

## Description of the DNC interface (Binary format)

### 1. Functionality

The DNC interface creates a connection between a superordinate computer (production master computer, FMS computer, DNC host computer etc.) and the control computer of an NC machine. After activation of the DNC operation the DNC computer (master) takes over the control of the NC machine (client). All data such as NC programs, tool data, zero point shifts can be transmitted between DNC computer and NC machine. The entire production control is completely taken over by the DNC computer. The automation devices such as doors, clamping chuck (collet), sleeve, coolant etc. can be controlled by the DNC computer. The actual status of the NC machine is displayed on the DNC computer.

To meet the functional possibilities of the Sinumerik 840d, the protocol was provided with some extensions. However, the Sinumerik 840d can be continued in operation with the original protocol (in the future called compatible protocol), even though with limitations. During the start it is reported to the control if the extensions are to be used. In the document reference is made to the extensions each time.

### 2. Communication

The protocol for the communication between NC machine (DNC interface) and the DNC computer is designed in such a way that a connection can be carried out via character-oriented (e.g. RS-232) communications layers as well as via block-oriented ones (e.g. Ethernet / TCP/IP or USB). Communication is executed package-oriented in acknowledgement traffic.

Presently, the connection to the DNC computer can only be set up via the RS-232 interface and TCP/IP.

If data are transmitted via the serial interface, eight data bits must be used in binary mode, otherwise the transmitted data will become useless and a wrong check sum is reported for each package.

If **TCP/IP is used**, incoming connections at Port 5557 are listened to. In case, the TCP/IP connection is interrupted in operation, the control remains in DNC operation and can be controlled again with commands after a new connection reset-up.

#### 2.1. Package setup

The transmitted packages consist of a package header and the package data which can have a maximum length of 256 bytes in compatible mode and a maximum length of 65535 bytes with activated extensions of Sinumerik 840d. The enlargement of the package size was necessary to transmit also longer program data.

*Package header:*

<b>Field contents</b>	<b>Bytes</b>	<b>Note</b>
Check sum	1, binary	The checksum is formed by adding up the entire package incl. the data without the checksum itself.
Command group	1, ASCII	Command group (see 3 <sup>rd</sup> command description)
Command identification	1, ASCII	Command identification (see 3 <sup>rd</sup> command description)
Package number	1, binary	The package number serves for identifying the order of commands consisting of various packages (e.g. program transmission). The first package in the command has number one. The last one has always number 69 (ASCII 'E'), thus, the command can consists of max. 69 packages.
Message number	2, binary	The packages are marked by consecutive numbers to enable an identification of the data packages in case of error.
Command length	2, binary	Indicates the number of bytes of the useful data without the package header.

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### Package data:

The package data contain the useful information which is different for each of the commands (see 3<sup>rd</sup> command description).

### 2.2. Command traffic

Communication between the computers is executed in acknowledgement traffic. Before the start of a new command the acknowledgement of the last command must be waited for.

## 3. Command description

### 3.1. General

In the following the DNC commands are described. The division into special command groups is carried out at random.

#### Explication of the command syntax:

The arrows indicate the direction of the data flow:

▶ from the DNC computer to the NC control

◀ from the NC control to the DNC computer

The two characters indicate the respective command group and identification (ASCII-characters!).

Further data refer to the area of the useful command data. If useful data are not described and some of them are transmitted in spite of that, they are ignored and the command is executed regularly.

### 3.2. Communication error

In case of errors during the transmission or with inadmissible commands the following messages can be sent to the DNC computer.

Direction	Meaning	Comm.	Data
▶	General communication error	N V	1
▶	Unknown command	N V	2
▶	Error in check sum	N V	3
▶	Inadmissible command	N V	4
▶	Incomplete package	N V	5

In case of a general communication error the driver reports an error during receipt to the interface. Therefore, the package was rejected.

An inadmissible command exists if this command is not allowed during the actual status of the control. This is the case when a new command is sent before the last one has been acknowledged by the control. Another possibility would be the receipt of commands without prior activation of the DNC operation and/or after having already switched off the DNC operation. An inadmissible command is also reported if a package length exceeds 256 bytes, although the extensions for the Sinumerik 840d are not activated.

