message frames for synchronization and end-of-work

4.3.1 Synchronization

4.3.1.1 General information on synchronization

Synchronization means to supply the host again with current data of the machine after a fault has occurred so that the system image in the host corresponds to reality. Consequently, a synchronization is always necessary, if the host has lost machine data, for example,

- on warm restart after power interrupt
- on initial start/warm restart after computer fault
- after repairing a defective transmission section
- after cancellation of the manual mode.

A distinction is made between automatic and manual synchronization.

a) Manual synchronization

If data has got lost during disconnection of the communication partners, and this cannot be reported by the lower-level controls (e.g. number of manufactured parts), this data has to be entered manually on the host by the operator, using interactive screen forms with prompts.

b) Automatic synchronization

With automatic synchronization, only data can be updated, which can be transferred to the host on request by the distributed intelligence of the machine.

The following data at least has to be reported to the host:

– Host modes of the machine control
– Workpiece carriers present at the machine, and their statuses
– Tools present at the machine (this is interrogated, for example, immediately after successful synchronization).

The machine control must report to the host a machine image which is complete in itself. Statuses which change during the interactive synchronization session can cause the reported image to become inconsistent. Therefore, the PLC generates "Synchronization abort" for each change in status that could cause the image to become inconsistent.

In order to increase the probability of success, the machine control can send to the host "Acknowledgement for synchronization beginning" only when no further changes in status have to be expected (e.g. after end of machining ; or after interruption of machining at suitable place).

The host computer checks whether automatic or manual synchronization is possible and begins with the corresponding sessions.

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Conditions for synchronization:

- With the positive acknowledgement R _ SY _ _ _ _ initiated by the PLC user program, the synchronization routine begins in the PLC.
- In the output command list, the user can mark which message frames can be transmitted to the host from the PLC on its own initiative until the end of synchronization. In the case of these message frames, the message is transmitted directly to the host without aborting synchronization.

  If status changes occur on the SINUMERIK or machine during synchronization, however, which cause message frames to be transmitted to the host that are not permissible during synchronization, then the message frame is transmitted to the host followed by the synchronization abort message T _ SY _ F _ _ .
- The PLC user has the possibility to prevent a foreseeable synchronization abort, by delaying the initiation for transmitting the synchronization acknowledgement (R _ SY _ _ _ _) in the PLC until corresponding status changes have been terminated (e.g. : tool change, end of machining).
- During synchronization, a pallet transport operation (within the machine, from/to the machine) and a tool unloading/loading operation must be interlocked by the PLC user program.
- A synchronization request from the host can be requested at any time.
- With automatic synchronization, the message frames "Beginning of synchronization" , "Acknowledgement for beginning of synchronization", "End of synchronization" and "Synchronization abort by PLC or host" are identical with those for manual synchronization.

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4.3.1.2 Manual synchronization by host

The following interactive session takes place during manual synchronization between SINUMERIK and the host.

Function	Host CNC	M. fr. type
1. Beginning of synchronization host transmits the request for synchronization	T _ S Y _ _ _ _ fnr ——————————>	S
2. Rejection from CNC		
a) negative acknowledgement reaction from the PLC: user permits no synchronization	T _ S Y _ F _ _ fnr <—————————— 1)	S
b) Positive acknowledgement from CNC to beginning of synchronization with transmission of machine status data to the host	R _ S Y _ _ _ _ fnr [<ms bu mf f z m _>] <——————————	S
With manual synchronization the host operator enters the current data of the machine image in the host		
3. End of synchronization message from the host: host has received all relevant information for synchronization and acknowledges with end message	T _ S Y _ _ E _ fnr ——————————>	S
Possibilities for synchronization abort: (synchronization abort is possible at any time by either partner)		
communication abort by host	R _ S Y _ F _ _ fnr ——————————>	S
or		
communication abort by CNC (e.g. if a change in status occurs during synchronization)	T _ S Y _ F _ _ fnr <——————————	S

Comments on useful data:

1) See Section 4.3.1.4 for status data of the machine.

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4.3.1.3 Automatic synchronization by host

With automatic synchronization the actual machine image data is transmitted to the host with the aid of message frames. The following interactive session takes place.

Function	Host CNC	M. fr. type
1. Beginning of synchronization initiation by host	T _ S Y _ _ _ _ fnr ——————————>	S
2. Response from CNC a) Rejection from the PLC negative acknowledgement	T _ S Y _ F _ _ fnr <——————————	S
b) Positive acknowledgement from CNC to beginning of synchronization with transmission of the machine status data to the host Beginning of session : "Report the pallet data to the host"	1) R _ S Y _ _ _ _ fnr [<ms bu mf f z m _>] <——————————	S
3. Host computer requests transmission of the workpiece carrier data (pallet data) with pppp=0 and g=0	T _ S P _ _ _ g fnr [<pppp>] ——————————>	P
4. Acknowledgement from CNC a) Negative acknowledgement from the PLC	T _ S P _ F _ g fnr <——————————	P
b) Positive acknowledgement with reporting of the pallet data (workpiece carrier data)	R _ S P _ _ _ g fnr [<pppp#>] <——————————	P
5. Host acknowledges the receipt of the reported pallet data positively and requests further workpiece carrier data (with g and pppp from the previous message frame "Report pallet data" see 4.b).	T _ S P _ _ _ g fnr [<pppp>] ——————————>	P
6. Repeat of 4. and 5. for all pallets available on the machine	(Repeat loop) <——————————	P
7. CNC reports the data of the last pallet to the host	R _ S P _ _ E g fnr [<pppp#>] 2) <——————————	P
End of session : "Report the pallet data to the host"		
8. End of synchronization message from the host (host has received all relevant information for synchronization)	T _ S Y _ _ E _ fnr ——————————>	S

Comments on useful data:

pppp: Pallet number (4 bytes, ASCII)
#: Pallet data (workpiece carrier data) (see Section 4.3.1.5)
1): Machine status data (see Section 4.3.1.4)
2): Message frame "Report data of the last pallet to host "(R _ SP _ _ Eg) can be transmitted with or without useful data.

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Possibilities for synchronization abort

Function	Host CNC	M. fr. type
Abort by CNC (e.g. if status change during synchronization)	T _ S Y _ F _ _ fnr <———————————	
or		
abort by host	R _ S Y _ F _ _ fnr ———————————>	
or		
CNC acknowledges "Request for pallet data" negatively	T _ S P _ F _ g fnr <———————————	
or		
CNC acknowledges "Reporting the pallet data" negatively	R _ S P _ F _ g fnr ———————————>	

An abort of the synchronization run is possible at any time by either partner.

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4.3.1.4 Machine status data

The machine status data which is reported by the CNC as positive response to beginning of synchronization to the host is listed below.

The respective status identifications have been specified by the PLC user program to the standard function blocks via defined interfaces.

The status data are reported with the standard message frame:

R _ SY _ _ _ _ fnr [<ms bu mf f z m _ >]

ms	:	Identification for machine stoppage resulting from PLC and NC alarms	(1 fixed point word)
		= 0 no machine stoppage	
		= 1 machine stoppage	
bu	:	Identification for operator interrupt	(1 fixed point word)
		= 0 there is no operator interrupt	
		= 1 there is at least one operator interrupt	
mf	:	Identification for material flow interrupted resulting from operator interrupt	(1 fixed point word)
		= 0 material flow is not interrupted	
		= 1 material flow is interrupted	
f	:	End-of-work flag	(1 byte, ASCII)
		= 2 - last machinable workpiece machined	
		= 4 - end-of-work reached, components are switched off	
		= 6 - no end-of-work, components are switched on	(= normal state)
z	:	Status flag (host mode of machine)	(1 bytes, ASCII)
		= N - normal mode	
		= S - special mode	
		= W - maintenance mode	
m	:	Identification "Manual manufacturing" since the last successful (i.e. positively concluded) synchronization	(1 byte, ASCII)
		= 0 - no manual status	
		= 1 - manual manufacturing	
-	:	Blank (space) owing to compliance of the word boundary	

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4.3.1.5 Pallet data (workpiece carrier data)

"Reporting the pallet data" to the host computer is effected with the message frame

R _ SP _ _ _ g fnr [<pppp # >]

The pallet data (workpiece carrier data) which are reported to the host with automatic synchronization are explained below.

pppp: Pallet number (4 bytes, ASCII)

#= ii data

ii = format identification for pallet data

When *ii = 01* (= standard pallet data *) then # :*

 # = 01 Pnr bb zz fz k r jj hhhh yyyy zzzz nnnn uuuu ssss ....

The data fz k r jj hhhh yyyy zzzz nnnn uuuu ssss .... is also reported with the message frame "End of machining"(see Section 4.2.5).

ii: Format identification for pallet data (2 bytes, ASCII)

= 01 with standard pallet data

pnr: NC program number (fixed point word (FXP2))

= 0 - if not yet known (i.e. host has not yet given a "Program selection with start enable" for the pallet)

bb: Machining flag (2 bytes, ASCII)

= 0 - undefined - if production was manual

= 1 - pallet taken over by transport system"Pallet arrival at the machine" not yet reported

= 2 - "Pallet arrival at the machine" already reported; Acknowledgement not yet sent

= 3 - "Pallet arrival at the machining station" already reported; Acknowledgement already sent "Pallet arrival at the machining station" not yet received.

= 4 -"Pallet arrival at the machining station" already reported. "Program selection and start enable" not yet received.

= 5 - "Program selection and start enable" already received; "Beginning of machining " not yet reported

= 6 - "Beginning of machining " already reported; "End of machining " not yet reported

= 7 - "End of machining " reported, pallet finish machined, shifted out to output station and not yet fetched by transport system

= 8 - "End of machining" reported, pallet finish machined, pallet on machining station and waiting for "Program selection" sequence operation or "Remove pallet from machining station"

= 9 - "Remove pallet from machining station" received; Acknowledgement for "Remove pallet from machining station" not yet sent

= 10 - Acknowledgement for "Remove pallet from machining station" sent, pallet shifted on output position and not yet fetched by the transport system

= 11 - "Pallet arrival at the machine" already reported, acknowledgement already sent. "Pallet arrival at the machining station" not yet reported, "Program selection" already received.

= 99 - Pallet to storage at input/output station, is not reported to host with "Pallet arrival message", not brought in and not machined.

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zz: Status identification (2 bytes, ASCII)
= 01 - Pallet is at input position before machining station
= 02 - Pallet is at machining station
= 03 - Pallet is at output position after machining station

fz: Manufacturing status to the control of the material flow (1 fixed point word)
= 0 - processed without error (further machining according to manufacturing process plan)
= 1 - Reject (no further machining according to manufacturing process plan, pallet can be unloaded)
= 2 - Rework (no further machining according to manufacturing process plan, pallet can be unloaded. The parts can be made "good" by reworking outside of the FMS).
= 3 - Unfinished (no further machining according to manufacturing process plan, pallet can be unloaded. It was not possible to decide whether the complete pallet should be handled as reject or rework).
= 4 - Repeat (the intended operation must be repeated on another machine, e.g. it was not possible to start machining the pallet.

k: Identification for sequence machining (1 byte, ASCII)
= I: Identical machining station for sequence operation
= U: Diffferent machining station for sequence operation

r: Reserve (1 byte, ASCII)

jj: Format identification for end machining data
= 01 for standard end machining data

hhhh: Stopping place name with respect to transport system (4 bytes, ASCII)
= input buffers for status identification= 01,
= output buffer for status identification = 03
= blanks, if not used or pallet being machined

yyyy: Number of good parts (4 bytes, ASCII)
Blanks, if machining not yet ended

zzzz: Number of reject parts (4 bytes, ASCII)
= Blanks, if machining not yet ended

nnnn: Number of the re-machining parts (4 bytes, ASCII)
= Blanks, if machining not yet ended

uuuu: Number of the unfinished parts (4 bytes, ASCII)
= Blanks, if machining not yet ended

ssss: Total operation time (4 bytes, ASCII)
= Blanks, if machining not yet ended

....: Programmable user part (e.g. for measuring results)

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4.3.2 End-of-work

4.3.2.1 General information on end-of-work

The "End-of-work" state should make it possible for plant components to be switched off for a limited period of time, e.g. after the end of a shift, at the weekend, etc. The SINUMERIK, however, remains switched on.
After initiating the end-of-work, operations that have already started are completed normally by the machine but no new pallet is brought to the machining position on the machine. Workpiece carriers which have fully been processed are pushed into the output buffer as usual.

Sequence operations on the same machine are also carried out.

For starting the plant the host sends "End of end-of-work", which then should be acknowledged by the CNC after all plant components have been switched on again. Initiation is effected by PLC user program.

The temporary status is defined with the aid of the end-of-work flag. The end-of-work flag is transmitted as useful data in the end-of-work message frames.

Conditions for end-of-work session:

- A request for the end of end-of-work from the host is possible at any time and in every mode, i.e. even if end-of-work has not yet been achieved.
- The user should not generate a negative acknowledgement if initiation was effected twice or more times; e.g. when a running process is activated again.
- The message Q _ FA _ _ _ _ [<2>] "Last workpiece processed may only be transmitted to the host after end of machining message (from all machining stations of the machine) (initiation from PLC user program).
- The SINUMERIK reports all message frames sent on own initiative during the end-of-work statuses (e.g."NC alarm on".)

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4.3.2.2 End-of-work session sequence

Function	Host CNC	M. fr. type
1. Host sends command "Initiate end-of-work "	C _ F A _ _ _ _ fnr [<1>] ——————————>	S
2. Response from CNC:		
a) negative acknowledgement: User gives initiation for "End-of-work not achievable" (neg. acknowledgement)	C _ F A _ F _ _ fnr [<1>] <——————————	S
b) positive acknowledgement: PLC reports "Last machinable workpiece machined" (initiation in the PLC user program)	Q _ F A _ _ _ _ fnr [<2>] <——————————	S
3. Host sends command "End-of-work achieved, switch off components"	C _ F A _ _ _ _ fnr [<3>] ——————————>	S
4. Response from CNC	C _ F A _ F _ _ fnr [<3>] <——————————	S
a) negative acknowledgement: User gives initiation for "Components cannot be switched off"		
b) positive acknowledgement: User gives initiation for message frame "Components are switched off" to host	Q _ F A _ _ _ _ fnr [<4>] <——————————	S
. . END-OF-WORK! . .		
5. Host sends command "End of end-of-work, switch on components"	C _ F A _ _ _ _ fnr [<5>] ——————————>	S
6. Response from CNC		
a) negative acknowledgement: User gives initiation for message frame "Components cannot be switched on"	C _ F A _ F _ _ fnr [<5>] <——————————	S
b) positive acknowledgement: User gives initiation for "Components are switched on", e.g. normal status has been achieved again	Q _ F A _ _ _ _ fnr [<6>] <——————————	S

Comments on useful data:

End-of-work flag (1 byte, ASCII)

= 1 : Initiate end-of-work
= 2 : End-of-work possible; last machinable workpiece machined
= 3 : End-of-work has been achieved; switch off components
= 4 : End-of-work has been achieved; components are switched off
= 5 : Initiate normal status; switch on components
= 6 : Normal status has been achieved; components are switched on

* : Other message frames/sessions are possible between host and CNC between these end-of-shift message frames

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4.4 Tool message frames

4.4.1 General information on tool message frames

The tool message frames can be divided into the following functions:

1. Tool magazine management
   – Interrogate complete tool magazine assignments
   – Interrogation of tools used
   – Reporting a tool
2. Loading and unloading operations
   – Random loading of a tool into the magazine
   – Random unloading of a tool from magazine
   – Computer-supported loading of a tool magazine
   – Computer-supported unloading of a tool magazine

The management and magazine loading/unloading functions are implemented with the aid of standard function blocks (Package 1) in the PLC.

The session examples represented for tool loading and tool unloading are sequences as required by the host where Siemens FMC**/**FMS are used.

The processes between machine operator and PLC listed in the examples are not mandatory; they should simply be considered as application examples. Manipulation devices, etc. can also be used instead of the operator.

The defined sequences for tool loading**/**unloading with code carrier assume that the read/writing device of the tool code carrier is linked via the CNC and all data are stored on the code carrier.

Conditions for tool sessions:

- Tool loading, tool unloading and tool interrogation sessions in SINUMERIK 850 cannot run in parallel.

  On SINUMERIK 840**/**880, it is possible to set by means of PLC MD 7002.6 whether tool loading**/**unloading sessions are allowed in parallel to tool interrogation.
- If a message frame is acknowledged negatively by the host or by the CNC during the session "Tool loading" (6th character = F), the data stored for the tool must again be deleted (user). The session is automatically aborted and must be reinitiated, if necessary.
- The information which has been written on the code carrier is transmitted to the computer in the acknowledgement message frame in the case of random unloading.

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4.4.2 Tool data

The following data memories are available with the SINUMERIK 840/850/880 for storing tool data:

- The TOA memory in the NC
- The data blocks in the PLC

The tool data between NC and PLC are distributed such that the actual tool data (geometry, wear, life etc.) are stored in the TOA area, while the actual assignments (allocation tables for tool number and place number, etc. and the tool identifications) are kept in the PLC.

The TOA memory in the NC contains a minimum of 10 and a maximum of 16 parameters (P0 to P15) per tool cutting edge.

The meaning of the parameters P0 to P9 is defined by the tool type. The parameters P11 to P15 can be freely assigned by the user, e.g. for life, early warning limit life, etc.

The tool data is entered into the TOA memory with the aid of a loading cycle. One TOA memory is required for the data of each single cutting edge in the case of multi-edge tools.

During transmission of tool data between host computer and CNC, the data of one tool cutting edge is included per message frame; i.e. in the case of multi-edge tools the tool data must be transmitted one edge at a time with several message frames.

Further information concerning tool management in the SINUMERIK 840, SINUMERIK 850 or SINUMERIK 880 is given in the description "Standard Function Blocks Package 1 Tool Management".

The tool data which are exchanged in the message frames between computer and SINUMERIK is described below. This data consist of a fixed block and a project-specific block. The variable data part must be matched to the computer used.

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4.4.2.1 Description of tool data

The following data is exchanged with the tool message frames between host computer and machine control:

1. Magazine number (mnr) (1 fixed point word)
   Range of values: 0 ... 8
   0 = all magazines (with "Tool interrogation" request)

2. Magazine place number (mpnr) (1 fixed point word)
   Range of values: -3 204
   -1 = gripper
   -2 = feeder
   -3 = spindle
   0 = request is issued by the host at the start with "Tool interrogation "
   1 to 204 = place number in the magazine
   The tools which are currently in the spindle, feeder and gripper are also reported when interrogating the magazine assignments.

