Description of the DNC interface
(reduced ASCII 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). The entire production control is completely assumed 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.

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) as well as via block-oriented communication layers (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 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 with a maximum length of 9 bytes.

Package header:

Field contents	Bytes	Note
Check sum	1, binary	The checksum is formed by adding up the entire package incl. the data without the checksum itself. In order to get a valid character for the reduced ASCII format divide the checksum by 64 and then add 48 (ASCII '0') to the remainder of the division.
Command group	1, ASCII	Command group (see 3rd command description)
Command code/identification	1, ASCII	Command identification (see 3rd command description)
Package number	1, ASCII	The package number always has the end identification (ASCII 'E').
Message number	2, ASCII	The message number always is "00" (ASCII).
Command length	2, ASCII	Indicates the number of bytes of the useful data without the package header. The second byte must always be "0". Thus, a maximum useful data length of nine bytes results.

Package data:
'The package data contain the useful information which is different for each of the commands (see 3rd 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 (ASCII)
►	Unknown command	N V	2 (ASCII)
►	Error in check sum	N V	3 (ASCII)
►	Inadmissible command	N V	4 (ASCII)
►	Incomplete package	N V	5 (ASCII)

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.

A package is recognized as incomplete if a package 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 operation mode automatic (display DNC on the screen). DNC operation can be activated at any time (irrespective of the status of the control).

Direction	Meaning	Comm.	Data
►	Transition into DNC operation	B S	
◄	pos. acknowledgement	C V	
◄	Activation not possible (neg. acknowledgement)	N B	

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

3.4. Terminate DNC operation

The termination of the DNC operation is triggered by the DNC computer.

Direction	Meaning	Comm.	Data
►	Termination of DNC operation	B E	
◄	DNC operation terminated (pos. acknowledgement	Q B	

If the control is terminated with active DNC operation, a message is given to the DNC omputer.

Direction	Meaning	Comm.	Data
◄	Software of machine terminated	C B	

3.5. System status

During the execution of a command (production dialogues, referencing) the system status concerning this command is transmitted to the DNC computer.

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, processing status, SKIP), the status of the automation devices (doors, clamping devices, sleeve, coolant, auxiliary drives,…) as well as actual override values (feed, spindle).

3.5.1. Set-up system status

Designation	Memory type	Note
Operation mode of the machine	1 byte (ASCII) 1 byte (ASCII)	A..Automatic, M..Manual R .. Reference point valid,, F .. ref. run active, N .. Reference point not valid
NC program number	4 byte (ASCII)	actual program number, e.g. 0001 FFFF = no program selected
NC program status	1 byte (ASCII)	L .. active, R .. Reset
SKIP status	1 byte (ASCII)	1 .. active, 0 .. inactive
swivelled in tool	4 byte (ASCII)	tool number , e.g. 0001 FFFF = invalid tool
Door status	1 byte (ASCII)	0 .. open, 1 .. closed, 2 .. intermediate position
Clamping device	1 byte (ASCII)	0 .. released, 1 .. clamped, 2.. intermediate position
Sleeve	1 byte (ASCII)	0 .. back, 1 .. front, 2 .. intermediate position
Coolant	1 byte (ASCII)	0 .. off, 1 .. on
EMERGENCY-OFF status	us1 byte (ASCII)	0 .. OK, 1 .. Emergency-off
Auxiliary drives	1 byte (ASCII)	0 .. off, 1 .. on
Feed override value	4 byte (ASCII)	in per cent, e.g. 0100
Spindle override value	4 byte (ASCII)	in per cent, e.g. 0080
Blow-out status	1 byte (ASCII)	0 .. off, 1 .. on
Dividing device	1 byte (ASCII)	0 .. fixed, 1 .. in movement

3.6. Monitoring

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

Direction	Meaning	Comm.	Data
►	Connection monitoring	C V	
◄	Acknowledgement	Q V	

3.7. 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	

3.8. 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 interrupted.

Direction	Meaning	Comm.	Data
►	NC program selection	S W	Program number (4 bytes ASCII), e.g. 0001
◄	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 ASCII): 0=off / 1=on
◄	Acknowledgement	C Z	System status SKIP status
►	Change feed override value	O F	FOV- value in per cent (4 bytes ASCII) , e.g.0100
◄	Acknowledgement	C Z	System status feed override value
►	Change feed override value	O S	SPOV value in per cent (4 bytes ASCII), z.B.0080
◄	Acknowledgement	C Z	System status spindle override value

Peripheral commands:

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

3.9. Command cancellation

With this message the active command can be cancelled. All actions for the active command are interrupted.

Direction	Meaning	Comm.	Data
►	Cancel command	C A	
◄	Acknowledgement	Q A	

3.10. Determination of 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).

DNC-Interface (reduced ASCII format)

Direction	Meaning	Comm.	Data
►	Determine control type	C T	
◄	pos. acknowledgement	Q T	Control type: 0 .. Sinumerik 840d