A package is recognized as incomplete if it has not been completely received and no further data arrive in the control within a defined timeout. The package data received so far are rejected.

### 3.3. Start DNC operation

The DNC computer reports to the NC machine and requests a transition into DNC operation (1st command!). Thus, the NC machine is switched to operating mode automatic (display DNC on the screen). To use the extensions of the Sinumerik 840d, the 5<sup>th</sup> byte of the data must contain a 1. DNC operation can be activated at any time (irrespective of the status of the control).

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<i>Direction</i>	<i>Meaning</i>	<i>Comm.</i>	<i>Data</i>
▶	Transition into DNC operation	B S	Configuration bit field (4 bytes) Activation protocol extensions (1 byte)
◀	DNC operation activated (pos. acknowledgement)	C Z	System status acc. to configuration bit field
◀	Software version number	C V	SW version
◀	Activation not possible (neg. acknowl.)	N B	

The configuration bit field defines which modifications in the system status of the control and the machine are to be automatically transmitted to the DNC computer (see 3.5. configuration system status message). If DNC operation was activated and the configuration bit field was valid (4 bytes must have been transmitted), first the actual system status is transmitted. If the configuration bit field has not been valid or all bytes on zero, this message is dropped.

Byte 5 of the data indicates the version of the DCN protocol to be used. If it is set to one, the protocol extension for the Sinumerik 840d is activated. If the byte is missing or contains another value, the one compatible to the original version of the WinNC32 becomes the DNC protocol.

In case of successful activation of the DNC operation the message of the software versions is transmitted in any case and contains the following information in the useful data.

<i>Designation</i>	<i>Memory type</i>	<i>Note</i>
Device type	byte	1 .. Control 2 .. PCCOM-board (AC95), RS485-slide-in board (AC88) 3 .. ACIF (AC95 und AC88) 4 .. Axis controller 6 .. PLC 7 .. Machine keyboard
SW-Version low byte	byte	Subversion number
SW-Version high byte	byte	Main version number

If you try to send the command with already activated DNC operation, you receive a neg. acknowledgement, but DNC operation remains active.

### 3.4. Terminate DNC operation

Termination of the DNC operation is triggered by the DNC computer.

<i>Direction</i>	<i>Meaning</i>	<i>Comm.</i>	<i>Data</i>
▶	Termination of DNC operation	B E	
◀	DNC operation terminated (pos. acknowledgement)	Q B	

If the control is terminated with active DNC operation, a message to the DNC computer is effected.

◀	Software of machine terminated	C B	
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### 3.5. Configuration system status message

The control is informed via the configuration bits which modifications of the system status of the machine and the control are sent automatically to the DNC computer. The configuration is determined during the start of the DNC operation (see 3.3. start DNC operation), but can be changed at any time by this command. The meaning of the configuration field is described in chapter 3.6. System status. If less than 4 bytes are transmitted for the configuration bit field, the automatic modification messages are switched off, but can be reactivated at any time by a new configuration command.

<i>Direction</i>	<i>Meaning</i>	<i>Comm.</i>	<i>Data</i>
▶	New configuration bit field	C K	Configuration bit field (4 bytes))
◀	Configuration bit field taken over	Q K	

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### 3.6. System status

The actual system status is transmitted to the DNC computer after start-up, after a status request as well as in case of a modification (according to configuration data).

The system status describes the operating mode of the machine (automatic, manual, reference point status), the program status (NC program number and/or NC program name, machining status, SKIP), the status of the automation devices (door, clamping device, sleeve, coolant, auxiliary drives,...), actual override values (feed, spindle) as well as alarm status.

Direction	Meaning	Comm.	Data
►	Request of system status	C Z	Configuration bit field (4 bytes)
◄	Transmission of the system status	C Z	Configuration bit field (4 bytes) System status (variable length))

If there are modifications in system status for which a notification has been requested, the following package is transmitted for each modification:

◄	Modified system status	C Z	Configuration bit field (4 bytes) System status (variable length))
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#### 3.6.1. Set-up configuration bit field

The configuration bit field is 4 bytes long and describes the data which are to be included in the acknowledge message of the system status (Bit=1->active). The bits must be filled in in the configuration bit field as follows. This corresponds exactly to the configuration of the bits of a 32-bit number in **Little Endian Byte Format**.