3. Tool identifications (kkkk)
   a) Tool blocked**/**usable (1 byte, ASCII)
      0 - Tool not blocked usable, (tool reusable)
      1 - Tool blocked, (tool not reusable)

   b) Prewarning life limit reached (1 byte, ASCII)
      1 - Prewarning life limit reached (not evaluated by Package 1 at this stage)

   c) User bit 2**/**1 (2 bytes, ASCII)
      (routing by Package 1 - PLC MD 2079**/**2078)

4. Tool identification number or T number (tnr) (8 decades, BCD, only positive values)
   All tools used in a FMS system must have a unique identification in the whole system. This identification consists of tool identification number (T number) and duplo number.

5. Duplo number (dnr) (4 decades, BCD, only positive values)
   The duplo number is used for identifying replacement tools of a tool type.

6. Number of allocated magazine half locations, front (2 decades, BCD, only positive values)

7. Number of allocated magazine half locations, rear (2 decades, BCD, only positive values)

8. Cutting edge number (2 decades, BCD, only positive values)
   (For single-edge tools the cutting edge number = 1)

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9. Tool type (2 decades, BCD, only positive values)
   The tools are divided into the following groups according to type:
   Type 01.....09 Tools with compensations X, Z and radius, e.g. turning tools
   Type 10.....19 Tools with length compensation e.g. drills
   Type 20 .....29 Tools with length and radius compensation, e.g. end mills
   Type 30 .....39 Tools with two length and one radius compensation, e.g. angle head cutters
   The tool type is entered in P1 parameters of the NC-TOA memory.

10. Geometry values
    10a Geometry value 1 (8 digits, BCD) P2 parameters
    10b Geometry value 2 (8 digits, BCD) P3 parameters
    10c Geometry value 3 (8 digits, BCD) P4 parameters

All three geometry values are always transmitted, values not required must be replaced with zeros.

The assignments depend on the type as follows:

Tool type	Geometry value		
	1	2	3
01.....09	Length X	Length Z	Radius
10.....19	Length	———	———
20.....29	Length	———	Radius
30.....39	Length 1	Length 2	Radius

11. Spare 1 (BCD) ≙ P5 in NC-TOA memory
    e.g. Wear value 1 (8 digits, BCD) or project-specific data

12. Spare 2 (BCD) ≙ P6 in NC-TOA memory
    e.g. Wear value 2 (8 digits, BCD)or project-specific data

13. Spare 3 (BCD) ≙ P7 in NC-TOA memory
    e.g. Wear value 3 (8 digits, BCD) or project-specific data
    Note: All 3 wear values must be transmitted when applying the wear values for inclusion in the of the calculation of geometry values; Values not required are replaced by zeros. The assignments of the wear values depend on the type.

12. Spare 4 (BCD) ≙ P8 in NC-TOA memory

13. Spare 5 (BCD) ≙ P9 in NC-TOA memory

14. Spare 6 (BCD) ≙ P11 in NC-TOA memory

15. Spare 7 (BCD) ≙ P12 in NC-TOA memory

16. Spare 8 (BCD) ≙ P13 in NC-TOA memory

17. Spare 9 (BCD) ≙ P14 in NC-TOA memory

18. Spare 10 (BCD) ≙ P15 in NC-TOA memory

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4.4.2.2 Tool data 1 (short tool block)

Frequently only a subset of the complete tool block is transmitted in the acknowledgement message frames between CNC and host computer.

This short tool block is identified in the message frames with tool data 1 and consists of the following five values.

No.	Designation	Words	Data format	Leading zeros
1	Magazine no. (mnr)	1	1 word, fixed point	–
2	Magazine place no. (mpnr)	1	1 word, fixed point	–
3	Identifications (kkkk)	2	ASCII , 4 bytes	–
4	T no. (tnr)	3	8 decades BCD	4
5	Duplo no. (dnr)	3	4 decades BCD	8

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4.4.2.3 Tool data 2 (complete tool block)

Designation		Length (words)	Data formats
Magazine number		1	Fixed-point
Magazine location		1	Fixed-point
Identifier		2	ASCII**/**bit
T number		3	8 decades BCD
Duplo number		3	4 decades BCD
User DBs (number: 0 ... 7)		0 ... 7[1)]	User format
Number of magazine locations in front		3	2 decades BCD
Number of magazine locations behind		3	2 decades BCD
Tool edge number		3	2 decades BCD
User P memory	(P0)	3[2)]	SG, 8 decades BCD, DP
Tool edge type	(P1)	3	2 decades BCD
Geometry 1	(P2)	3	SG, 8 decades BCD, DP
Geometry 2	(P3)	3	SG, 8 decades BCD, DP
Geometry 3	(P4)	3	SG, 8 decades BCD, DP
Wear 1, project-specific	(P5)	3	SG, 8 decades BCD, DP
Wear 2, ”	(P6)	3	SG, 8 decades BCD, DP
Wear 3, ”	(P7)	3	SG, 8 decades BCD, DP
Spare 1, ”	(P8)	3	SG, 8 decades BCD, DP
Spare 2, ”	(P9)	3	SG, 8 decades BCD, DP
Spare 3, ”	(P10)	3[3)]	SG, 8 decades BCD, DP
: :	:		:
: :	:		:
Spare 10, ” or 11[3)]	(P15)	3	SG, 8 decades BCD, DP

Explanations:

SG = sign
DP = decimal point
P1 ... 15 = parameters for TOA memory of the NC

1) Whether the user DBs of the magazine table are contained in the record is defined in a machine data bit (DB 64/D2.3). The number of user DBs, which each require one word of the record, is defined in a machine data word (DB 61/DW 2).

2) Whether P0 is contained in the record is defined in machine data bit DB 64/D 2.2.

3) Whether P10 is contained in the record is defined in machine data bit DB 64/D 2.1.

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4.4.3 Tool data and magazine assignments

4.4.3.1 Report tool data of all existing tools

The following session is implemented as a standard in the PLC, when the host computer requests "Report tool data of all tools available".

Function	Host CNC	M. fr. type
1. Request from host: Transmission of all tools existing in the magazine (including the tools in spindle, gripper and feeder) to the host (mnr = 0 und mpnr = 0) (initiation of the kernel sequence)	T_ T G _ _ _ _fnr [<mnr mpnr>] ——>	K
2. Response from PLC: a) negative acknowledgement from PLC leads to session abort	T _ T G_ F _ _ fnr [<mnr mpnr>] <——	K
b) positive acknowledgement: PLC transfers the data for the first cutting edge of the first tool to the host	R _ T G_ _ _ _ fnr [<Tool data2>] <——	K
3. Response from host: a) negative acknowledgement from host with error number; leads to session abort	R _ T G_ F _ _ fnr [<mnr mpnr>] ——>	K
b) positive acknowledgement from host: Request data of next cutting edge or next tool; mnr and mpnr from last reported message frame R _ TG _ _ _ _ (from 2.)	T _ T G_ _ _ _ fnr [<mnr mpnr>] ——>	K
4. Multiple repetition of 2. und 3. with multi-edge tools (cutting edge loop)	(Cutting edge loop) (<——>)	K
5. Host computer requests data of next cutting edge or next tool; mnr und mpnr from last reported message frame	T _ T G_ _ _ _ fnr [<mnr mpnr>] ——>	K
6. PLC transfers data of the first cutting edge of the next tool to host	R _ T G_ _ _ _ fnr [<WZ-Daten2>] <——	K
7. Multiple repetition of 2. to 6. until tool data of all tools have been reported to the host computer (tool loop)	(Tool loop) (<——>)	K
8. End of session message from PLC All tools in the magazine or all magazines reported to the host computer (end of the kernel sequence)	R _ T G_ _ E _ fnr [<mnr>] <——	K

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Comments on useful data:

mnr:	Magazine no.	(1 word fixed point)
mpnr:	Magazine place no.	(1 word fixed point)
Tool data 2:	Complete tool block (for description see Section 4.4.2.3)	

Conditions:

- With the aid of standard routines (FB Package 1: Tool management) the machine's tool-holding magazines are checked for existing tools available. If a tool is found, the tool data is reported to the host computer, one message frame being used for the data of each cutting edge. Consequently, multi-edge tools require several message frames the data being requested by the host.
- The host computer must allocate mnr and mpnr appropriately, with the first read request:
  – Read the complete magazine assignments of all mnr = 0 and mpnr = 0
  – Read the complete magazine assignments of a mnr = 1 .... 8 and mpnr = 0

  With subsequent request for reading of further cutting edges or further tools mnr = 1 ... 8 and mpnr 0 must be specified by the host.
- The tool interrogation process is aborted in the case of a negative acknowledgement from host or PLC during the tool interrogation. Tool interrogation must then be reinitiated by the host. If the PLC causes an abort, the cause is reported to the host by a note in the error number.
- If no further tool is found which has not been reported, the message frame R __ TG __ __ E __ is sent to the host computer. The magazine number(mnr) is reported to the host with this message frame.

  When interrogating the magazine assignments this is,
  – for all magazines: mnr= 0
  – for single magazines: mnr= number of the last reported single magazine.

  The session "Report tool data of all existing tools" is thus ended.
- Apart from the tool-holding magazines, grippers, feeders and spindles are also checked for tools and any tools which they contain are reported.

  The magazine place number is then dependent on tool management e.g.
  – for grippers = - 1
  – for feeders = - 2
  – for spindles = - 3

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4.4.3.2 Load magazine assignments (only with SINUMERIK 840/880)

The complete tool data of a magazine or a cartridge are transmitted from the computer to the CNC with the function "Load magazine assignment". The initiative for this sequence proceeds from the host.

The session "Load magazine assignments" is implemented as a standard only in the case of the computer link with SINUMERIK 840/880.

Function	Host CNC	M. fr. type
1. Host computer begins the session with transmission of the tool data of the first cutting edge	R _ M B _ _A _ fnr [<Tool data2>] ——————————>	K
2. Response from CNC:		
a) negative acknowledgement from PLC and session abort.	R _ M B _ F A _ fnr [<Tool data1>] <——————————	K
b) positive acknowledgement from PLC PLC acknowledges the receipt of the data positively and requests the data of the next cutting edge.	T _ M B _ _ A _ fnr [<Tool data1>] <——————————	K
3. Response from host: Host computer transmits the tool data of the next cutting edge (multi-edge tool) or the tool data of the first cutting edge of the next tool (single-edge tool)	R _ M B _ _ _ _ fnr [<Tool data2>] ——————————>	K
4. Response from CNC:		
a) negative acknowledgement from PLC and session abort	R _ M B _ F _ _ fnr [<Tool data1>] <——————————	K
b) PLC acknowledges the receipt of the data positively and requests the data of the next cutting edge.	T _ M B _ _ _ _ fnr [<Tool data1>] <——————————	K
5. Multiple repetition of 3. und 4. until the tool data of the penultimate cutting edge of the last tool are reported.	Repetition of 3.and 4. <——————————>	K
6. Host computer transmits the data of the last cutting edge of the last tool and initiates end of session.	R _ M B _ _ E _ fnr [<Tool data2>] ——————————>	K
7. Response from CNC:	R _ M B _ F E _ fnr [<Tool data1>]	K
a) negative acknowledgement from PLC and session abort	<——————————	
b) PLC acknowledges the end of session message and the receipt of the data positively.	T _ M B _ _ E _ fnr [<Tool data1>] <——————————	K
Possibilities for session abort on side of host: The computer can abort the session at any time with the abort message frame.	T _ MB _ F _ _ fnr ——————————>	K

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Comments on useful data:

Tool data 1: Shortened tool block (Section 4.4.2.2)
Tool data 2: Complete tool block (Section 4.4.2.3)

Conditions:

- "Load magazine assignment" is initiated and ended again by the host. The acknowledgement of the CNC is effected by the tool block 1 of the last received message frame. The host computer can abort the session at any time by a specific abort message frame.
- With the SINUMERIK 840/880 the session "Load magazine assignments" is only implemented as a standard on the CNC side. The session does not exist on the host side with Siemens FMS systems.
- The user must enable the tools as soon as the entire magazine is loaded (tool data + tools in the machine).
- This sequence does not support loading of only one single-edge tool. In this case, you must use the "random loading" dialog.

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4.4.4 Report tool data for tools used

The following session is implemented in the PLC as a standard when the host requests "Report tool data of the tools used".

Function	Host CNC	M. fr. type
1. Request from host: Transmission of all tools used (of one magazine or of all magazines) to the host since the last interrogation (initiation of kernel sequence)	T _ T Q _ _ _ _ fnr [<mnr mpnr>] —————>	K
2. Response from the PLC: a) negative acknowledgement from PLC leads to session abort	T _ T Q _ F _ _ fnr [<mnr mpnr>] <—————	K
b) positive acknowledgement from PLC PLC transmits the data of the first cutting edge of the first tool used to the host	R _ T Q _ _ _ _ fnr [<Tool data2>] <—————	K
3. Response from host: a) negative acknowledgement from host with error number; leads to session abort	R _ T Q _ F _ _ fnr [<mnr mpnr>] —————>	K
b) positive acknowledgement from host: Host computer requests the data for the next cutting edge or for the next tool, mnr and mpnr from the last reported message frame R_TQ____ (from 2.)	T _ T Q _ _ _ _ fnr [<mnr mpnr>] —————>	K
4. Multiple repetition of 2. and 3. for multi-edge tools (cutting loop)	(Cutting edge loop) (<—————>)	K
5. Host computer requests the data for the next cutting edge or for the next tool; mnr and mpnr from the last reported message frame R_TQ____	T _ T Q _ _ _ _ fnr [<mnr mpnr>] —————>	K
	R _ T Q _ _ _ _ fnr [<Tool data2>] <—————	K
6. PLC transfers the data of the first cutting edge of the next tool used to host computer		
7. Multiple repetition of 2. to 6. until the data of all tools is reported to the host computer (tool loop)	(Tool loop) (<—————>)	K
8. End of session message from PLC: All tools used of one magazine or all magazines reported to host (end of the kernel sequence).	R _ T Q _ _ E _ fnr [<mnr mpnr>] <—————	K

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Comments on useful data:

mnr:	Magazine no.	(1 word fixed point)
mpnr:	Magazine place no.	(1 word fixed point)
Tool data 2:	Complete tool block (for description see Section 4.4.2.3)	

Conditions:

- With the aid of standard routines (FB Package 1: tool management) the machine's tool-holding magazines are checked for tools used. If a tool is found that has been used and not yet been reported, the tool data is reported to the host.

Otherwise, the same conditions apply a those given for "Report tool data of all existing tools" (Section 4.4.3.1).

4.4.5 Reporting a tool

Reporting a tool on initiative of the PLC is possible in the case of the computer link with SINUMERIK 840/850/880. Initiation is effected via user interface.

In the case of computer link with SINUMERIK 850 only reporting of one tool is possible with transmission of the tool data for the first cutting edge.

All cutting edges of a tool can be reported with the computer link for SINUMERIK 840/880 (PLC MD7005.0).

4.4.5.1 Reporting a single-edge tool (only with SINUMERIK 840/880)

Function	Host CNC	M. fr. type
1. Reporting the tool data of the only cutting edge to the host computer. (Initiation is effected via user interface)	R_ T S_ _ E_ fnr [<Tool data2 of the only cutting edge>] <———	P
2. Response from host:		
a) Negative acknowledgement from host with error number.	R_ T S_ F E_ fnr [<Tool data1>] ———>	K
b) Positive acknowledgement from host, host confirms receipt of data.	T_ T S_ _ E_ fnr [<Tool data2>] ———>	K

Comments on useful data:

Tool data 1:	Shortened tool block (Section 4.4.2.2)
Tool data 2:	Complete tool block (Section 4.4.2.3)

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4.4.5.2 Reporting a multi-edge tool (only in the case of SINUMERIK 840/880)

Function	Host CNC	M. fr. type
1. Reporting the tool data of the first cutting edge to the host computer. (initiation is effected via user interface)	R_T S_ _ A_ fnr [<Tool data2 of the first cutting edge>] <———	P
2. Response from host: a) negative acknowledgement from host with error number	R_T S_F A_ fnr [<Tool data1>] ———>	K
b) positive acknowledgement from host: Host computer requests the data of the next cutting edge	T_T S_ _ _ _ fnr [<Tool data1>] ———>	K
3. Response from PLC: a) negative acknowledgement from PLC with error number	T_T S_F_ _ fnr [<Tool data1>] <———	K
b) positive acknowledgement from PLC: PLC transmits the tool data of the next cutting edge to the host computer	R_T S_ _ _ _ fnr [<Tool data1>] <———	K
4. Multiple repetition of 2. und 3. in the case of multi-edge tools (cutting loop)	(Cutting edge loop) (<———>)	K
5. Host computer requests the tool data of the next cutting edge	T_T S_ _ _ _ fnr [<Tool data 1>] ———>	K
6. PLC transmits the tool data of the last cutting edge to the host computer	R_T S_ _ E_ fnr [<Tool data2 of the last cutting edge>] <———	K
7. Host computer acknowledges receipt of tool data of the last cutting edge	T_T S_ _ E_ fnr [<Tool data1>] ———>	K

Comments on useful data:

Tool data 1: Shortened tool block (Section 4.4.2.2)
Tool data 2: Complete tool block (Section 4.4.2.3)

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4.4.5.3 Reporting the first cutting edge of a tool

Function	Host CNC	M. fr. type
Reporting a tool to the host computer on self initiative of the PLC (with transmission of the tool data of the first cutting edge) (initiation is effected via user interface)	R_ T S_ _ _ _ fnr [<Tool data2 of the first cutting edge>] <———————————————	P

Comments on useful data:

Tool data 2: Complete tool block (for definition see Section 4.4.2.3)

Conditions:

- Initiation for "Reporting a tool" to the host computer must be effected in the PLC user program via the user interface. Only the magazine number and the magazine place number must be allocated as data for the user interface.

  The message frame is to be sent:
  a) if the identification "Tool blocked" has been set for a tool (i.e. life has elapsed or a tool has been broken)
  b) if identification "Prewarning limit life time" has been set for a tool
  c) in the case of possible other user-specific causes (e.g. if tool was changed from spindle in order to report the actual life to the host computer)

  The host computer can make a distinction between a), b) or c) by means of tool identifications and the remaining lives.

- Also for multi-edge tools only the data of the first cutting edge is reported to the host computer.

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4.4.6 Random loading

With "Random loading", the machine control or the machine operator decides not only the time of loading, but also which tool is to be loaded into the magazine. Initiation of the kernel sequence must be effected by the PLC user program via the user interface, the tool to be loaded being reported to the host.

4.4.6.1 Random loading without code carrier

With "Random loading without code carrier" the tool data is contained in the host and must be transmitted to the SINUMERIK when loading.