Byte 0								Byte 1							
7	6	5	4	3	2	1	0	15	14	13	12	11	10	9	8
Byte 2								Byte 3							
23	22	21	20	19	18	17	16	31	30	29	28	27	26	25	24

*Meaning of the individual bits:*

- 0: Operation mode of the machine
- 1: NC program number
- 2: NC program status
- 3: SKIP status
- 4: Swivelled-in tool
- 5: Door status
- 6: Clamping device status
- 7: Sleeve status
- 8: Coolant status
- 9: EMERGENCY-OFF status
- 10: Auxiliary drive status
- 11: Main spindle - number of revolutions
- 12: Feed override value
- 13: Spindle override value
- 14: Alarm/message
- 15: Blow-out status
- 16: Dividing device
- 17: Alarm/ message information
- 18: NC program stack
- 19: active NC program line

#### 3.6.2. Set-up system status

The system status informs the DNC computer on modifications at the machine or is directly requested by a command. At the beginning there is the configuration bit field (4 bytes) which indicates which parts of the system status in this package are transmitted. Then the data of the system status follow.

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Format of data compatible protocol (in the same order as in the configuration bit field):

No	Designation	Memory type	Note
0	Operating mode of the machine	byte (ASCII) byte (ASCII)	A..Automatic, M..Manual R .. Reference point valid, F .. Ref. run active, N .. Reference point not valid
1	NC program number	word (2 bytes)	actual program number 0xFFFF = no program selected
2	NC program status	byte (ASCII)	L .. active, R .. Reset
3	SKIP status	byte	1 .. active 0 .. inactive
4	swivelled-in tool	word (2 bytes)	Tool number 0xFFFF = invalid tool
5	Door status	byte	0 ..open, 1 .. closed, 2 .. intermediate position
6	Clamping device	byte	0 .. released, 1 .. clamped, 2.. intermediate position
7	Sleeve	byte	0 back, 1 .. front, 2 .. intermediate position
8	Coolant	byte	0 .. off, 1 .. on
9	EMERGENCY-OFF status	byte	0 .. OK, 1 .. Emergency-off
10	Auxiliary drives	byte	0 .. off, 1 .. on
11	Main spindle speed	word (2 bytes)	speed in rpm
12	Feed override value	byte	in per cent
13	Spindle override value	byte	in per cent
14	Alarm/message active	byte	0 ..everything OK, 1 .. alarm accumulates, 2 .. message accumulates
15	Blow-out status	byte	0 .. off, 1 .. on
16	Dividing device	byte	0 .. fixed, 1 .. in movement
17	Alarm/message information	word (2 Bytes)	Type: 1 .. converter alarm 2 .. PLC alarm 3 .. axis controller alarm 4 .. surface alarm 5 .. converter message 6 .. PLC message
		word (2 Bytes)	Number of the alarm and/or the message
18	NC program stack	word (2 Bytes)	Number of the program actually processed 0xFFFF = no program in process
19	active NC program line	word (2 Bytes) ASCII-String	Length of the program line (max. 250 characters) active program line

Modifications in the format of the data for the extensions of the Sinumerik 840d:

No	Meaning	Memory type	Note
1	NC program name	word (2 Bytes) ASCII-String	Length of the program type + name (0, if no program is selected) Program type + name (see 4.3. NC program transmission)
2	NC program status	byte (ASCII)	L .. active, R .. Reset, S .. Stop
14	Alarm/message off	byte	0 ..everything OK, 1 .. alarm accumulates, 2 .. message accumulates, 3 .. alarm and message accumulate
17	Alarm/message information	word (2 Bytes)	Number of alarms and messages
		word (2 Bytes)	Type (see old protocol)
		word (2 Bytes)	Number of the alarm and/or the message
		word (2 Bytes) ASCII-String	Length of the alarm/message text Alarm/message text
18	NC program stack	word (2 Bytes) ASCII-String	Length of the program type + name (0, if no program is processed) Program type + -name of the edited program (see 4.3. NC program transmission)
19	active NC program line	word (2 Bytes) ASCII-String	Length of the program line (no limitation) active program line

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### 3.7. Monitoring

The DNC computer has the possibility to control at any time (also with active peripheral command or data transfer) if the connection to the control still is operative (ALIVE message).

Direction	Meaning	Comm.	Data
▶	Connection monitoring	C V	
◀	Acknowledgement	Q V	

### 3.8. Referencing

This command starts referencing the NC machine. If referencing is not terminated within the time limit set, you receive a negative acknowledgement.

Direction	Meaning	Comm.	Data
▶	Referencing the machine	A R	
◀	Referencing OK	C Z	System status operating mode of machine
◀	Referencing failed	N A	

### 3.9. Production dialogues

These commands control the production of workpieces. Among them are commands for program influence such as program selection, program start, program stop, skipping NC blocks, resetting the machine (RESET), commandos for triggering the automation devices such as the doors, the clamping device, the coolant, the tool turret, etc. as well as commands for production influence such as modification of the override values. If peripheral requests are declined by the PLC (e.g. dividing device not available) or if the time limit is exceeded you receive a negative acknowledgement and the command is cancelled.

Direction	Meaning	Comm.	Data
▶	NC program selection	S W	Program number ((2 bytes binary)
◀	Acknowledgement	C Z	System status NC program number

▶	NC start release	S S	
◀	pos. acknowledgement	C Z	System status of NC program status
◀	neg. acknowledgement	N S	

▶	RESET at machine	S R	
◀	pos. acknowledgement	C Z	System status of NC program status
◀	neg. acknowledgement	N S	

▶	NC-STOP at machine	S H	
◀	pos. acknowledgement	C Z	System status of NC program status
◀	neg. acknowledgement	N S	

▶	Activate/disable SKIP	S A	Status (1 byte): 0=off / 1=on
◀	Acknowledgement	C Z	System status SKIP status

▶	Change feed override value	O F	FOV- value in per cent (1 byte)
◀	Acknowledgement	C Z	System status feed override value

▶	Change feed override value	O S	SPOV value in per cent (1 byte)
◀	Acknowledgement	C Z	System status spindle override value

Extensions of the Sinumerik 840d:

Direction	Meaning	Comm.	Data
▶	NC program selection	S W	Program type + name (see 4.3. NC program transmission)
◀	Acknowledgement	C Z	System status program type + name



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Peripheral commands:

Direction	Meaning	Comm.	Data
▶	Swivel tool turret	P T	none (swivel to next position)
▶	Auxiliary drives	P A	Status (1 byte): 1=on / 0=off
▶	automatic doors	P D	Status (1 byte): 0=open / 1=close / 2=stop
▶	Clamping device	P S	Status (1 byte): 0=release / 1=clamp
▶	Sleeve	P P	Status (1 byte): 1=forward / 0=backw.
▶	Coolant	P C	Status (1 byte): 1=on / 0=off
▶	Blow-out	P B	Status (1 byte): 1=on / 0=off
▶	Dividing device	P I	none (to next division)

◀	pos. acknowledgement	C Z	System status of requested peripheral equipment
◀	neg. acknowledgement	N P	

### 3.10. Command cancellation

With this message the active command can be cancelled. All actions for the active command are interrupted. If a data transfer between DNC computer and control is active, it is also cancelled.

Direction	Meaning	Comm.	Data
▶	Cancel command	C A	
◀	Acknowledgement	Q A	

### 3.11. Positioning the axes

With this command the axes of the NC machine can be positioned. The data contain the axis name and the incremental traverse path. If the traverse movement is not terminated within the time limit, an invalid axis or an invalid traverse path was indicated, you receive a negative acknowledgement. This can also occur if the feed selected is so small that the movement cannot be terminated within the time limit.