The PLC reports to the host computer which tool it wishes to load (initiation is effected via the user interface). The host then transmits to the SINUMERIK the tool data with magazine place number = 0. In the SINUMERIK the data is entered in the corresponding tool data memories. An acknowledgement is sent to the host that confirms that the tool data has been stored without error. In the case of multi-edge tools, the host computer then sends the block of the next tool cutting edge. The host marks in the identification (7th character = E) the transmission of the block of the last (in the case of single-edge tools this is consequently also the first) tool cutting edge.

4.4.6.1.1 Random loading of a single-edge tool

Function	Host CNC	M. fr. type
1. PLC request the host to transmit the tool block of a selected tool (specification of ma- gazine number, T number, duplo number; magazine place number, identification = 0) initiation is effected via user interface (introduction of the kernel sequence)	T _ WB _ _ A _ fnr [<Tool data 1>] <———	P
2. Response from host:		
a) negative acknowledgement with error message; Refuse tool loading abort	T _ WB _ F A _ fnr [<Tool data 1>] ———>	K
b) positive acknowledgement: Host transfers to PLC the tool data of the single cutting edge with magazine place number = 0	R _ WB _ _ E _ fnr [<tool data2>] ———>	K
3. Acknowledgement of the tool data input from PLC		
a) negative acknowledgement from PLC, e.g. error in loading cycle	R _ WB _ F E _ fnr [<Tool data 1>] <———	K
b) positive acknowledgement from PLC: tool data was entered into the tool memory (end of kernel sequence)	T _ WB _ _ E _ fnr [<Tool data 1>] <———	K

Comments on useful data:

Tool data 1: = [<mnr mpnr kkkk tnr dnr>] (see Section 4.4.2.2)
Tool data 2: = Complete tool block (see Section 4.4.2.3)

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4.4.6.1.2 Random loading of a multi-edge tool

Function	Host CNC	M. fr. type
1. PLC requests host to transmit the tool block of a selected tool (specification of magazine number, T number , duplo number; magazine place number = 0, identification = 0) initiation is effected via user interface (introduction of the kernel sequence "Random loading without code carriers")	T _ WB _ _ A _ fnr [<Tool data 1>] <———	P
2. Response from host:		
a) negative acknowledgement with error message reject tool loading abort	T _ WB _ F A _ fnr [<Tool data 1>] ———>	K
b) positive acknowledgement host computer transfers the tool data of the first cutting edge to PLC	R _ WB _ _ _ _ fnr [<Tool data 2>] ———>	K
3. Acknowledgement of the tool data input from PLC:	R _ WB _ F _ _ fnr [Tool data 1>] <———	K
a) negative acknowledgement from PLC, e.g. error during loading cycle, leads to abort		
b) positive acknowledgement from PLC: Tool data of the first cutting edge was entered into tool memory and request to host to send block of the next tool cutting edge	T _ WB _ _ _ _ fnr [<Tool data 1>] <———	K
4. Multiple repetition of 2.b) and 3.b) until the tool data of the penultimate cutting edge has been transferred to the PLC and entered in the tool memory with the aid of the loading cycle.	Cutting edge loop (<———>)	K
5. Host transmits the tool data of the last cutting edge to PLC (end of the cutting loop).	R _ WB _ _ E _ fnr [<Tool data 2>] ———>	K
6. PLC acknowledges the tool data of the last cutting edge:		
a) negative acknowledgement from PLC, e.g. error during loading cycle	R _ WB _ F E _ fnr [<Tool data 1>] <———	K
b) positive acknowledgement from PLC: tool data of the last cutting edge was entered in the tool memory (the end of the kernel sequence "Random loading without code carriers")	T _ WB _ _ E _ fnr [<Tool data 1>] <———	K

Comments on useful data:

Tool data 1: = [<mnr mpnr kkkk tnr dnr>] (see Section 4.4.2.2)
Tool data 2: = Complete tool block (see Section 4.4.2.3)

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4.4.6.1.3 Random loading - Report loaded tool

After the tool has been loaded into the magazine and the tool data has been completely (i.e. all cutting edges) entered in the corresponding NC or PLC memories, the loaded tool with the corresponding place number in the magazine can be reported to the host. The initiation must be effected in the PLC user program via the user interface.

a) Message "Tool is loaded "

Function	Host CNC Operator	M. fr. type
1. Operator has loaded tool and acknowledged positively	Tool is in magazine <—————————— (limit switch signal)	
2. Message "Tool is loaded": PLC reports "Tool is loaded" together with the corresponding magazine place number to the host computer	Q_ WB _ _ _ _ fnr [<Tool data 1>>] <——————————	P

b) Message "Tool loading not possible "

Function	Host CNC Operator	M. fr. type
1. Operator cannot load tool and has acknowledged negatively	Tool cannot be loaded <—————————— into the magazine	
2. Message "Loading negative" : PLC reports "Tool loading not possible" to the host The tool data entered in the tool data memories must be deleted again (by PLC user program)!	Q_ WB _ F _ _ fnr [<Tool data 1>] <——————————	P

Comments on useful data:

Tool data 1: = [<mnr mpnr kkkk tnr dnr>] (see Section 4.4.2.2)

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4.4.6.1.4 Example of session "Random loading"

The following is an example for the session "Random loading without code carrier" for a tool with three cutting edges. The example shows the positive sequence without possible session abort message frames.

Function	Host	CNC Operator	M. fr. type
1. Operator specifies magazine number, T number, duplo number and tool size		mnr tnr dnr tool size <– – – – – – – – – – – – –	
2. Request corresponding tool block of a tool (magazine number, T number, duplo number) (initiation of the kernel sequence)	T _ WB _ A _ _ fnr [<Tool data 1>] <———		P
3. Transfer tool data of the first cutting edge of tool to PLC	R _ WB _ _ _ _ fnr [<Tool data 2 of the first cutting edge>] ———>		K
4. Receive acknowledgement for tool data of the first cutting edge or transfer to the loading cycle, position the magazine and request for next cutting edge block to be sent.	T _ WB _ _ _ _ fnr [<Tool data 1>] <———		K
5. Transfer tool data of the second cutting edge to PLC	R _ WB _ _ _ _ fnr [<Tool data 2 of the second cutting edge>] ———>		K
6. Receive acknowledgement for tool data of the second cutting edge or transfer to the loading cycle and request for next cutting edge block to be sent	T _ WB _ _ _ _ fnr [<Tool data 1>] <———		K
7. Transfer tool data of the (third) last cutting edge to PLC	R _ WB _ _ E _ fnr [<Tool data 2 of the last cutting edge>] ———>		K
8. Receive acknowledgement for tool data of the last cutting edge or transfer to the loading cycle (end of the kernel sequence)	T _ WB _ _ E _ fnr [<Tool data 1>] <———		K
9. Operator is requested to load tool at loading location		Tool loaded – – – – – – – – >	
10. Operator has loaded tool at loading location and acknowledges positively		Tool is in magazine <– – – – – – – – (Limit switch signal)	
11. PLC reports "Tool is loaded" to the host with the corresponding magazine place number	Q _ WB _ _ _ _ fnr [<Tool data 1>] <———		P

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4.4.6.2 Random loading with code carrier
(all cutting edge data on code carrier)

In the case of "Random loading with code carrier" the data of the tools for all cutting edges is contained on the code carrier and must be transmitted to the host when loaded. With a message frame, the data of one cutting edge at a time including magazine place number is reported to the host which always supplies an acknowledgement.

The data must previously have been read on the code carrier, with additional PLC software being necessary for transmission of the data from the reader to the PLC (Package 6 and Package 7).

4.4.6.2.1 Random loading of a single-edge tool

Function	Host CNC	M. fr. type
1. The PLC transmits the complete tool data of the single cutting edge (with magazine place number) to the host	R _ WB C _ E _ fnr [<Tool data 2>] <———	K
2. Acknowledgement from host:		
a) negative acknowledgement: Host rejects "Load tool" (identification with error number)	R _ WB C F E _ fnr [<Tool data 1>] ———>	K
b) positive acknowledgement: Host computer acknowledges the loading process positively with data from 1.	T _ WB C _ E _ fnr [<Tool data 1>] ———>	K

Comments on useful data:

Tool data 1: = [<mnr mpnr kkkk tnr dnr>] (see Section 4.4.2.2)
Tool data 2: = Complete tool block (see Section 4.4.2.3)

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4.4.6.2.2 Random loading of a multi-edge tool

Function	Host CNC	M.fr.type
1. The PLC transmits the tool data of the first cutting edge to the host computer (initiation of the kernel sequence)	R_WB C_A_ fnr [<tool-data2>] <———	K
2. Acknowledgement by host computer:		
a) negative acknowledgement: Host refuses "Load tool" (identification with error number)	R _ WB C F A _ fnr [<tool data1>] ———>	K
b) Positive acknowledgement: Host computer acknowledges tool data positively and requests the data for the next cutting edge	T _ WB C _ _ _ fnr [<tool data1>] ———>	K
3. Response by PLC:		
a) Negative acknowledgement: PLC cannot transmit tool data of next cutting edge (identification with error number)	T _ WB C F _ _ fnr [<tool data1>] <———	K
b) PLC transmits tool data of the next cutting edge to the host computer	R _ WB C _ _ _ fnr [<tool data2>] <———	K
4. Multiple repetition of 2.b) and 3.b) for multi-edge tools, until the tool data of the penultimate cutting edge have been transmitted to the host computer.	(cutting edge loop) (<———>)	K
5. Host computer requests the transmission of the tool data for the next cutting edge	T _ WB C _ _ _ fnr [<tool data1>] ———>	K
6. PLC transmits the tool data of the last cutting edge to the host computer	R _ WB C _ E _ fnr [<tool data2>] <———	K
7. Acknowledgement from host:		
a) Negative acknowledgement: Host refuses "Load tool"(identification with error number)	R _ WB C F E _ fnr [<tool data1>] ———>	K
b) Positive acknowlegement: Host acknowledges positively receipt of tool data (end of kernel sequence "Random loading with code carrier")	T _ WB C _ E _ fnr [<tool data1>] ———>	K

Comments on useful data:

Tool data 1: = [<mnr mpnr kkkk tnr dnr>] (see Section 4.4.2.2)
Tool data 2: = complete tool block (see Section 4.4.2.3)

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4.4.6.2.3 Example for session "Random loading with code carrier"

The following is an example for the "Random loading with code carrier" session for a tool with three cutting edges, where all tool data is stored on the code carrier. The example shows the positive sequence without possible session abort message frames.

Function	Host CNC Operator	M.fr.type
1. Operator transfers tool to loading point.	mnr <– – – – – – – –	
2. Read tool data onto code carrier.	Read tool data without mnr, mpnr and <– – – – – – – – kkkk Tool is in magazine <– – – – – – – – (limit switch signal)	
3. After the tool data of the first cutting edge has been transferred to the loading cycle, the magazine has been positioned and the tool is loaded into the magazine, the tool data is transmitted with magazine place number of the 1st cutting edge	R _ WB C _ A _ fnr [<tool data2>] <————————————	K
4. Request of the tool block for the 2nd cutting edge	T _ WB C _ _ _ fnr [<tool data1>] ————————————>	K
5. PLC transmits the tool data of the 2nd cutting edge to the host computer	R _ WB C _ _ _ fnr [<tool data2>] <————————————	K
6. Request for transmission of the tool block of the 3rd cutting edge	T _ WB C _ _ _ fnr [<tool data1>] ————————————>	K
7. PLC transmits the tool data of the last cutting edge to the host computer	R _ WB C _ E _ fnr [<tool data2>] <————————————	K
8. Host computer acknowledges the loading process positively	T _ WB C _ E _ fnr [<tool data1>] ————————————>	K

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4.4.7 Random unloading

With this function, the machine control or the machine operator decides both about the time of unloading and which tool is to be unloaded. The PLC reports to host the tool to be unloaded and its data.

Initiation is via the user interface in the PLC user program. The standard fetches the data from the corresponding tool memories and transmits it to the host computer. Receipt of the tool block is acknowledged by the host. In the case of multi-edge tools, the standard then sends the data of the next cutting edge to the host computer. The transmission of the block of the last cutting edge is specified by the PLC in the identification (7th character = E).

If the host computer checks the reusability of the tool (e.g. remaining life limit exceeded), the host computer can communicate this by the tool identification "Tool blocked" (evaluation and acknowledgement of identification is possible in the PLC user program). Depending on the identification ”Tool blocked” in the message frame 'T_WE_ _E', Package 5 enters error 8000_H in the user interface [only in the case of tool identifier in ASCII**/**PLC MD 7001.7=0]).

With "Random unloading" a distinction is not made in the message frames between host computer and SINUMERIK whether the tools are provided with data code carriers or not. Thus, the subsequent sequences apply to "Random unloading" with and without code carrier. However, the tool data have to be rewritten on the code carrier in the case of tool unloading with code carrier, additional PLC software being required for transmission of the data to the writing device.

4.4.7.1 Random unloading of a single-edge tool

Function	Host CNC	M.fr.type
1. The PLC transmits the tool data of the single tool cutting edge to the host computer. Initiation is via the user interface	R _ WE _ _ E _ fnr [<tool data2>] <———	P
2. Acknowledgement from host computer:		
a) Negative acknowledgement: Host computer refuses the unloading request (identification with error number)	R _ WE _ F E _ fnr [<tool data1>] ———>	K
b) Positive acknowledgement: Host computer confirms positively unloading request as well as receipt of the tool data. Where applicable, the host sets the criterion "Tool reusable" via identification "Tool blocked".	T _ WE _ _ E _ fnr [<tool data1>] ———>	K

Comments on useful data:

Tool data 1: = [<mnr mpnr kkkk tnr dnr>] (see Section 4.4.2.2)
Tool data 2: = complete tool block (see Section 4.4.2.3)

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4.4.7.2 Random unloading of a multi-edge tool

Function	Host CNC	M.fr.type
1. The PLC transmits the tool data of the first tool cutting edge to the host computer. Initiation is via the user interface (initiation of kernel sequence " Random unloading without code carriers").	R _ WE _ A _ _ fnr [<tool data2>] <———	P
2. Acknowledgement from host:		
a) Negative acknowledgement: Host computer refuses unloading request (identification with error number).	R _ WE _ F A _ fnr [<tool data1>] ———>	K
b) Positive acknowledgement: Host computer confirms unloading request as well as receipt of the tool data positively and requests the data for the next cutting edge	T _ WE _ _ _ _ fnr [<tool data1>] ———>	K
3. Response from PLC	T _ WE _ F _ _ fnr [<tool data1>] <———	K
a) Negative acknowledgement:		
b) Positive acknowledgement: The PLC transmits the tool data of the next cutting edge to the host computer	R _ WE _ _ _ _ fnr [<tool data2 of 2.cutting edge>] <———	K
4. Multiple repetition of 2.b) und 3.b) for multi-edge tools, until the tool data of the penultimate cutting edge have been transferred	(cutting edge loop) (<———>)	
5. Host computer requests the tool data of the next cutting edge	T _ WE _ _ _ _ fnr [<tool data1>] ———>	K
6. PLC transmits the tool data of the last cutting edge to the host computer	R _ WE _ _ E _ fnr [<tool data2 of last cutting edge>] <———	K
7. Host computer acknowledges positively receipt of the tool data of the last cutting edge. The criterion "Tools reusable" is set by the host computer where applicable by means of identification "Tool blocked". (End of kernel sequence "Random unloading")	T _ WE _ _ E _ fnr [<tool data1>] ———>	K

Comments on useful data:

Tool data 1: = [<mnr mpnr kkkk tnr dnr>] (see Section 4.4.2.2)
Tool data 2: = complete tool block (see Section 4.4.2.3)

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4.4.7.3 Random unloading – Report unloaded tool

After the tool has been loaded from the magazine and the tool data have been completely transmitted to the host computer (i.e. for all cutting edges), the physical unloading of the tool can be reported to the host computer. Initiation has to be effected in the PLC user program via the user interface. The data of the unloaded tool should be deleted from the tool memories previously (erasure by PLC user program).

a) Message "Tool unloaded"

Function	Host CNC Operator	M.fr.type
1. Request to operator to unload tool and confirm reusability where applicable.	unload tool – – – – – – – – – – – –>	
2. Operator has unloaded tool (with identification "Tool blocked" or " Tool reusable")	tool has been unloaded from magazine <– – – – – – – – – – – – (e.g. limit switch signal)	
3. Unload tool performed (pos. acknowledgement)	Q_ WE _ _ _ _ fnr [<tool data1>] <————————————————	P

b) Message "Unload tool not possible"

Function	Host CNC Operator	M.fr.type
1. Request to operator to unload tool and confirm reusability where applicable.	unload tool – – – – – – – – – – – –>	
2. Operator cannot unload tool	tool has not been unloaded <– – – – – – – – – – – –	
3. "Unload tool" cannot be performed (neg. acknowledgement)	Q_ WE _ F _ _ fnr [<tool data1>] <————————————————	P

Comments on useful data:

Tool data 1: = [<mnr mpnr kkkk tnr dnr>] (see Section 4.4.2.2)
Tool data 2: = complete tool block (see Section 4.4.2.3)

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4.4.7.4 Example for session "Random unloading"

The following is an example for a "Random unloading" session for a tool with three cutting edges. The example shows the positive sequence without possible session abort message frames.

Function	Host	CNC	Operator	M.fr.type
1. Operator specifies magazine no., T-no. and duplo no. for the tool to be unloaded			mnr, tnr, dnr <– – – – – – – – – – – –	
2. The tool data is transferred to the host computer after the magazine has been positioned and the tool data of the individual cutting edges of the unloading cycle has been supplied. (Initiation of kernel sequence) (Initiation is via user interface)	R _ WE _ _ A _ fnr [<tool data 2 of 2. cutting edge>] <————————————————			P
3. Positive acknowledgement from host: Host computer acknowledges receipt of the data for the 1st cutting edge positively and requests the data of the next cutting edge	T _ WE _ _ _ _ fnr [<tool data 1>] ————————————————>			K
4. Transfer tool data of the 2nd cutting edge to host (pos. acknowledgement)	R _ WE _ _ _ _ fnr [<tool data 2 of 2. cutting edge>] <————————————————			K
5. Tool data for 2nd cutting edge has been received by host or request for data of next cutting edge (pos. acknowledgement)	T _ WE _ _ _ _ fnr [<tool data 1>] ————————————————>			K
6. PLC transfers the tool data of last (3rd) cutting edge to host (pos. acknowledgement).	R _ WE _ _ E _ fnr [<tool data 2 of last cutting edge>] <————————————————			K
7. Host computer acknowledges receipt of the tool data of the last cutting edge positively. (Where applicable, host sets "Tool reusable" via identification "Tool blocked") (End of kernel sequence)	T _ WE _ _ E _ fnr [<tool data 1>] ————————————————>			K
8. Request to operator to unload tool			unload tool – – – – – – – – – – – –>	
9. Operator acknowledges "Tool unloaded"			tool has been unloaded <– – – – – – – – – – – –	
10. PLC reports to host "Tool unloading executed" (positive acknowledgement) (initiation is via user interface)	Q _ WE _ _ _ _ fnr [<tool data 1>] <————————————————			P

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4.4.8 Loading and unloading of tool cartridges using SINUMERIK 850 with interface modules CP535, CP525 CP524, AS512 in the external PLC area, or SINUMERIK 880 SW6 and higher, or SINUMERIK 840 SW2 and higher

To achieve an automatic tool flow, tools - which have been set according to planning specifications and are available in a warehouse - must be supplied to the machine tool for automated manipulation.

For this purpose, tools which have been set at an order picking location are commissioned in tool cartridges and transferred automatically to the machine tool. For an automatic change of the tools between cartridge and magazine, message frame sequences have been defined which describe the interactive session between the CNC and the host computer.

Tools which are transported to the CNC in cartridges are loaded into the tool magazine after arrival at the machine tool (loading procedure).

Tools in the magazine of the machine tool which are no longer required, are loaded from the magazine into the cartridge (unloading procedure). The required session is divided into the following sequences:

- Arrival of the tool cartridge at the machine tool
- Host computer transmits the loading list
- Host computer transmits the unloading list
  Start enable for loading/unloading
- CNC reports end of machining and current cartridge allocation

Conditions:

Conditions for synchronization

The message frames defined in Section 4.3.1 "Synchronization" or their project-specific extensions apply to the synchronization session.

Arrival of the tool cartridge at the machine is reported with the cartridge number, without a list of its contents.

For this message, the same message frame sequence is used with which workpiece pallets are reported. Instead of the pallet number (pppp) the cartridge number (kkkk) as well as the machining flag (bb) and the stopping station number (hhhh) must be transmitted. There are two machining statuses for the tool cartridges during synchronization:

1. Tool cartridge before machining
   The CNC has not yet received start enable for machining from the host and must transmit the cartridge arrival message frame after synchronization (R _ KN _ _ M _) again.
2. Tool cartridge being machined
   The CNC has already received from host the start enable for machining the cartridge. After synchronization the CNC must report to the host end of machining and cartridge assignment .

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4.4.8.1 Arrival of tool cartridge at the machine

Function	Host CNC	M.fr.type
1. The PLC reports the tool cartridge arrived at the machine to the host.	R_K N__ M _ fnr [<kkkk tt hhhh>] <———————————————	P
2. Response from host:		
a) Negative acknowledgement: The reported cartridge and the data of the host are not consistent.	R _ K N _ F M _ fnr [<kkkk tt hhhh>] ———————————————>	P
b) Positive acknowledgement: The reported cartridge exists in the corresponding data block of the host. Therefore, the host compiles the block for the cartridge contents.	Q _ K N _ _ M _ fnr [<kkkk tt hhhh>] ———————————————>	P

Erläuterung der Nutzdaten:

kkkk:	Cartridge number	(4 bytes, ASCII)
tt:	Cartridge type Cartridge type is not evaluated at present on the CNC side	(2 bytes, ASCII)
hhhh:	Stopping station number Number of the stopping station to which the cartridge has been delivered.	(4 bytes, ASCII)

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4.4.8.2 Transmitting the loading list

If the machine control has reported an arrived tool cartridge to the host, the host defines the appropriate assignment of the cartridge on the basis of the cartridge number. This data is transmitted by the host to the machine control (CNC) in the form of a loading list.

Faults during transmission of the loading list:

During transmission of the loading list, the SINUMERIK (PLC) does not transmit error messages to the host in the case of logical faults (if e.g. the cartridge assignment data sent by the host cannot be processed by the PLC). A Q-TL acknowledgement is sent instead.

The corresponding negative acknowledgement is only sent in response to the start enable for machining of the cartridge transmitted to the host with the message frame C _ TE _ F _ _ . Subsequently the previously transmitted loading and unloading list must be deleted in the PLC. The session can be restarted from the PLC by a new "Tool cartridge at machine" arrival message (message frame R _ KN _ _M _). A similar procedure applies to the transmission of the unloading list.

Function	Host CNC	M.fr.type
1. The host computer transmits the assignment for the tool cartridge arrived at the machine tool to the CNC (1st message frame)	R _ T L _ _ _ _ fnr [<*>] ——————————>	K
2. Acknowledgement by CNC The PLC has received a loading list message frame and requests further cartridge assignment data.	Q _ T L _ _ _ _ fnr [<kkkk>] <——————————	K
3. Multiple repetition of 1. and 2. for the transmission of further cartridge assignment data to the CNC	(repeat loop) <——————————>	K
4. The host computer transmits the last message frame with cartridge assignment data to the CNC	R _ T L _ _ E _ fnr [<*>] ——————————>	K
5. Acknowledgement by CNC The PLC acknowledges the complete receipt of the loading list.	Q _ T L _ _ E _ fnr [<kkkk>] <——————————	K

Comments on useful data:

*:	= [< kkkk tt hhhh aa anz kb1.... >]	
kkkk:	Cartridge number	(4 bytes, ASCII)
tt:	Cartridge type	(2 bytes, ASCII)
	Cartridge type is at present not evaluated on the CNC side	
hhhh:	Stopping place number	(4 bytes, ASCII)
aa:	Number of the tool places on the cartridge	(1 fixed point word)
anz:	Number of valid tool blocks	(1 fixed point word)
kb1:	Cartridge assignment tool block 1	
:	: :	
kb5:	Cartridge assignment tool block 5	

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All tools on the cartridge are described with the aid of the cartridge assignment tool blocks. Only the assigned cartridge places are reported. A maximum of 5 cartridge assignment tool blocks (kb1...kb5) can be transmitted in a message frame.

Kbx: = mnr kpnr zi zu tnr dnr hnr hpv hph, x = 1 bis 5

mnr: Target magazine number (1 fixed point word)
Number of the magazine into which the tool is to be loaded.
Target magazine number is at present not evaluated on CNC side.

Kpnr: Cartridge place number (1 fixed point word)
Tool location on delivered cartridge.

zi: Target identification (1 byte, ASCII)
Target identification is not evaluated at present on the CNC side.

zu: Status identification (1 byte, ASCII)
0= not unloaded from the cartridge
3= conditional load of tool into the magazine
4= unconditional load of tool into the magazine
5= tool exchange (see unloading list)
7= tool not identifiable or wrong tool (errors can be reported with identification "7")

tnr: T-number (3 words; BCD, 8 decades)
See Section 4.4.2.1 tool data

dnr: Duplo number (3 words; BCD, 4 decades)
See Section 4.4.2.1 tool data

hnr: Tool holder number (3 words; BCD, 8 decades)
Tool holder number is not evaluated at present on CNC side.

hpv: Half places, front (3-words; BCD, 2 decades)
Tool size; Magazine half places, front.

hph: Half places, rear (3 words; BCD, 2 decades)
Tool size; Magazine half places, rear.

Notes on cartridge data:

If the cartridge is empty, "0 "(anz =00) is sent as number of tools on the cartridge.
Tool blocks not used are preset with zeros.

A cartridge assignment tool block has a length of 36 bytes.

A cartridge assignment message frame has a maximum length of 204 bytes (194 bytes of useful data).

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4.4.8.3 Transmitting the unloading list

The host transmits an unloading list for a tool cartridge delivered to the machine tool. The list contains all tools which are to be unloaded from the magazine into the cartridge due to wear, break or a production job change.

Function	Host CNC	M.fr.type
1. The host transmits the unloading list for the tool cartridge arrived at the machine tool to the CNC (1st message frame).	R _ T U _ _ _ _ fnr [<*>] ——————————————————>	K
2. Acknowledgement by CNC The PLC has received an unloading list message frame and requests further data.	Q _ T U _ _ _ _ fnr [<anz>] <——————————————————	K
3. Multiple repetition of 1. and 2. for the transmission of further unloading list message frames.	(repeat loop) <——————————————————>	K
4. The host computer transmits the last unloading list message frame to the CNC	R _ T U _ _ E _ fnr [<*>] ——————————————————>	K
5. Acknowledgement by CNC The PLC acknowledges the complete receipt of the loading list.	Q _ T U _ _ E _ fnr [<kkkk>] <——————————————————	K

Comments on useful data:

*: = [< anz ke1..... >]
anz: Number of valid tool blocks (1 fixed point word)
ke1: Cartridge unloading tool block 1

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The tools which are to be unloaded from the magazine are described with the aid of the cartridge unloading tool blocks.

A maximum of 11 cartridge unloading tool blocks (ke1 ..... ke11) can be transmitted in a message frame.

kex:	= zi zu tnr dnr hnr x = 1 to 11	
zi:	Target identification	(1 byte, ASCII)
	Target identification is not evaluated at present on CNC side	
zu:	Status identification	(1 byte, ASCII)
	1 = conditional unloading of tool from magazine	
	2 = unconditional unloading of	
	Tool from magazine 5 = exchange tool (see loading list)	
tnr:	T number	(3 words; BCD, 8 decades)
	See Section 4.4.2.1 tool data	
dnr:	Duplo number	(3 words; BCD, 4 decades)
	See Section 4.4.2.1 tool data	
hnr:	Tool holder number	(3 words; BCD, 8 decades)
	Tool holder number is not evaluated at present on the CNC side.	

Note:

If no tools have to be unloaded from the magazine, "0" is sent as the tool number (anz=00).

Tool blocks not used are preset with zeros.

A cartridge unloading tool block has a length of 20 bytes.

A cartridge unloading message frame has a maximum length of 232 bytes (222 bytes of useful data).

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4.4.8.4 Processing enable of a tool cartridge

After the loading and unloading list of the tool cartridge has been transmitted without error to the CNC, the host sends processing enable. The (mechanical) loading/unloading process proper starts after the CNC has positively acknowledged the processing enable.

During loading/unloading, the CNC holds the current assignment of the cartridge (cartridge assignment list). Transmission of the tool data to the host for the tools unloaded from the magazine can be effected with the aid of standard sequences - see Section 4.4.6 "Random Loading" and Section 4.4.7 "Random unloading".

Function	Host CNC	M.fr.type
1. Processing enable The host computer has transmitted without error the loading/unloading list for the delivered cartridge to the CNC and now enables processing of the cartridge.	C _ T E _ _ _ _ fnr [<kkkk>] ——————————————————>	P
2. Acknowledgement by CNC a) Negative acknowledgement:*) The PLC acknowledges the processing enable negatively. The start enable given by the host computer is eliminated.	C _ T E _ F _ _ fnr [<kkkk>] <——————————————————	P
b) Positive acknowledgement: The PLC acknowledges to the host start of cartridge processing and processes the loading/unloading list received.	Q _ T E _ _ _ _ fnr [<kkkk>] <——————————————————	P

Comments on useful data:

kkkk: Cartridge number (4 bytes, ASCII)
Number of cartridge for which processing has been started.

*) *The loading/unloading list previously transmitted to the host for this cartridge must be deleted. The session can be restarted with the message frame "Arrival of cartridge at the machine".*

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4.4.8.5 Transmission of cartridge assignment to host

After loading/unloading of the tool cartridges has been terminated, end of processing and the current cartridge assignment are transmitted by the CNC to the host computer. Only those places of the cartridge are reported to which tools are assigned.

Function	Host CNC	M.fr.type
1. Processing of a tool cartridge has been terminated. End of processing and current cartridge assignment are transmitted to the host computer (1st message frame).	R _ T P _ _ _ _ fnr [<*>] <———	K
	R _ T P _ F _ _ fnr [<kkkk>] ———>	K
2. Acknowledgement by CNC		
a) negative acknowledgement The host computer acknowledges negatively the end of machining or the current cartridge assignment data. An inconsistency has been established in the host computer between the message frame data and the data within the host itself.	Q _ T P _ _ _ _ fnr [<kkkk>] ———>	K
b) positive acknowledgement The host computer has received a message frame with the current cartridge assignment data and requests the next block.		
3. Multiple repetition of 1. and 2. for transmission of the current cartridge assignment data to the host computer.	(repeat loop) <———>	K
4. The CNC transmits the last message frame of the current cartridge assignment data to the host computer.	R _ T P _ _ E _ fnr [<*>] <———	K
5. Acknowledgement by CNC		
a) negative acknowledgement The host computer acknowledges negatively the current cartridge assignment data.	R _ T P _ F E _ fnr [<kkkk>] ———>	K
b) positive acknowledgement The host computer acknowledges complete receipt of the current cartridge assignment.	Q _ T P _ _ E _ fnr [<kkkk>] ———>	K

Comments on useful data:

* : =[<kkkk tt hhhh aa anz kb1 ....>]
See Section 4.4.8.2 "Transmit loading list" for comments on useful data.

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4.5 Message frames for the transmission of NC files

4.5.1 General information on file transfer

NC files can be transmitted as a result of

- Initiative by the host
- Request from machine operator via NC operator panel

Both the data request and the data transmission can occur simultaneously with workpiece machining (operator-process communication or tool session). The transmission of NC programs (MPF main programs and SPF subroutines) and main memory data (ZOA , RPA TEA, TOA, SEA, GIA, IKA) is possible.

The NC programs are structured according to a fixed scheme. The program data are transmitted with ASCII code.

For details of a NC program structure please refer to the SINUMERIK 800 or SINUMERIK 840 Programming Guide.

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4.5.2 Session – Transmit NC files to NC, Request by host

Function	Host CNC	M.fr.type
1. Request by host to CNC to receive NC data	P R a a a _ _ _ fnr [<vv... bb...>] ——————————————————>	S
2. Acknowledgement by CNC		
a) Negative acknowledgement with error number and abort	P R a a a F _ _ fnr <——————————————————	S
b) Positive acknowledgement: Data request by CNC	T N a a a _ _ _ fnr <——————————————————	S
3. Acknowledgement by host		
a) Negative acknowledgement with error number and abort	T N a a a F _ _ fnr ——————————————————>	S
b) Transmission of the NC data from host to CNC	R N a a a _ _ _ fnr [<%MPF 1234 LF ..>] ——————————————————>	S
4. Acknowledgement by CNC		
a) Negative acknowledgement with error number and abort	R N a a a F _ _ fnr <——————————————————	S
b) Request by CNC to transmit next data block (subsequent data block) to host	T N a a a _ _ _ fnr <——————————————————	S
5. Repetition of 3. and 4. if several data blocks are transmitted	(repeat loop) (<——————————————————>)	S
6. End of NC data transmission with or without useful data	R N a a a _ E _ fnr [<.....M30 LF>] ——————————————————>	S
7. Acknowledgement by CNC		
a) Negative acknowledgement for end message with error number and abort	R N a a a F E _ fnr <——————————————————	S
b) Positive acknowledgement for end message file transfer terminated	R E a a a _ _ _ fnr <——————————————————	S

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Comments on useful data:

aaa:	NC data type	
	MPF = Main Program File	
	SPF = Sub Program File, subroutine	
	ZOA = ZO data (zero offset active)	
	RPA = R parameters (R parameters active)	
	TEA = machine data	
	TOA = tool offsets	
	SEA = setting data	
	GIA = Gear interolation data	
	IKA = Data for interpolation and compensation with tables IKA 1, IKA 2, IKA3	
vvvv:	from program no. (MPF, SPF)	(4 bytes, ASCII)
bbbb:	up to program no. (MPF, SPF)	(4 bytes, ASCII), (optional)
_vvvvv:	from beginning of area (ZOA, RPA TEA, TOA, SEA, GIA, IKA)	(6 bytes, ASCII)
_bbbbb:	to end of area (ZOA, RPA TEA, TOA,SEA, GIA, IKA)	(6 bytes, ASCII)

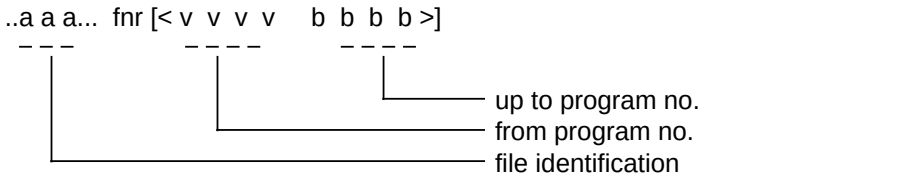
1) For structure of NC data, please refer to the SINUMERIK 800 Programming Guide .

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4.5.2.1 Representation of the request message frames for file transfer, Request by host

The file transfer session starts with a request message frame. The data type and the data area are contained in the request message frame. In the following, the request message frames defined for the file transfer session due to "Request by host" are shown for SINUMERIK 840/850/880.

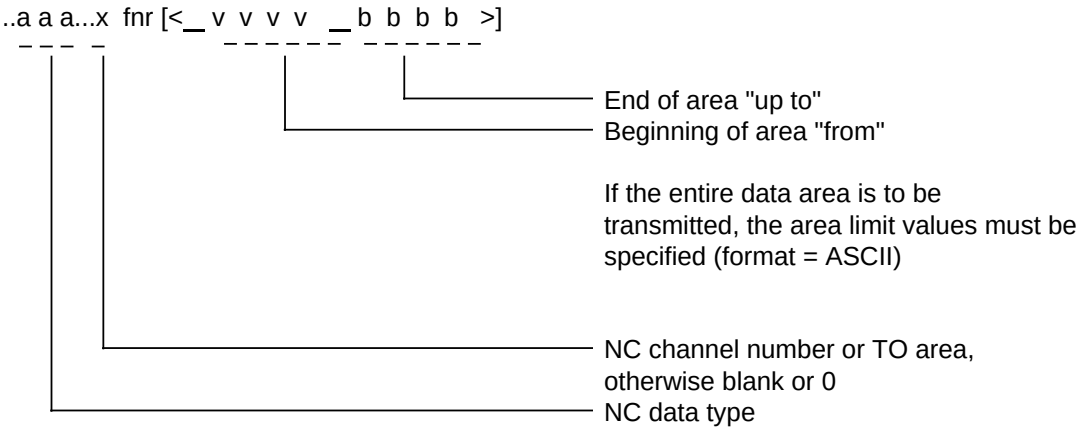
Representation of request message frames for NC files



ASCII format

aaa = MPF : Main programs
aaa = SPF : Subroutines
aaa = CLF : Clear statement
vvvv...bbbb = from program no. up to program no.