Direction	Meaning	Comm.	Data
▶	Positioning command	A M	Data for positioning the axes
◀	pos. acknowledgement	Q M	
◀	neg. acknowledgement	N M	

Data for axis positioning:

Designation	Memory type	Note
Axis designation	byte (ASCII)	axis letter ('X','Y','Z')
Axis traverse path	float (4 Byte)	traverse path for the axis in [mm] or [Inch]

### 3.12. Determining the actual axis position

The actual axis positions for the required axes of the NC machines are transmitted to the DNC computer by means of this command. The configuration data specify the position data contained in the answer. If the assigned axis does not exist or if it is not a linear axis, a neg. acknowledgement is sent to the DNC computer.

Direction	Meaning	Comm.	Data
▶	Determine axis positions	C P	Configuration data for the axis positions
◀	pos. acknowledgement	C P	Axis positions
◀	neg. acknowledgement	N P	

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### Configuration data for the positions of the axes:

These determine the axes and the kind of position data (e.g. actual position, target position, etc.) to be transmitted.

Designation	Memory type	Note
Axis designation	byte (ASCII)	Axis letter ('X','Y','Z') or 255 for all axes
Request data	byte	Bits which determine the kind of position data: <ul style="list-style-type: none"> <li>0: actual position (relative to the workpiece zero point)</li> <li>1: target position</li> <li>2: residual path</li> <li>3: absolute actual position</li> </ul>



### Returned position data:

The axis position data are always transmitted as an answer to the command 'Actual axis positions' in the workpiece coordinate system. At the beginning of the data there are the 'Configuration data for the axis positions', followed by an entry for every requested axis with the respective position data as described in the following.

Designation	Memory type	Note
Axis designation	byte (ASCII)	Axis letter ('X','Y','Z')
Value for the actual position	float	only if bit 0 of the 'request data' is set
Value for the target position	float	only if bit 1 of the 'request data' is set
Value for the residual path	float	only if bit 2 of the 'request data' is set
Value for the absolute position	float	only if bit 3 of the 'request data' is set

### 3.13. Determination the control type

This command can be used to examine if the control is a Sinumerik 840 d (package is answered regularly) or another control (package is answered as unknown command).

Direction	Meaning	Comm.	Data
	Determine control type	C T	
	pos. acknowledgement	Q T	Control type 0 .. Sinumerik 840d (extensions disabled) 1 .. Sinumerik 840d (extensions active)




## 4. Transmission of data

### 4.1. General

All data necessary for the production of a workpiece such as NC program data, tool data and zero point shifts can be transmitted between the NC machine and the DNC computer in both directions. If the compatible protocol to WinNC32 is used, the data can have a maximum size of 17664 bytes (= 69 packages with 256 bytes each). However, if the extensions of the protocol for the Sinumerik 840d are used, approx. 4,3MBytes (= 69 packages, with 65535 bytes each) are possible.

If at the beginning of the data transmission a neg. acknowledgement is returned, the control is not ready to take over data. This is the case if e.g. a peripheral command is still active or a data transmission is already running. If during the transfer of data a neg. acknowledgement is returned, the data transfer is completely cancelled and must be started again.

### Transmission of data from the DNC computer to the control:

Direction	Meaning	Comm.	Data
	Inquiry for the transmission of data	D S	
	Request of data transmission	Q P	
	neg. acknowledgement	N D	



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▶	Transmit data package 1	D P	Data (NC programs, tool data, zero point shifts)
◀	Request for data transmission	Q P	Package number of the last package received correctly (e.g. 1)
◀	neg. acknowledgement	N D	Error number (see 4.2. Error data transmission)
.....			
▶	Transmit data package 69 (ASCII 'E')	D P	Data (last package)
◀	pos. acknowledgement end data transmission	Q P	End identification 1 byte) 69 (ASCII 'E')
◀	neg. acknowledgement	N D	Error number (see 4.2. Error data transmission)

*Transmission of data from the NC control to the DNC computer:*

Direction	Meaning	Comm.	Data
▶	Request data backtransfer	D R	Kind of data (see 4.3. NC program up to 4.5. Transmission tool data)
◀	Data package 1	D P	Data (NC programs, tool data, zero point shifts)
◀	neg. acknowledgement	N D	Error number (see 4.2. Error data transmission).
▶	Request for data transmission	Q P	Package number of the last package received correctly (e.g. 1)
.....			
◀	Transmit data package 69 (ASCII 'E')	D P	Data (last package)
▶	pos. acknowledgement end data transmission	Q P	End identification (1 Byte) 69 (ASCII 'E')
▶	neg. acknowledgement	N D	

*Cancellation of data transmission:*

Direction	Meaning	Comm.	Data
▶	Cancellation of data transmission	D A	
◀	Acknowledgement of cancellation	Q A	

### 4.2. Error data transmission

The following errors can be sent to the DNC computer during data transmission with a neg. acknowledgement.