General representation of the request message frames for NC main memory data



For the individual NC main memory data, the following applies:

ZOA – data active zero offset

aaa = ZOA
x = 0 : Zero offset
x = 1...8 : NC channel number for angle of rotation offsets with SINUMERIK 850
x = 1...4 : NC channel number for angle of rotation offsets with SINUMERIK 840
x = 1...G : NC channel number for angle of rotation offsets with SINUMERIK 880
vvvvv.bbbbb = is not relevant as only entire data area transferable

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RPA – active R parameters (central and channel-specific)

aaa = RPA
x = 0 : central R parameters
x = 1...8 : Channel number for channel-specific R parameters with SINUMERIK 850
x = 1...4 : Channel number for channel-specific R parameters with SINUMERIK 840
x = 1...9, A, B, C, D, E, F, G: Channel number for channel-specific R parameters with SINUMERIK 880
_vvvvv... _bbbbb = _00900 ... _00999: Area limits with central R parameters
_vvvvv... _bbbbb = _00000 ... _00499: Area limits with channel-specific R parameters

TEA1 – NC machine data

aaa = TE1
x = _
_vvvvv... _bbbbb = _00000 ... _65000: Area limits

TEA2 – PLC machine data

aaa = TE2
x = _
_vvvvv... _bbbbb = _00000 ... _09999: Area limits

TEA4 – Cycle machine data

aaa = TE4
x = 0 : Central cycle MDs
x = 1...8 : Channel number for channel-specific cycles MD with SINUMERIK 850
x = 1...4 : Channel number for channel-specific cycles MD with SINUMERIK 840
x = 1...9, A, B, C, D, E, F, G: Channel number for channel-specific cycle MDs with SINUMERIK 880
_vvvvv... _bbbbb = _01000 ... _09999: Area limits with central cycle MDs
_vvvvv... _bbbbb = _00000 ... _00999: Area limits with channel-specific cycle MDs

SEA – NC setting data

aaa = SE1
x = _
_vvvvv... _bbbbb = _00000 ... _06000: Area limits

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SEA4 – cycle setting data

aaa = SE4
x = 1...8 : Channel number for channel-specific cycle SDs with SINUMERIK 850
x = 1...4 : Channel number for channel-specific cycle SDs with SINUMERIK 840
x = 1...9, A, B, C, D, E, F, G: Channel number for channel-specific cycle SDs with SINUMERIK 880
_vvvvv... _bbbbb = _00000 ... _00999: Area limits with channel-specific cycle SDs

(x=0: central cycle SDs are not provided at present.)

TOA – active tool offsets

aaa = TOA
x = 1...9, A, B, C, D, E, F, G: Number of the TO area
_vvvvv... _bbbbb = _00000 ... _00819: Area limits

In case of the loading request (FLR NC) from the host, the file identification in the identifier and the area limits (from...to) are not evaluated.

IKA – data for interpolation and compensation with tables

aaa = IKA
x = 1...3: IKA data type
_vvvvv... _bbbbb = _00000 ... _00032: Area limits for IKA1 and IKA2 data
_00000 ... _16000: Area limits for IKA3 data (up to SW 3)
_000001 ... _065535: Area limits for IKA3 data (up to SW 4)

GIA - Gear interpolation data
_000000 ... _000045: Area limits

Notes:

- If area beginning is greater than end of area or end of area is missing, only area beginning is output.
- If area beginning is greater than area limit, no data are transmitted in the message frame (e.g. with TOA< % TOA M30>).
- In the case of TEA1, TEA2, TEA4 an error is reported as from area end 65000 (64k). Only the last 5 digits are evaluated. The last 4 positions are always evaluated in the case of the remaining main memory data.
- If with TOA data the number of the TO area is defined as " or "0", then an error message is output.
- IKA-data only become effective after Power On.

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4.5.3 Session – Transmit NC files to NC, Request by operator

Function	Host CNC	M.fr.type
1. Request by operator to send NC data.	T D a a a _ _ _ fnr [<vvvv bbbb>] <———	S
2. Acknowledgement by host:		
a) Negative acknowledgement with error number, e.g. NC data does not exist	T D a a a F _ _ fnr ———>	S
b) Request by host for CNC to receive NC data	P R a a a _ _ _ fnr [<vvvv bbbb>] ———>	S
3. Acknowledgement by CNC:		
a) Negative acknowledgement with error number and abort	P R a a a F _ _ fnr <———	S
b) Data request by CNC	T N a a a F _ _ fnr <———	S
4. Acknowledgement by FLR:		
a) Negative acknowledgement with error number and abort	T N a a a _ _ _ fnr ———>	S
b) Transmission of NC data blocks from host to CNC	1) R N a a a _ _ _ fnr [<%MPF 1234 LF...>] ———>	S
5. Acknowledgement by CNC:	R N a a a F _ _ fnr <———	S
a) Negative acknowledgement with error number		
b) Request by CNC to host computer to send next data block (subsequent data block)	T N a a a _ _ _ fnr <———	S
6. Repetition of 4. and 5. if transmitting further subsequent data blocks.	(repeat loop) (<———>)	S
7. End of NC data transmission with or without useful data.	R N a a a _ E _ fnr [<....M30 LF>][1)] ———>	S
8. Acknowledgement by CNC:		
a) Negative acknowledgement for end message with error number and abort	R N a a a F E _ fnr <———	S
b) Positive acknowledgement for end message file transfer terminated [2)]	R E a a a _ _ _ fnr <———	S

Comments on useful data:

aaa: NC data type
MPF = Main Program File
SPF = Sub Program File, subroutine

vvvv: from program no. (4 bytes, ASCII)

bbbb: up to program no. (4 bytes, ASCII), (optional function)

1) For structure of NC data, please refer to the SINUMERIK 800 Programming Guide

2) Depending on NC MD

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4.5.4 Session – Retransmit NC files to host, Request by host

Function	Host CNC	M.fr.type
1. Request by host to CNC to send NC data	P T a a a _ _ _ fnr [<vv...bb...>] ——————————>	S
2. Acknowledgement from CNC	P T a a a F _ _ fnr <——————————	S
a) Negative acknowledgement with error number and abort	1)	
b) Positive acknowledgement: Retransmission of NC data to host	R N a a a _ _ _ fnr [<%MPF 1234 LF...>] <——————————	S
3. Acknowledgement by a host		
a) Negative acknowledgement with error number and abort	R N a a a F _ _ fnr ——————————>	S
b) Request by host to CNC to send next data block (subsequent data block)	T N a a a _ _ _ fnr ——————————>	S
4. Acknowledgement by CNC		
a) Negative acknowledgement with error number and abort	T N a a a F _ _ fnr <——————————	S
b) Positive acknowledgement: Transmission of subsequent data blocks to host	R N a a a _ _ _ fnr [<.....>][1] <——————————	S
5. Repetition of 3. and 4. if further subsequent data blocks are transmitted	(repeat loop) (<——————————>)	S
6. End of NC data retransmission	R N a a a _ E _ fnr [<.....M30 LF>][1] <——————————	S
7. Acknowledgement by host	R N a a a F E _ fnr ——————————>	S
a) Negative acknowledgement to end message with subsequent abort		
b) Positive acknowledgement to end message, file transfer ended successfully [2]	R E a a a _ _ _ fnr ——————————>	S

1) *For structure of NC data, please refer to Programming Guide SINUMERIK System 800*

2) *Depending on NC MD*

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Comments on useful data:

aaa : NC data type
- MPF = Main Program File
- SPF = Sub Program File, subroutine
- ZOA = ZO data (zero offset active)
- RPA = R parameters (R parameter active)
- TEA = machine data
- TOA = tool offsets
- SEA = setting data
- IKA = Data for interpolation and compensation with tables IKA1, IKA2, IKA3
- GIA = Gear interpolation data

vvvv:	from program no.	(4 bytes, ASCII)
bbbb:	up to program no.	(4 bytes, ASCII), (optional function)
_vvvvv:	from area (ZOA, RPA TEA, TOA, SEA, GIA, IKA)	(6 bytes, ASCII)
_bbbbb:	up to end of area(ZOA, RPA TEA, TOA, SEA, GIA, IKA)	(6 bytes, ASCII)

Representation of the request message frames:

The file transfer session starts with a request message frame in which data type and data area are communicated.

The request message frames defined for SINUMERIK 840/850/880 are explained in Section 4.5.2.1.

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4.5.5 Session – Retransmit NC files to host, Request by operator

Function	Host CNC	M.fr.type
1. Request by operator to host to receive NC data	R D a a a _ _ _ fnr [<vvvv bbbb>] <———	S
2. Acknowledgement by host:		
a) Negative acknowledgement with error number and abort	R D a a a F _ _ fnr ———>	S
b) Request by host to CNC to send NC data	P T a a a _ _ _ fnr [<vvvv bbbb>] ———>	S
3. Acknowledgement by CNC		
a) Negative acknowledgement with error number and abort	P T a a a F _ _ fnr <———	S
b) Positive acknowledgement Retransmission of NC data to host	1) R N a a a _ _ _ fnr [<%MPF 1234 LF...>] <———	S
4. Acknowledgement by host:		
a) Negative acknowledgement with error number and abort	R N a a a F _ _ fnr ———>	S
b) Request by host to CNC to send next data block (subsequent data block)	T N a a a _ _ _ fnr ———>	S
5. Acknowledgement by CNC		
a) Negative acknowledgement with error number and abort	T N a a a F _ _ fnr <———	S
b) Retransmission of further subsequent data blocks	R N a a a _ _ _ fnr [<.....>][1)] <———	S
6. Repetition of 4. and 5. in the case of further subsequent data blocks	(repeat loop) (<———>)	S
7. End of NC data retransmission with or without useful data	R N a a a _ E _ fnr [<.....M30 LF>][1)] <———	S
8. Acknowledgement by host:		
a) Negative acknowledgement to end message with subsequent abort	R N a a a F E _ fnr ———>	S
b) Positive acknowledgement to end message, file transfer ended successfully [2)]	R E a a a _ _ _ fnr ———>	S

1) *For structure of NC data, please refer to the SINUMERIK 800 Programming Guide.*

2) *Depending on NC MD*

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Comments on useful data:

aaa : NC data type
MPF = Main Program File
SPF = Sub Program File, subroutine
vvvv: from program no. (4 bytes, ASCII)
bbbb: up to program no. (4 bytes, ASCII), (optional function)

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4.5.6 Session – Erasing NC files (MPF and SPF)

Function	Host CNC	M.fr.type
1. Announce erasing of NC files.	P R C L F _ _ _ fnr ——————————>	S
2. Acknowledgement by CNC		
a) Negative acknowledgement with error number and abort	P R C L F F _ _ fnr <——————————	S
b) Request by CNC to host to transmit erase data	T N C L F _ _ _ fnr <——————————	S
3. Acknowledgement by host		
a) Negative acknowledgement with error number and abort	T N C L F F _ _ fnr ——————————>	S
b) Positive acknowledgement transmit erase data to CNC/NC	1) R N C L F _ _ _ fnr [<%CLF LF...data>] ——————————>	S
4. Acknowledgement by CNC		
a) Negative acknowledgement with error number and abort	R N C L F F _ _ fnr <——————————	S
b) Request subsequent erase data block	T N C L F _ _ _ fnr <——————————	S
5. Repetition of 3. and 4. in the case of further subsequent erase data blocks.	(repeat loop) (<——————————>)	S
6. End of session: Erase NC data.	R N C L F _ E _ fnr [<.....>][1)] ——————————>	S
7. Reply for end of session:		
a) Positive acknowledgement: "Erasure successfully completed"	R N K OM _ _ _ fnr [<fsp>] <——————————	S
b) Negative acknowledgement: Reply "Erasure could not be performed"	R N K OMF _ _ fnr <——————————	S

Comments on useful data:

fsp: Free NC memory in bytes (2 fixed point words)

---

1) For structure of data when erasing NC programs, please refer to Programming Guide SINUMERIK System 800.

When erasing part programs the following applies to the data:

a) Erasing a single part program: MPF 1234 LF

b) Erasing several part programs: MPF0001, 0234LF
(i.e. erase part programs % 1 to % 234)

c) Erasing all part programs MPF0000, 9999LF
The same applies to the erasure of subroutines.

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4.5.7 Execution from external

With the function "execution from external", you can read long part programs from an external mass storage medium via a serial interface or computer link into the control and execute them at the same time.
The part program is read into a circular buffer where it is executed immediately.

Dialog call - execution from external

Function	FLR CNC	M.fr.type
I) Preparation of the function The VDI signal is influenced by the user program. Acknowledgement a) Negative and abort b) Positive	P E E P F_ _ _ <fnr> [pnr] ——>	A
	P E E P F F_ _ <fnr> [pnr] <——	A
	Q E E P F_ _ _ <fnr> [pnr] <——	A
II) Start the function The frame from the computer also causes NC start	C_C S_ _Ag <fnr> [ND1] ——>	A
Note: The preparation is changed so that no error message is output if a program is started that is not yet in the control. Acknowledgement a) Negative acknowledgement (on II) and abort b) Positive acknowledgement (on II) After sending the frame the SINUMERIK begins with III automatically.	C_C S_ _FAg <fnr> [pppp] <——	A
	C_C S_ _Ag <fnr> [pppp] <——	A
III) NC data transfer **Note:** The dialog "transfer of NC data to the NC initiated by the user via screen form": The code for data/file type is MPF. 1. Request to host computer to send NC data	T D M P F_ _ _ <fnr> [ND2] <——	S
2. Acknowledgement from the host computer a) Negative acknowledgement with error number	T D M P F F_ _ <fnr> [ ] ——>	S
b) Request for CNC to send NC data	P R M P F_ _ _ <fnr> [ND2] ——>	S
3. Acknowledgement from CNC	P R M P F F_ _ <fnr> [ ] <——	S
a) Negative with abort	T N M P F_ _ _ <fnr> [ ] <——	S
b) Data request from CNC		

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Function	Host CNC	M.fr.type
4. Acknowledgement from the host computer:		
a) Negative acknowledgement with error number and abort	T N M P F F_ _ <fnr> [ ] ——————————>	S
b) Transfer of NC frames from the host computer to the CNC	R N M P F_ _ _ <fnr> [ ] ——————————>	S
5. Acknowledgement from the CNC:		
a) Negative acknowledgement with error number	R N M P F F_ _ <fnr> [ ] <——————————	S
b) Request by CNC to the host computer to send the next frame	T N M P F_ _ _ <fnr> [ ] <——————————	S
6. Repetition of 4. and 5. for transfer of following frames.	Repeat loop <——————————>	
7. End of NC data transfer with or without useful data.	R N M P F _ E _ <fnr> [ND4] ——————————>	
8. Acknowledgement from the CNC:		
a) Negative acknowledgement for end message with error number and abort	R N a a a F E _ _ fnr <——————————	S
b) Positive acknowledgement for end message, [1] file transfer ended	R E a a a _ _ _ fnr <——————————	S

Explanations:

ND1 = pppp pnr k rrrrr
ND2 = vvvv bbbb
ND3 = %MPF 1234 LF ... M30 LF
pppp = pallet number
pnr = NC program number
k = parameter for following machining
rrrrr = spare
vvvv = from program number
bbbb = to program number

[1] *depending on NC MD*

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4.5.8 Conditions for NC file transfer

- NC data request as well as NC data transmission can take place in parallel to workpiece machining (operator-process communication).
- In the case of NC file transfer the sequence of message frames with higher priority (i.e. all message frames except for file transfer, e.g. alarm message from PLC) can be interrupted.
- It not is possible to run several file transfer sessions simultaneously (request would be rejected with error message frame).
- For each incoming message frame with the F error code the correspondingly negative acknowledged session is aborted by the CNC.
- If one or several transmission errors occur during the file transfer in the NC (RS 232C (V.24) alarm), they are automatically cancelled on reinitiation of a file transfer (PRMPF message frame...).
- The incompletely loaded NC files have to be erased by the host. The session can be repeated after elimination of the error cause.
- It is possible to transmit several file types (e.g. MPF, SPF) with only one initiation command. The CNC does not check whether the host changes the data type during transmission.
- The message frame file transfer end message can optionally contain data (example: RNaaa E [<...data...M30 LF>])
- After the erase message frame (RNCLF E) the CNC sends an acknowledgement message frame to the host with which the free NC memory is reported.
- In the NC programs only LF is permissible as end of block. When NC programs are retransmitted to the host, CRs (carriage return) and blanks are not transmitted.
- Header, intermediate header and trailer of NC programs are not stored in the NC part program memory.
- When retransmitting NC programs to the host, transmission of several NC programs is optionally possible by specifying bbbb (up to program no.) in the request message frame.
- If, in a current file transfer session, the partner (e.g. host computer) sends a new request (PRaa, PTaaa), the current file transfer is aborted without feedback and the new request is processed.

  These functions are only valid when request is initiated by the partner (e.g. host computer).
- If the file transfer has been initiated by the operator, it changes immediately to its initial state when aborted by the operator, and a new request is processed immediately.
- When cycle inhibit is active (PLC interface signal) no cycles are retransmitted or erased.
- File transfer is modified by means of NC MD 5147 as follows (880**/**840 only)
  Bit 0: With**/**without pos. end message frame (”REaaa_ _ _fnr”)
  Bit 1: Acknowledge entered FT data immediately (improves data throughput)
  Bit 2: Do not erase NC programs that have just been run
  Bit 3: Do not overwrite cycles in the UMS (EPROM) (880 SW 6)
- A timeout limit can be specified for the file transfer session by means of NC MD 31 (880**/**840 only).
- Control characters hex 00 to 19 in the useful data are rejected by the part program driver, but permitted in the comparison run.
- In the AS512 header, the useful data must be even.

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- SINUMERIK 850 with interface module in the external PLC area:
  If NC data are read in**/**out via a V.24 interface during a NC file transfer request, this request is acknowledged negatively with error number 3102 "Program input busy".
- SINUMERIK 840**/**850**/**880 with interface module in the COM area:
  NC programs can be transmitted simultaneously via the RS-232-C (V24) interface or computer link interface.
- The SINUMERIK 850 with the interface modules CP535, CP525, CP524, AS512 in the external PLC area has an own data buffer for the transmission of NC files (common buffer for input and output).

  When transmitting NC files to the SINUMERIK (input) the NC programs must be loaded into this separate data buffer.

  Branching for loading of the data is initiated on
  – File transfer with AS512 by the host:
    Host specifies the relevant target address in AS512 header
    Co-ordination flag: F 006.5
    Input buffers: DB 04, DW05
  – File transfer with CP535 by means of function blocks (package 5)
    Package 5 function blocks compare the first two characters of the message frame identification for each incoming message frame. If these are 'PT' or 'PR', the receive buffer is automatically loaded into the NC data buffer (DB04, DW05).
- The following NC MDs are used with "Execution from external" (840**/**880 only):
  MD 5148 - 5151: "Log. partner receiver"
  MD 5152: "Location receiver"
  MD 30: "Size of circular buffer"
  MD 130*: "Interface of execution from external"

4.5.9 Link between SINUMERIK 840C (SW 3 and higher) and host computer

The message frames described in this section are supplied with the configuring software SINPS 315 (231) version 7.2 and higher.