*Meaning of the error number with negative acknowledgement:*

- 1: Unknown data type
- 2: Error during file handling
- 3: Parameter index too large, value area exceeded
- 4: Wrong package number
- 5: Insufficient storage space (NC control)

### 4.3. NC program transmission

NC programs can be exchanged in both directions between the DNC computer and the control. Since, however, the compatible DNC protocol (WinNC32) only supports program numbers for main and subprograms, some limitations are applicable when using the original protocols. Main programs are filed as parts programs (e.g. 0000.MPF) and so are subprograms (e.g. 0001.SPF). If the extensions of the protocol are used for the Sinumerik 840d, all programs and the user cycles (without limitation of the file name) can be transmitted.

*Program types compatible protocol:*

Program type	Note
\$MP	Main program filed in the parts programs with 4-digit number

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\$SP	Subprogram with 4-digit number
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*Program types extensions Sinumerik 840d:*

<b>Program type</b>	<b>Note</b>
\$MF	Parts program
\$SF	Subprogram
\$CU	User cycle
\$WM	Workpiece main program
\$WS	Workpiece subprogram

The indicated program types of the Sinumerik 840d are for the NC program transmission as well as for the System status (actual NC Program and program just processed).

The program types are followed by the respective program name (without the extension e.g. "\$MFTEST" for the parts program TEST.MPF). With workpieces, the name of the workpiece (also without extensions) followed by a backslash '\' before the program name is indicated additionally (e.g. "\$WMTEST\TEST" for the main program TEST.MPF in the workpiece TEST.WPD).

### 4.3.1. To the control

During the NC program transmission to the control it is possible to transmit various programs at one time. For each NC program to be transmitted the following data must be transmitted to the control. If the program type handed over is not valid, transmission is cancelled with the error "Invalid data type". If an error occurs during program writing (e.g. the program cannot be written, invalid file name), the data transfer is cancelled with "Error in file handling".

*Compatible protocol (for each program to be transmitted)*

<b>Meaning</b>	<b>Memory type</b>	<b>Note</b>
Program type	ASCII-String	<ul style="list-style-type: none"> <li>"\$MP" for main programs (parts programs)</li> <li>"\$SP" for subprograms</li> </ul>
Program number	ASCII-String	4 characters and CR-LF character (\r\n = end of line) (e.g. parts program 0043.MPF: "\$MP0043\r\n")
Program data	ASCII-String	NC blocks with CR-LF at the end of line (format like with NC programs of the control)

*Extensions Sinumerik 840d (for each program to be transmitted):*

<b>Meaning</b>	<b>Memory type</b>	<b>Note</b>
Program type	ASCII-String	Program type (see 4.3. NC program transmission)
Program number	ASCII-String	Program names and CR-LF character (e.g. program TEST.MPF in the workpiece TEST.WPD: "\$WMTEST\TEST\r\n")
Program data	ASCII-String	NC blocks with CR-LF at the end of line (format like with NC programs of the control)

### 4.3.2. To the DNC computer

To transmit NC programs to the DNC computer, you have to describe them before. Various requests can be combined in one package. Unless adequate programs are found, an empty package (without useful data) is sent to the DNC computer. The programs transferred back are in the same format as during the transmission to the control (see 4.3.1. To the control). In case a request contains an invalid program type or an invalid file name, it is ignored and no data are transmitted for this request.