The interface for data transfer, the directory output and the transfer of delete instructions between the MMC and**/**or directory output of the NC of the SINUMERIK 840C and the host computer is described below.

On the MMC the data are stored in workpieces which can be created in the LOCAL directory or GLOBAL directory.

In the case of the NC, all the loaded programs are in the ROOT directory.

Three request types are defined in the MMC and the LOCAL**/** or GLOBAL**/** directory can be placed at the beginning. The default value is LOCAL**/**.

Request 1:	<Workpiece>/<File name>.EXT	one particular workpiece file of the specified data type
Request 2:	<Workpiece>	all the workpiece files
	<Workpiece>**/***	all the workpiece files
	<Workpiece>**/***.EXT	all the workpiece files of the specified data type
	<Workpiece>**/**<name>*	all the workpiece files starting with the specified name

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<Workpiece>**/**<name>*.EXT	all the files of the workpiece starting with the specified name and of the corresponding data type
<Workpiece>**/**MPF[from, to]	all MPFs (SPFs similarly) of the workpiece in the specified range
Request 3 *	all workpieces under LOCAL
<name>*	all workpieces under LOCAL beginning with the specified name
<name>*.EXT	all the workpieces under LOCAL starting with <name> and which are of the corresponding data type
<all possibilities under request 2>	

The file name must start with MPF for main programs and SPF for subroutines and must end with a number between 0 and 9999. Directory and file names may only consist of letters, numbers and underscore lines.

The following file types can be used:

Data type	Host computer extension
Source program	SRC
Tool list	TOL
Main program	MPF
Subroutine	SPF
Work schedule	FAF
R parameters	RPA
Setting data	SEA
Cycle setting data	SE4
Zero offset	ZOA
Tool offsets	TOA
Comments	COM
Job list	JOB
IKA curve pointers	IK2
IKA points	IK3
IKA configurations	IK1
Gear interpolation data	GIA

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4.5.9.1 Data transfer from host computer to MMC

Sequence A: Transfer file from host computer to MMC

Function	Host MMC	M.fr.type
1) Request to MMC to receive data	PAPRG __ __M fnr <Request 1> ——————————>	S
Negative acknowledgement	PAPRGF _ M fnr <——————————	S
Send next data block	TCPRG __ __ M fnr <——————————	S
2) Negative acknowledgement	TCPRGF _ M fnr ——————————>	S
Data transmission from host to MMC	RCPRG _ M fnr <Data> ——————————>	S
3) Negative acknowledgement	RCPRGF _M fnr <——————————	S
Send next data block	TCPRG __ __M fnr <——————————	S
4) Repeat 2) and 3) until error or 5)		
5) End of data transmission	RCPRG _ EM fnr <[Data]> ——————————>	S
6) Negative acknowledgement	RCPRGFEM fnr <——————————	S
Everything written	RBPRG _ _ M fnr <——————————	S

Precisely one file can be transmitted for every Sequence A. The workpiece is created if it does not already exist. Transmission is aborted if the file already exists on the MMC. If transmission is ended prematurely, the partially transmitted file stays on the MMC.

Sequence B: MMC requests host to send data to MMC

Function	Host MMC	M.fr.type
1) Request by MMC to host	TIPRG _ _ M fnr <Request 2> <——————————	S
Negative acknowledgement	TIPRGF _ M fnr ——————————>	S
Transmission sequence A for each file which is addressed on the host (see above)		
Everything transmitted	RGPRG _ EM fnr ——————————>	S

The request (Request 2) must be split into individual message frames (A) of type (Request 1) by the host.

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4.5.9.2 Data transfer from MMC to host

Sequence C: Transfer file from MMC to host

Function	Host MMC	M.fr.type
1) Request to MMC to send data	PUPRG _ _ M fnr <Request 1> →	S
Negative acknowledgement	PUPRGF _ M fnr ←	S
Data transfer to host	RCPRG _ _ M fnr <Data> ←	S
2) Negative acknowledgement	RCPRGF _ M fnr →	S
Send next data block	TCPRG _ _ M fnr →	S
3) Negative acknowledgement	TCPRGF _ M fnr ←	S
Data block transfer to host	RCPRG _ _ M fnr <Data> ←	S
4) Repeat 2) and 3) until error or 5)		
5) End of data transmission	RCPRG _EM fnr <[Data]> ←	S
6) Negative acknowledgement	RCPRGFEM fnr →	S
Everything written	RBPRG _ _ M fnr →	S

The file must already exist in the workpiece on the MMC.

Sequence D: Request host for data transfer

Function	Host MMC	M.fr.type
1) Request by MMC to host to request data	RIPRG _ _ M fnr <Request 2> ←	S
Negative acknowledgement	RIPRGF _ M fnr →	S
Transmission sequence C		

The request by the MMC is sent back by the host in frame sequence C.

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4.5.9.3 Delete instruction for MMC

The host can transfer a file with delete instructions to the MMC. This is stored on the MMC temporarily, processed after the transmission and then deleted. Every line in the file can contain a request (Request 3) and must end with $C_R L_F$ or L_F. Empty lines are allowed.

Sequence E: Delete data on MMC

Function	Host MMC	M.fr.type
1) Request to MMC to receive delete file	PACLF _ _ M fnr ——>	S
Negative acknowledgement	PACLFF _ M fnr <——	S
Send next data block	TCCLF _ _ M fnr <——	S
2) Negative acknowledgement	TCCLFF _ M fnr ——>	S
Data transfer to MMC	RCCLF _ _ M fnr <Data> ——>	S
3) Negative acknowledgement	RCCLFF _ M fnr <——	S
Send next data block	TCCLF _ _ M fnr <——	S
4) Repeat 2) and 3) until error or 5)		
5) End of data transfer	RCCLF _ EM fnr <[Data]> ——>	S
6) Negative acknowledgement; not everything deleted	RCCLFFEM fnr <——	S
Everything deleted	RBCLF _ _ M fnr <fsp> <——	S

<Data> = PART**/**MPF1.MPF L_F This file deletes program MPF1 and all SPF subroutines in directory PART**/**.
PART**/**SPF* L_F

If the workpiece or file to be deleted is not on the MMC, the request is ignored. After a positive acknowledgement from the MMC, the addressed workpieces**/**files no longer exist and the free memory on the MMC is indicated as a 4 byte word.

4.5.9.4 Directory output from MMC or NC

The host can request the contents of the MMC or NC directory. When configuring the MMC message frames, MMC (50H) must be entered for "Location receiver", when configuring NC message frames, COM (30H) must be entered.

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Sequence F: Output MMC directory

Function	Hosst MMC	M.fr.type
1) Request to MMC to send directory	P _ DIR _ _ M fnr <Request 3> →	S
Negative Acknowledgement	P _ DIRF _ M fnr ←	S
Data transfer to host	R _DIR _ _ M fnr <Data> ←	S
2) Negative acknowledgement	R _ DIRF _M fnr →	S
Send next data block	T _ DIR _ _ M fnr →	S
3) Negative acknowledgement	T _ DIRF _ M fnr ←	S
Data transfer to host	R _ DIR _ _ M fnr ←	S
4) Repeat 2) and 3) until error or 5)		
5) End of data transfer	R _ DIR _ EM fnr <[Data]> ←	S

The directory data are sent to the host in the following format (each line must end with L_F):

Example: LOCAL**/** directory

%DIR	Beginning of file
/LOCAL	Requested directory (here the default directory)
SHAFT1,DIR	Directories
PART,DIR	
STANDARD,DIR	
#17367300,<MMC>	End of directory with free memory on MMC in bytes
M02	End of file identifier

Example: **/**LOCAL**/**SHAFT1 directory

%DIR	Beginning of file
/LOCAL/SHAFT1	Requested directory (here the default directory)
MPF13.MPF,1567,RW	Files with file lengths and access rights
MPF44.MPF,516,RW	
SPF44.SPF,67,RW	
JOBL.JOB,2013,RW	
DATEN.TOA,1389,RW	
#17350300,<MMC>	End of directory with free memory on the MMC in bytes
M02	End of file identifier

Explanation of access rights: see next page

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Sequence G: Output NCK directory

The following request formats only are permitted with the NCK:

Request <MPF*>	Output of directory entries of all MPF files (same for SPF)
<MPF123>	Output of directory entries of MPF123
<MPF[1,20]>	Output of directory entries of programs MPF1 to MPF20

Function	Host NCK	M.fr.type
1) Request to NCK to send directory	P _ DIR _ _ N fnr <Request> ——>	S
Negative acknowledgement	P _ DIRF _ N fnr <——	S
Data transfer to host	R _ DIR _ _ N fnr <Data> <——	S
2) Negative acknowledgement	R _ DIRF _ N fnr ——>	S
Send next data block	T _ DIR _ _ N fnr ——>	S
3) Negative acknowledgement	T _ DIRF _ N fnr <——	S
Data transfer to host	R _ DIR _ _ N fnr <——	S
4) Repeat 2) and 3) until error or 5)		
5) End of data transfer	R _ DIR _ EN fnr <[Data]> <——	S

The directory data are sent to the host in the following format (each line must end with L_F):

Example

%DIR	Beginning of file
/	It is always the ROOT directory that is output
MPF13.MPF,1567,RW	Files with file length and access rights
MPF44.MPF,516,RW	
SPF44.SPF,67,RW	
#17350,<NCK>	End of directory with free memory on the NCK in bytes
M30	End of file identifier

Explanation of access rights:

R	Program is readable (not for cycles if cycle disable has been set)
W	Program is writable
E	Program is executable
Z	Cycle
P	Program in circular buffer

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4.6 Sessions with coding systems

In automated manufacturing, pallet and tool data are stored frequently on code carriers which can be read automatically.

Message frame sequences which allow automatic data transfer between the coding station and the SINUMERIK have been defined for the session between SINUMERIK 840/850/880 and the coding systems.

4.6.1 Session with pallet coding stations

Message frame sequences are defined between the pallet coding system "Moby M" and SINUMERIK 840**/**850**/**880 enabling reading and writing of the code carrier. The session is run via configurable message frames on the SINUMERIK side.

Connection of the Moby M to the SINUMERIK is via CP315 or AS 512.

Note:

- The presence of a data carrier in the writing/reading area of the coding station is communicated to the SINUMERIK by a hardware signal.
- Before the session with a new data carrier is started, the session with the current data carrier must be terminated.
- If the coding station receives a message frame with F identification, the message frame is rejected.
- If the coding station receives an unintelligible identification, the unintelligible identification is returned with the error code "F".

Function	**Coding station (Moby M) — CNC**	**M.fr.type**
1. Read pallet data: The CNC requests the coding station to transmit the data of the code carrier.	T_C R _ __ _ fnr [<*>] <———	P
2. Response of the coding station:		
a) Negative acknowledgement: The coding station cannot supply any data; error cause is communicated by means of error number.	T _ C R _ F _ _ fnr [<sm>] ———>	P
b) Positive acknowledgement: The coding station transmits the required pallet data to the CNC.	R _ C R _ _ _ _ fnr [<*DAT>] ———>	P
3. Multiple repetition of 1. and 2. for transmission of further pallet data to the CNC	(repeat loop) <———>	P

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Function	Coding station (Moby M) CNC	M.fr.type
4. Write pallet data: The CNC requests the coding station to write the message frame data on the code carrier.	R _ C W_ _ _ _ fnr [<*DAT>] <————————————	P
5. Response of the coding station:		
a) Negative acknowledgement: The coding station cannot write the data on the code carrier. The error cause is communicated by means of the the error number.	R _ C W_ F _ _ fnr [<sm>] ————————————>	P
b) Positive acknowledgement: The coding station has written the data on the code carrier.	T _ C W_ _ _ _ fnr [<*>] ————————————>	P
6. Multiple repetition of 4. and 5. for writing of further pallet data.	(repeat loop) <————————————>	P
7. Request session end: CNC requires end of session with the current data carrier	C _ C N _ _ _ _ fnr <————————————	P
8. Response of the coding station		
a) Negative acknowledgement: The coding station cannot end the session with the current data carrier.	C _ C N _ F _ _ fnr ————————————>	P
b) Positive acknowledgement: The coding station has ended the session with the current data carrier and is ready to process a new data carrier.	Q _ C N _ _ _ _ fnr ————————————>	P
9. Reset message frame The reset message frame can be sent at any time during the session. The reset message frame aborts the pending instruction. The coding station does not acknowledge the reset message frame.	C _ C N _ _ _ _ fnr <————————————	P

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Comments on useful data:

* =	[<s m tt aa zz>]	
s:	Interface number In the user software, a message frame can be assigned to a specific channel with the aid of the interface number.	(1 byte, ASCII)
m:	SIM number If several write/read devices are connected to an interface, they are addressed via the SIM no.	(1 byte, ASCII)
tt:	Data carrier type Range of values 0000 to 0007, identifies the data carrier type used.	(2 bytes, BCD)
aa:	Address Identifies the starting address of a data block on the data carrier.	(2 bytes, BCD)
zz:	Number Identifies the size of the data block to be processed.	(2 bytes, BCD)
DAT:	User-specific useful data The user-specific useful data can have any data format. The maximum number of the user-specific useful data is 216 bytes.	

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4.6.2 Sessions with tool coding stations (example for Package 6)

Message frames are defined between tool coding stations and SINUMERIK 840/850/880 which ensure reading and writing of tool data on code carriers. On the SINUMERIK side, the session is run via configurable message frames.

Connection of the tool coding stations to the SINUMERIK is via CP 315 or AS 512.

Note:

- The presence of a data carrier in the write/read area of the coding station is communicated to the SINUMERIK by means of a hardware signal.
- The maximum length of the message frame useful data (message frame without identification and error number) is 224 bytes.

Function	Coding station CNC	M.fr.type
1. Read tool data: The CNC requests the coding station to transmit the data of the code carrier.	T _ C B _ _ _ _ fnr [<st aa zz>] <———	P
2. Response of the coding station:		
a) Negative acknowledgement: The message frame cannot be processed by the coding station. The error cause is communicated by means of an error number.	T _ C B _ F _ _ fnr [<st >] ———>	P
b) Positive acknowledgement: The coding station transmits the required tool data to the CNC.	R _ C B _ _ _ _ fnr [<staazzTool -D>] ———>	P
3. Write tool data: The CNC requests the coding station to write the message frame data on the code carrier.	R _ C E _ _ _ _ fnr [<staazzTool-D>] <———	P
4. Response of the coding station:		
a) Negative acknowledgement: The coding station cannot write the tool data on the data carrier. The error cause is communicated by means of an error number.	R _ C E _ F _ _ fnr [<st >] ———>	P
b) Positive acknowledgement: The coding station has written the tool data on the data carrier.	T _ C E _ _ _ _ fnr [<st aa zz>] ———>	P
Delete data carrier		
5. Delete initiation from data carrier	R _ C L _ _ _ _ fnr [<anw>] <———	P
a) positive acknowledgement	T _ C L _ _ _ _ fnr [<anw>] ———>	P
b) negative acknowledgement	R _ C L _ F _ _ fnr [<anw >] ———>	P

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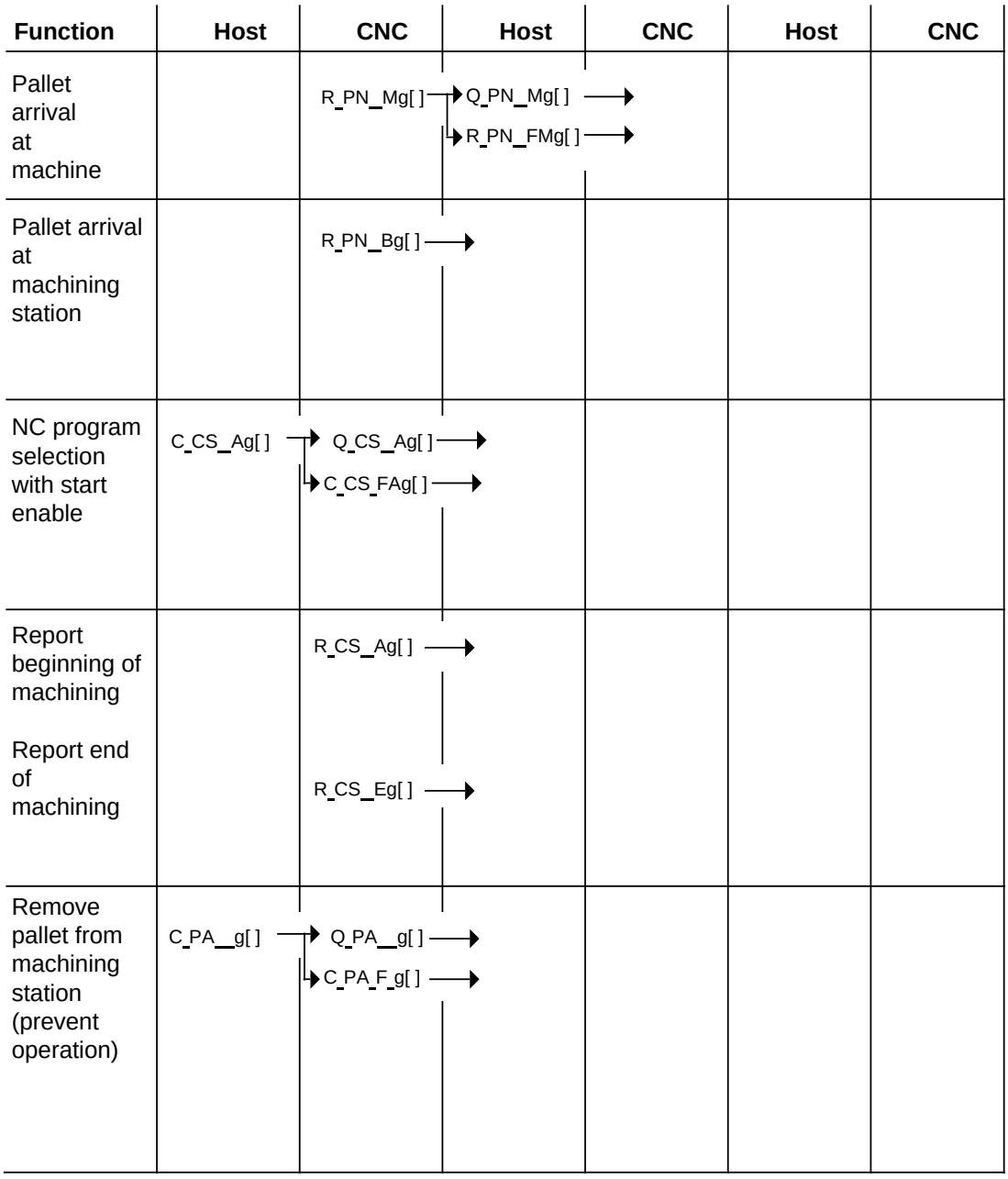
Comments on useful data:

S:	Sub-address Number of the coding station	(1 byte, ASCII)
t:	Transport address Number of the read/write head	(1 byte, BCD)
aa:	Start address Address on the code carrier from which tool data are to be read from or written onto the code carrier	(2 bytes, BCD)
zz:	Number of bytes Number of the tool data bytes to be transmitted	(2 bytes, BCD)
Tool-D:	Tool block Tool block which is written on the code carrier or read from the code carrier The format of the tool block has to be defined by the user and must be processed by the user himself.	
anw:	To be defined by the user.	

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5 Message Frame Sequences

5.1 Operator-process communication



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5.2 Influencing the NC

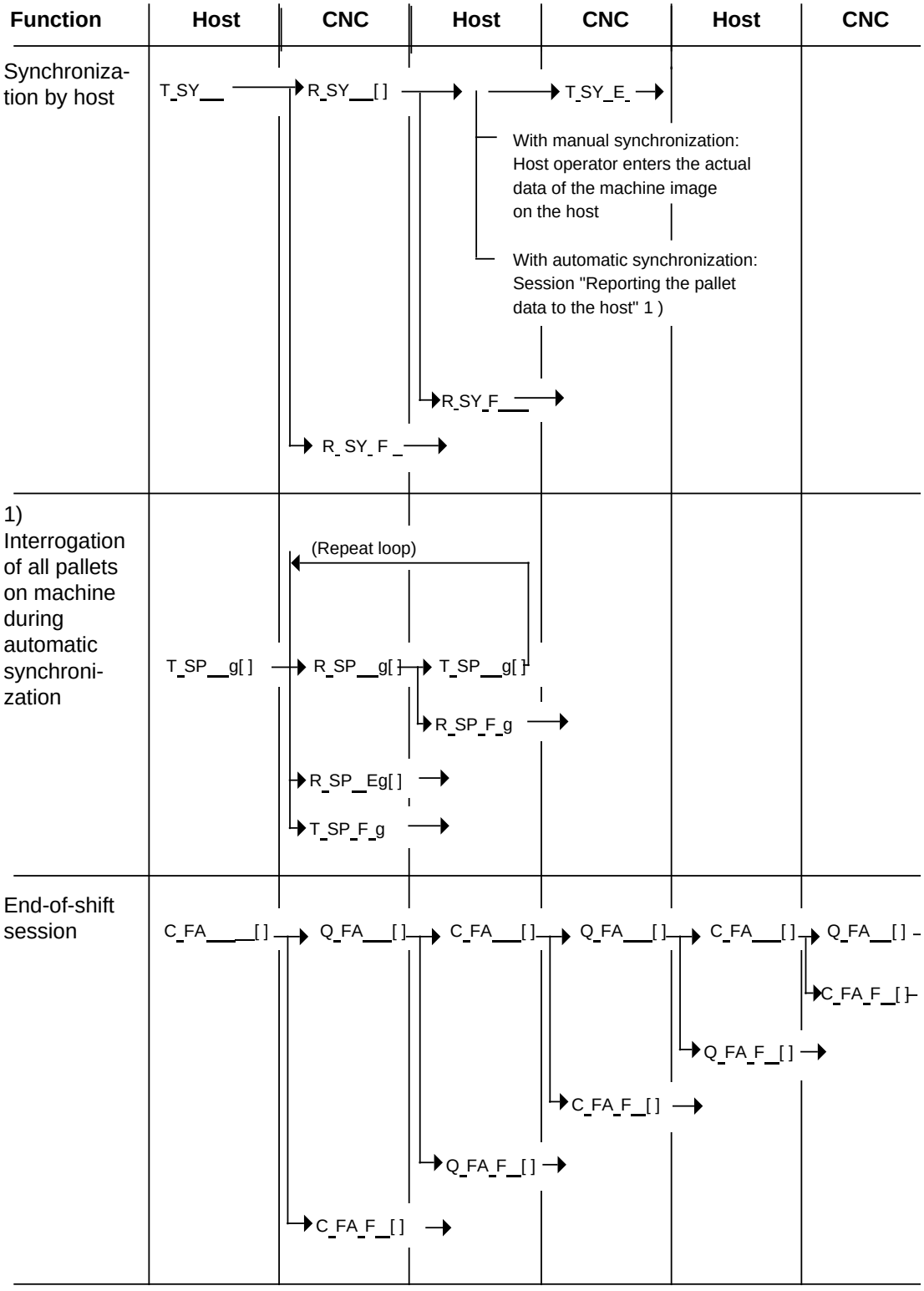
Function	Host	CNC	Host	CNC	Host	CNC
Report NC alarm On		R_AL_KN[ ] →				
Report NC alarm Off		R_AL_GN[ ] →				
Report PLC alarm On		R_AL_KP[ ] →				
Report PLC alarm Off		R_AL_GP[ ] →				
Report operator interrupt On		R_BU_K [ ] →				
Report operator interrupt Off		R_BU_G [ ] →				
Report PLC status message On		R BM K [ ] →				
Report PLC status message Off		R_BM_G [ ] →				
Continuation message, end of a job stoppage		R_FS__ →				
Connection monitoring	T_OK__ →	R.OK__ →				

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Function	Host	CNC	Host	CNC	Host	CNC
FMS mode changeover by host	C_MO__ [ ] →					
Select FMS mode by PLC		R_MO_[ ] →				
Initiation of cold restart for computer link by PLC		R_NS__ →				

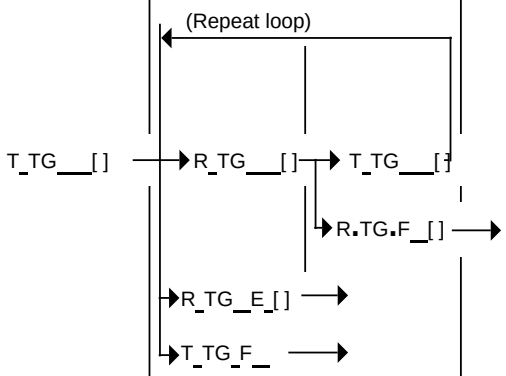
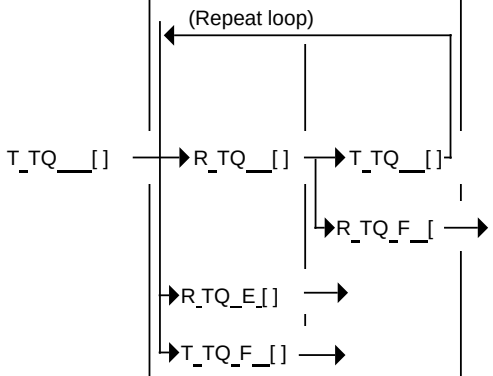
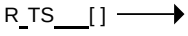
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5.3 Synchronization and end-of-work



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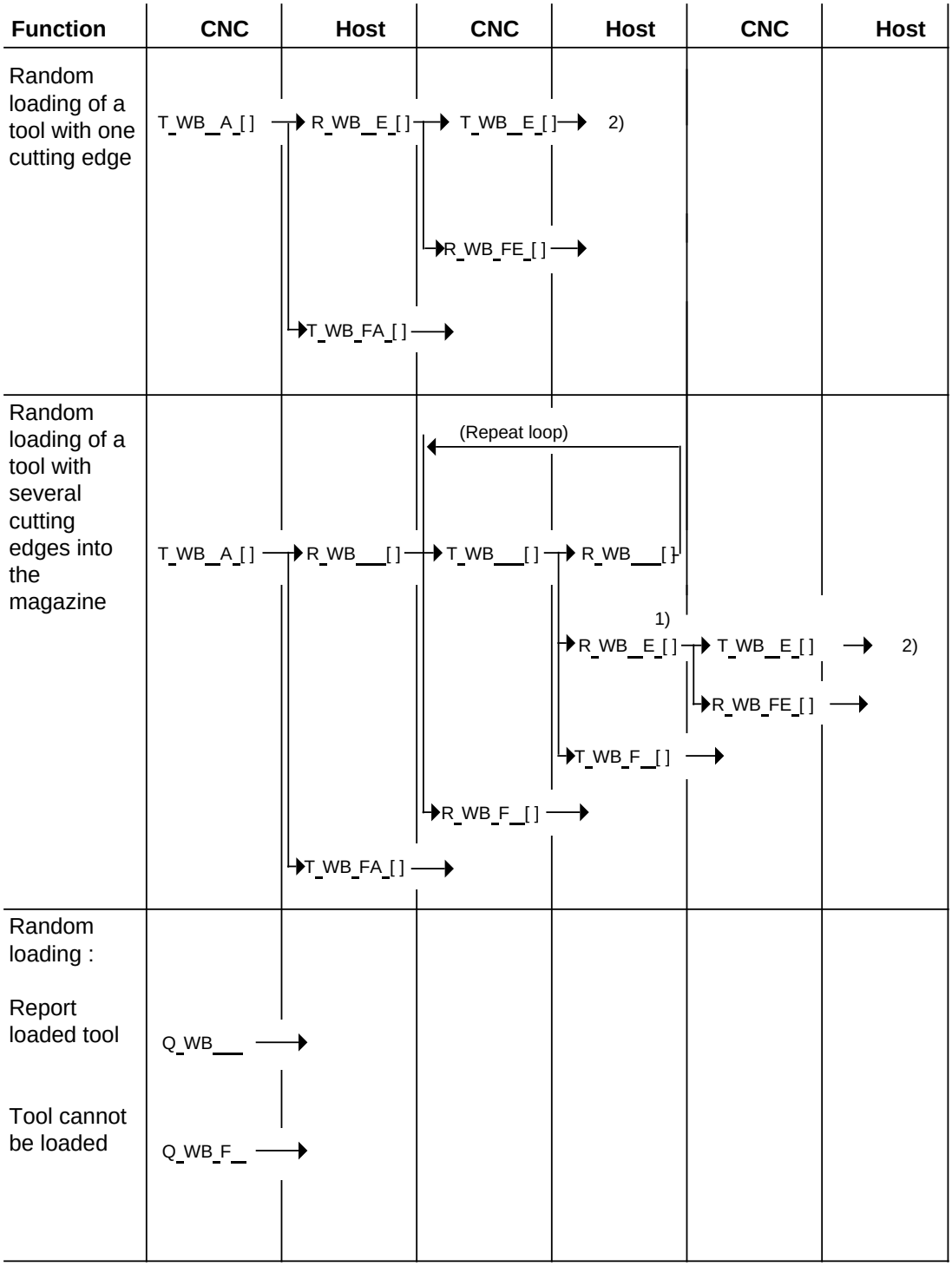
5.4 Reporting tool magazine data

Function	Host	CNC	Host	CNC		
Reporting the entire magazine assignment to the host						
Reporting the tools used from the magazine to the host						
Reporting a tool to the host on own initiative						

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5.5 Loading and unloading the tool magazine

5.5.1 Random loading without code carrier

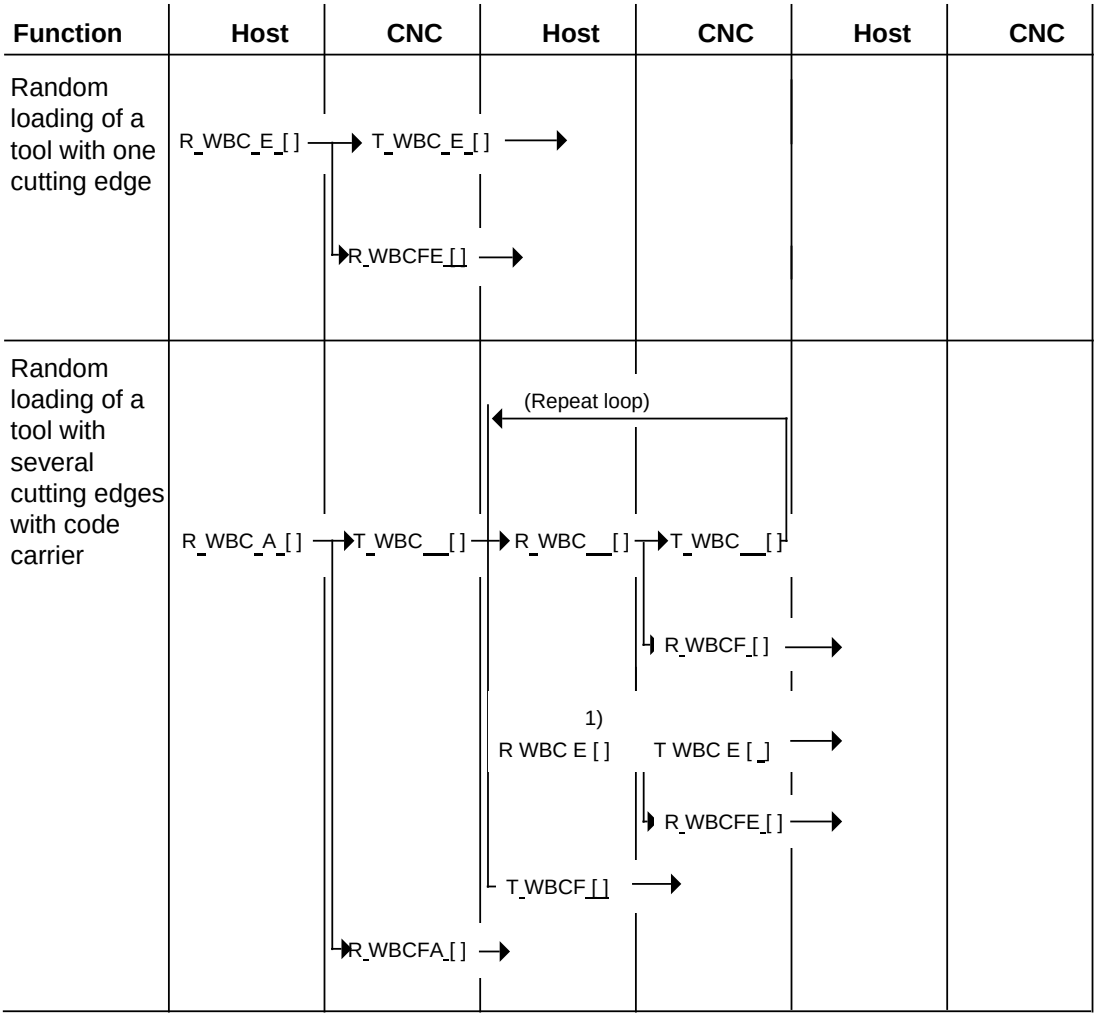


1) Transmission of the tool data for last cutting edge.

2) End of the random loading with acknowledgement Q_WB___ or Q_WB_F__.

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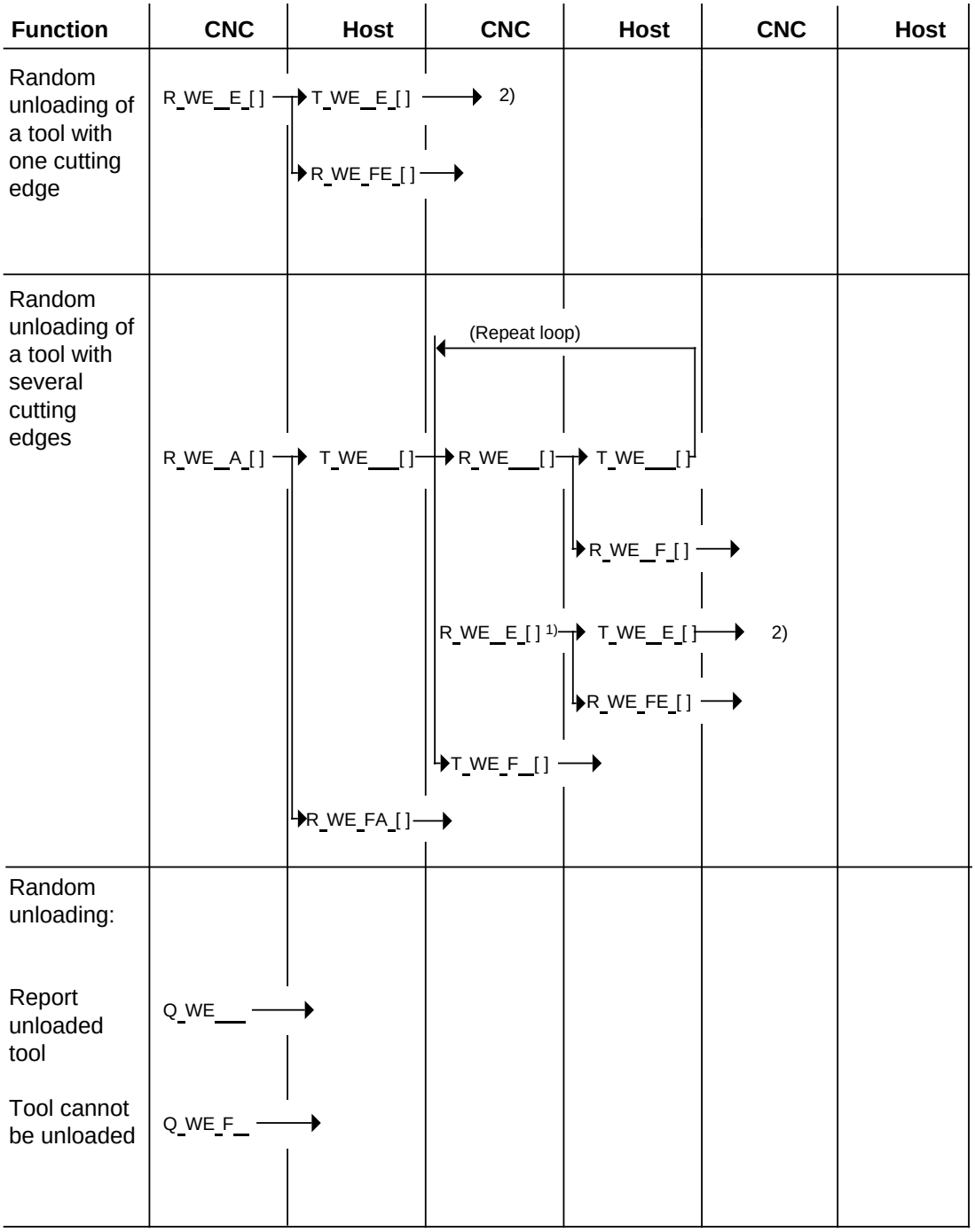
5.5.2 Random loading with code carrier



1) Transmission of the tool data for last cutting edge.