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*Compatible protocol (per entry):*

Meaning	Memory type	Note
Program identification	ASCII-String	<ul style="list-style-type: none"> <li>"\$MP" for main programs (parts programs)</li> <li>"\$SP" for subprograms</li> </ul>
Program number Start	word (2 Byte)	Start of the program numbers, for the transmission
Program number End	word (2 Byte)	End of the program numbers, for the transmission

*Extension Sinumerik 840d (per entry):*

Meaning	Memory type	Note
Program type	ASCII-String	Program type (see 4.3. NC program transmission)
Program name	ASCII-String	Program name and CR-LF character (end of line) Wildcard ? (any character) and * (any String) can be used. (z.B. "\$WMTEST\T*\r\n" for all main programs in the workpiece TEST.WPD that begin with T)

### 4.4. Transmission zero point shift

#### 4.4.1. To the control

With zero point shifts a separate entry is transmitted for every date. Only those data have to be transmitted which are to be modified. Various zero point shifts can be transmitted in one package at one time. In case the number of the shift register or the axis handed over does not exist, the data transfer is cancelled with the error "Parameter index too large, value area exceeded".

Meaning	Memory type	Note
Data identification	byte (ASCII)	'Z' for zero point shifts

*per entry:*

Number shift register	byte	z.B. 54, data for G54
Axis designation	byte (ASCII)	axis letter ('X','Y','Z','C' for main drive)
Shift coarse	float (4 bytes)	
Shift fine	float (4 bytes)	

#### 4.4.2. To the DNC computer

During the back transfer of the zero point shifts the shifts for all registers G54 to G57 and for all existing axes are transmitted. In the request only the data identification for zero point shifts 'Z' (ASCII) must be entered in the useful data. The data transferred back are in the same format as during the transmission to the control (see 4.4.1. To the control).

### 4.5. Transmission tool data

#### 4.5.1. To the control

With the tool data one entry is transmitted for each parameter as stated below. Only those parameters must be transmitted which are to be modified.

*Compatible protocol:*

Since the Sinumerik 840d with tools supports various cutters, but the DNC protocol of the WinNC32 does not support them, the modifications respectively concern the first cutter of the tool. Unless a tool exists for which a parameter has been transmitted or the parameter number is beyond the valid area, the data transfer is cancelled with the error "Parameter index too large, value area exceeded".

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<i>Meaning</i>	<i>Memory type</i>	<i>Note</i>
Data identification	byte (ASCII)	'T' for tool data

*per entry:*

Tool group	byte	always 0, since not used at the moment
Tool number	byte	
Parameter number	byte	Number of the tool parameter
Parameter value	float (4 bytes)	new value for the parameter of the tool

*Meaning of the parameter number:*

- 0: Tool number for change system (not used))
- 1: Tool type
- 2: L1 Geometry
- 3: L2 Geometry
- 4: Diameter/radius
- 5: L1 Wear
- 6: L2 Wear
- 7: Diameter/radius
- 8: L1 Basis
- 9: L2 Basis

*Extensions Sinumerik 840d:*

Here the tool group actually not used is employed for the transfer of the cutter number. If a tool does not yet exist, it is created. The same is valid for the cutters provided that always only the next non-available cutter can be created. If, e.g. already two cutters exist in the tool, only cutter three can be created. To be able to modify all existing tool parameters in the Sinumerik 840d, new parameters have been introduced.

*Meaning of the new parameter numbers:*

- 10: L3 Geometry
- 11: L3 Wear
- 12: L3 Basis
- 13: Cutter position
- 14: Groove width for grooving saw and/or rounding radius for milling tools
- 15: Excess length for grooving saw
- 16: DP 9
- 17: DP 10
- 18: Angle for tapered milling tools
- 19: Wear groove width for grooving saw and/or rounding radius for milling tool
- 20: Wear excess length for grooving saw
- 21: DP 18
- 22: DP 19
- 23: Wear angle tapered milling tools
- 24: Free angle
- 25: DP 25

### 4.5.2. To the DNC computer

The data for all existing tools and parameters are transmitted during the back transfer of the tool corrections. In the request only the data identification for zero point shifts 'T' (ASCII) must be entered in the useful data. The data transferred back are in the same format as during the transmission to the control (see 4.5.1. To the control).

If the compatible protocol is selected, of each tool only the first cutter (tool group on 0) and only the parameters zero to nine are transmitted. If the extensions of the Sinumerik 840d have been activated, all cutters and all defined parameters are transmitted.