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5.5.3 Random unloading with/without code carrier

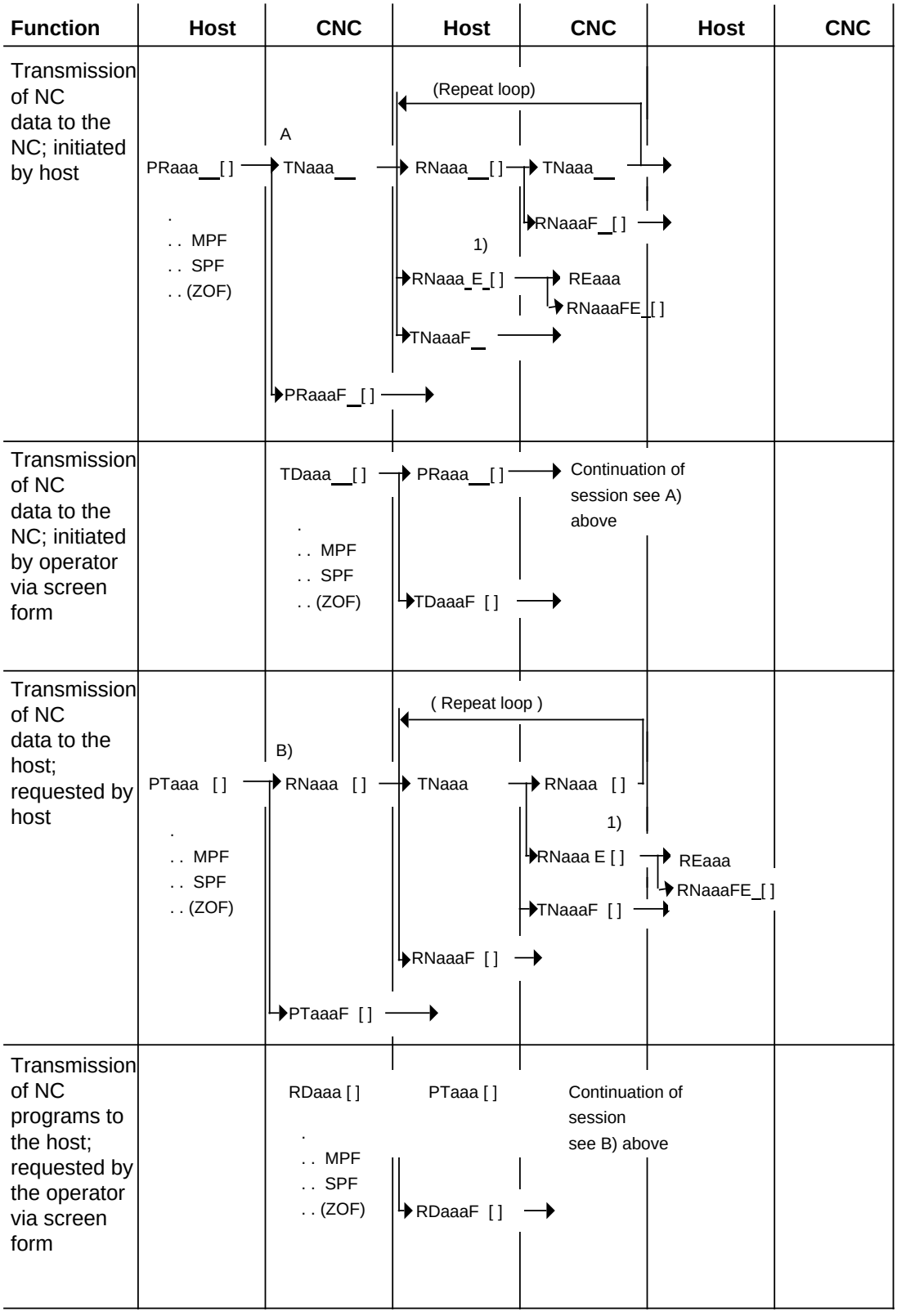


1) *Transmission of the tool data for last cutting edge*

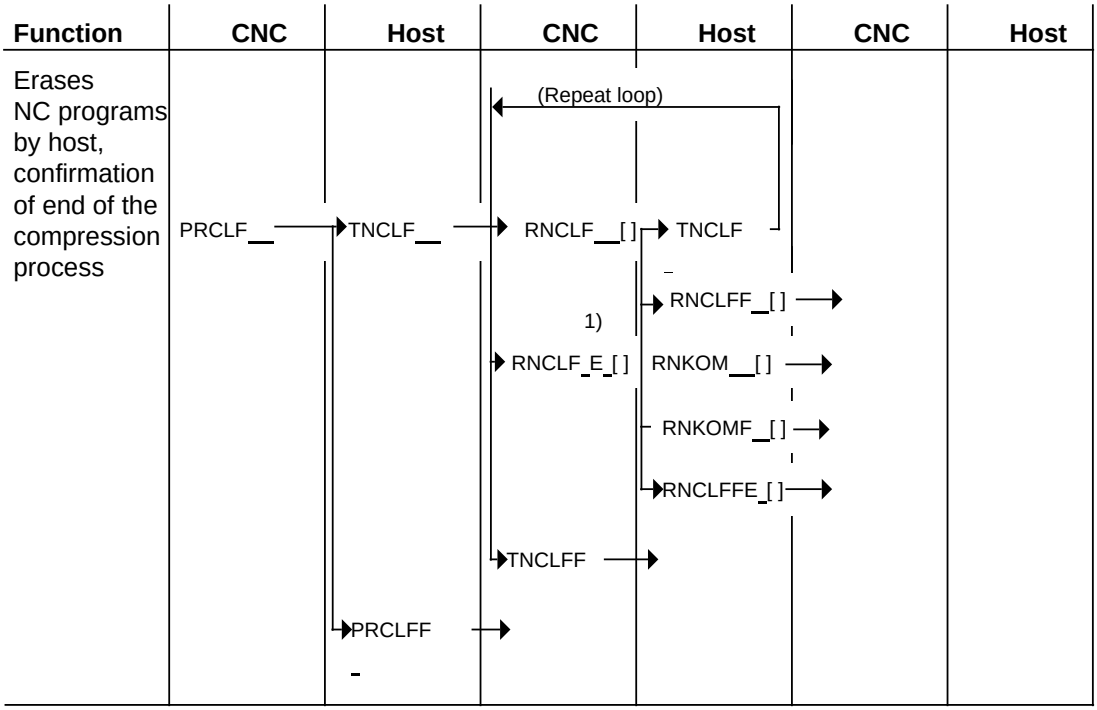
2) *End of random unloading with "Report unloaded tool " (Q WE___) and/or message for tool unloading not possible Q(_WE_F_).*

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5.6 NC file transfer



1) when last data file is transferred (message frame with or without useful data).



Note: File transfer between SINUMERIK 840C (MMC and NCK) and the host computer is described in Section 4.5.9.

1) transfer of last delete file.

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6 Data Formats of the Useful Data

The following data formats are used for the useful data:

- ASCII characters
- Fixed point numbers
- Binary-coded decimal numbers (BCD numbers)
- Binary codes (bit pattern)

The structure of the formats for fixed point and binary-coded decimals is explained below in greater detail.

6.1 Fixed point numbers

In fixed point format a number with a sign is represented either as a

single-word fixed point number or as a
two-word fixed point number

Negative numbers are represented as two's complement.

6.1.1 Structure of the single-word fixed point number (FXP2)

Byte	n								n+1							
Bit no.	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Meaning	SG	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^{9}	2^{8}	2^{7}	2^{6}	2^{5}	2^{4}	2^{3}	2^{2}	2^{1}	2^{0}

Bit 0 = 2^0 = Low-order bit

Bit 14 = 2^{14} = Most significant bit

Bit 15 = Sign for positive or negative number

for range of values: >-32768 to +32767

"0" = positive
"1" = negative

Range of values: -32768 FXP2 +32767

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Examples of single-word fixed point numbers:

- Error number (fnr)
- NC program number (pnr)
- NC alarm number (anr1)
- etc.

Example: -32768 = 8000 (hexadecimal)

Bit no.	7	6	5	4	3	2	1	0	Hexa-decimal	
Byte n	1	0	0	0	0	0	0	0	8	0
Byte n+1	0	0	0	0	0	0	0	0	0	0

Example: +32767 = 7FFF (hexadecimal)

n	0	1	1	1	1	1	1	1	7	F
n+1	1	1	1	1	1	1	1	1	F	F

Example: +9999 = 270F (hexadecimal)

n	0	0	1	0	0	1	1	1	2	7
n+1	0	0	0	0	1	1	1	1	0	F

Example: +204 = CC (hexadecimal)

n	0	0	0	0	0	0	0	0	0	0
n+1	1	1	0	0	1	1	0	0	C	C

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6.1.2 Structure of the two-word fixed point number (FXP4)

Byte	n								n+1							
Bit no.	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
Meaning	SG	2^{30}	2^{29}	2^{28}	2^{27}	2^{26}	2^{25}	2^{24}	2^{23}	2^{22}	2^{21}	2^{20}	2^{19}	2^{18}	2^{17}	2^{16}

Byte	n+2								n+3							
Bit No.	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Meaning	2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^{9}	2^{8}	2^{7}	2^{6}	2^{5}	2^{4}	2^{3}	2^{2}	2^{1}	2^{0}

Bit 0 = 2° = Low-order bit

Bit 30 = 2^{30} = Most significant bit

Bit 31 = Sign for positive or negative number
for range of values: -2^{31} to $< +2^{31}$

= "0" : positive
= "1" : negative

Range of values: -2^{31} FXP4 $< +2^{31}$

Examples of two-word fixed point numbers:

- Free NC memory in bytes (for response for end of compression)

Example: + 987 654 = F 1206 (hexadecimal)

Byte	7	6	5	4	3	2	1	0	Hexadecimal	
Bytes n	0	0	0	0	0	0	0	0	0	0
n+1	0	0	0	0	1	1	1	1	0	F
n+2	0	0	0	1	0	0	1	0	1	2
n+3	0	0	0	0	0	1	1	0	0	6

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6.2 Binary coded decimal numbers (BCD)

Structure of the binary-coded decimal numbers:

	Bit no.							
Byte	7	6	5	4	3	2	1	0
n	0	0	0	0	0	0	0	0
n+1	0	0	0	SG	Position 9			
n+2		Position 8			Position 7			
n+3		Position 6			Position 5			
n+4		Position 4			Position 3			
n+5		Position 2			Position 1			

SG = Signs
0= positive
1= negative

Three words are reserved for each binary coded decimal number (BCD).

These are positive or negative numbers, max. eight-digit numbers with decimal point and/or 9-digit numbers without decimal point being represented. The sign is always at the same position while the position of the decimal point is variable. The decimal point is represented with bit pattern 1110 (hexadecimal = E).

No decimal point is used for absolute values.

Some BCD data do not require the max. possible range of values so that only the last decades are relevant. All other decades must be preset here with zero.

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Examples of binary-coded decimal numbers:

With the exception of magazine number, magazine location number and identifications, all remaining tool data are transmitted in the message frames with BCD numerical format.

Examples::

- Tool identification number or T no.: BCD number, 8 decades
- Duplo number: BCD number, 4 decades
- Tool geometry value: BCD number, 8 decades, sign, decimal point
- etc.

Example: T no. = 12345678

Byte	7	6	5	4	3	2	1	0	Hexadecimal	
Byte n	0	0	0	0	0	0	0	0	0	0
Byte n+1	0	0	0	0	0	0	0	0	0	0
Byte n+2	0	0	0	1	0	0	1	0	1	2
Byte n+3	0	0	1	1	0	1	0	0	3	4
Byte n+4	0	1	0	1	0	1	1	0	5	6
Byte n+5	0	1	1	1	1	0	0	0	7	8

Example: Duplo no. = 2345

Byte	7	6	5	4	3	2	1	0	Hexadecimal	
Byte n	0	0	0	0	0	0	0	0	0	0
Byte n+1	0	0	0	0	0	0	0	0	0	0
Byte n+2	0	0	0	0	0	0	0	0	0	0
Byte n+3	0	0	0	0	0	0	0	0	0	0
Byte n+4	0	0	1	0	0	0	1	1	2	3
Byte n+5	0	1	0	0	0	1	0	1	4	5

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Example: Geometry value 1= + 1234.987

Byte	7	6	5	4	3	2	1	0	Hexade-cimal	
Byte n	0	0	0	0	0	0	0	0	0	0
Byte n+1	0	0	0	0	0	0	0	0	0	0
Byte n+2	0	0	0	1	0	0	1	0	1	2
Byte n+3	0	0	1	1	0	1	0	0	3	4
Byte n+4	1	1	1	0	1	0	0	1	E	9
Byte n+5	1	0	0	0	0	1	1	1	8	7

Example: Geometry value 1 = - 6534.987

Byte n	0	0	0	0	0	0	0	0	0	0
Byte n+1	0	0	0	1	0	0	0	0	1	0
Byte n+2	0	1	1	0	0	1	0	1	6	5
Byte n+3	0	0	1	1	0	1	0	0	3	4
Byte n+4	1	1	1	0	1	0	0	1	E	9
Byte n+5	1	0	0	0	0	1	1	1	8	7

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7 List of Error Messages from PLC/NC to Host Computer

There is a separate list for the error numbers signalled by the host computer or from the PLC**/**NC.

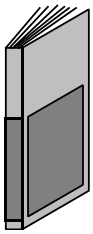
The list below contains the error numbers that were signalled with error frames from the SINUMERIK to the host computer. The range 5000 to 9999 is reserved for error messages that the user can set in his PLC program. The range 1 to 4999 is reserved for the standard and divided into several error groups.

The error numbers that the host computer sends to the SINUMERIK are not described here. If the Siemens FMS system is used, see FMS S850**/**CP535-FLR.

For further information on error numbers, see Section 2.2.3.

Ranges	Error group
1 ... 19	General errors during message frame input
20 ... 39	Errors during NC file transfer
40 ... 60	Errors in the pallet coding system "Moby M"
100 ... 199	Errors in tool message frames
200 ... 299	General errors during message frame output
3100 ... 3149	Errors during NC file transfer
3150 ... 3199	Error no. package 5
3200 ... 3399	Error no. package 1 "data traffic"
3400 ... 3499	Error no. during file transfer MMC (840C)
5000 ... 9999	Error number range for user

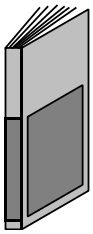
Note that the error number range for users can be activated partly by the NC and partly by the PLC.



An exact list of message numbers and the associated bit fields is to be found in the Section "bit fields for messages" in the documents:

Interface Description Part 1: Signals

for the control in question.



7.1 Error numbers in the response frame (with use of CP 315 with AS512 in the header and response frame):

Error number

20 : DB**/**DW No. or coordination flag in the AS512 header incorrect
54 : Frame length data in the AS512 header incorrect
FF : Event in wrong state (e. g. initial message frame received instead of the expected response frame).

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7.2 Error numbers in the message frame and in the user interface

No.	Meaning	Set by	Reported to		
			Host	User	
0	No error	–			
1	Identification character (1 to 5) not known (message frame input)	PLC Package 4	X	X	
1	Receiver not available (message frame output)	PLC (CP)		X	
2	Specified message frame lengths < 10 bytes	PLC Package 4	X		
3	Function is not processed (equivalent to FB MD bit not active) or abort by operator With file transfer: Message frame does not fit in the sequence (or timeout)	PLC Package 4	X		
4	User interface "input" allocated	PLC Package 4	X		
5	Useful data contains error (e.g. with mode and end-of-shift message frames)	PLC Package 4	X		
6	Useful data length is too great for user interface "input" or DB/DX too short	PLC Package 4	X		
7	User interface incorrectly defined (e.g. no. is too great)	PLC Package 4	X		
8	No data block defined for user useful data	PLC Package 4	X		
9	Synchronization abort due to illegal message frame during synchronization	PLC Package 4	X		
10	Message frame with incorrect length	PLC Package 4	X		
11	No error number in error message frame	PLC Package 4	X		
12					
13					
:					
:					
18					

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No.	Meaning	Reported by	Reported to		
			Host	User	
19					
20					
21					
22					
23					
24					
25					
26	Part program block > 120 characters (net data, i.e. without blanks, LF, etc.)	NC	X	X	
27	Input inhibited (occurs during MD input if no password is entered)	NC	X	X	
28					
29	Program block too long (max. 254 characters, i.e. including blanks, LF etc.)	NC	X	X	
30	Part program memory full	NC	X	X	
31	No further part program can be input (directory of NC part program memory is full)	NC	X	X	
32	Data format error	NC	X	X	
33	Stored program not equal to entered program	NC	X	X	
34	Directory not available or wrong request format	NC	X	X	
35					

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No.	Meaning	Reported by	Reported to		
			Host	User	
36					
37					
38					
39					
40	Error in the connection to the LBS Abort due to external faults	MOBY M		X	
41	Error in the data carrier RAM	MOBY M		X	
42	Previous command active: A new command has been transmitted to the SIM although the last command is still active	MOBY M		X	
43	NEXT command not possible or not permitted	MOBY M		X	
44					
45					
46					
47					
48					
49					
50	Battery voltage of DAT is below threshold value	MOBY M		X	
51					
52					
53					

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No.	Meaning	Reported by	Reported to		
			Host	User	
54					
55					
56					
57					
58					
59					
60					
61					
62					
63					
64					
65					
66					
67					
68					
69					
70					
71					
72					

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No.	Meaning	Reported by	Reported to		
			Host	User	
90					
91					
92					
93					
94					
95					
96					
97					
98					
99					
100	Tool interrogation session was aborted by loading/unloading	PLC	X	X	
101	NC channel for tool sessions not free i.e. kernel sequence cannot be started	PLC	X	X	
102	Tool session abort due to positive acknowledgement to synchronization request	PLC	X	X	
103	Error in the data blocks for magazine administration, number of DBs < 8 or illegal place no.	PLC	X	X	
104	NC alarm on; the kernel sequence for magazine interrogation or loading/unloading is not started or is aborted	PLC	X	X	
105	CPU failure (FY 24.4 interface = 1 signal); the sequence is not started or is aborted	PLC	X	X	

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8 Abbreviations

BCD	Binary-coded decimal
DP	Decimal point
FB	Function block
FMS	Flexible Manufacturing System
MMC	Man Machine Communication
MPF	NC Main Program File
NC	Numerical Control
NCK	Numerical Control Kernel
PDU	Protocol Data Unit
PLC	Programmable logic controller
SG	Sign
SPF	Sub Program File
ZOA	Zero offset active
1D-file	Files with variable length e.g. text files, MPF, SPF
2D-file	Files with fixed structure (length, number of columns/rows firmly defined) e.g. TOA , ZOA so-called main memory areas

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