AMK

AMKASYN

VARIABLE SPEED DRIVES

AZ-MC1
Multi-station
multi-channel
CNC continuous path control system

NC-PS
Interface description

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Contents

1 Classification

The AZ-MC1 card contains apart from the **N**umerical **C**ontrol **(NC)** (up to two channels) an integrated **p**rogrammable "adaptation" control (**PS**). The NC-PS interface is the interface between the numerical control and the integrated PS as well as a bit interface to higher-level and accessory systems (control panel and further NC subscribers to a serial communication bus), here named **global status**. From the viewpoint of the PS, NC-PS interface consists of the following blocks for each channel:

- Process image of the inputs from the NC (PAE)
- Process image of the outputs to the NC (PAA)
- Data blocks for reading global statuses (DBx)
- Function blocks for commanding the NCs (FBx)

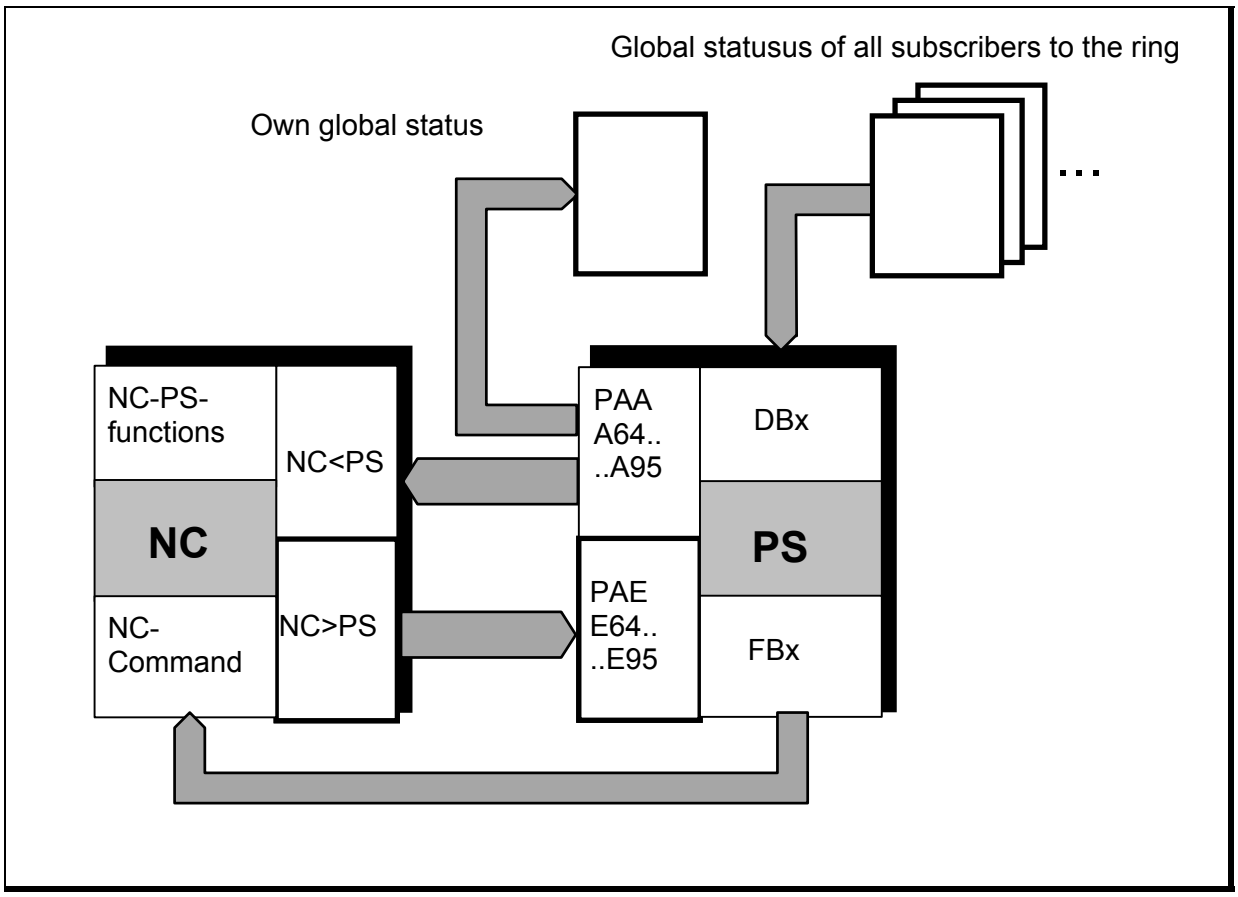


Fig.1: Block schematic of NC-PS interface (shown here for channel 1)

The NC core performs a number of "PS" functions without participation of the PS. Information is available to the PS in the NC status concerning the execution of a number of these functions (see Section 3.6 "M functions of the NC"). These functions include:

-Optional hold (M01)
-Spindle commands (e.g.: M03 S1000)
-Authorization of synchronous axes (e.g.: M28 S1000)
-Program end (M30)

2 Programmable control (PS)

The PS integrated in the NC contains all functions of the general AMK-PS description. With regard to drive commanding by the PS, it should be observed that drives which are assigned to the NC by configuration, i.e. in the drive commanding interface of which the NC is logged in, cannot be commanded simultaneously by the PS. Moreover, the integrated PS contains the interfaces described below from or to the NC for executing **m**achine (M) functions or for influencing and commanding the NC.
The integrated PS is notified by the NC through the **PS input image** (E64..E95/E96..E127) all NC orders programmed via M, S, T, H functions. Further, all important NC statuses as well as information about drive statuses of drives which are managed by the NC stand in the input image of the PS. The operation of the NC can be influenced via the **PS output image** (A64..A95/A96..A127). M functions with assigned acknowledgement mechanisms must be acknowledged by the PS in the output image (see below): A part of the PS output image is copied cyclically into the **global status** and is available through serial connections to accessory and higher-level systems (NCs linked through fibre optic cables and PC operator interfaces). Global statuses of accessory and higher-level systems can be read equally by definable data blocks and transferred into the logic operation level. Commands to the NC such as "NC program start" can be sent through special **function blocks (FBs)**.

2.1 Multi-channel capability

Multi-channel capability means that more than one complete NC core is located on an AZ-MC1 (max. 2 channels). The integrated PS operates both channels in this case. For this purpose the **input and output image** is extended by a complete block for the 2nd channel:

	NC channel 1	NC channel 2
Input image	E64..E95	E96..E127
Output image	A64..A95	A96..A127

The I/O No. for both channels is stated in each case in the following tables.

Both NC channels have their own **global status**. The global status of the 1st NC channel lies on the physical address of the SBUS subscriber (=4 for serial point-to-point connection), the global status of the 2nd NC channel stands in the address increased by 1.
(See also notes in the document "NC configuration").

In the **NC commanding (FB_NC)**, the channel index (0,1) must be entered in the commanding data block.

3 M functions

3.1 Acknowledgement mechanisms (QM)

4 different acknowledgement mechanisms (QM) can be assigned to the M functions for the PS. M functions with acknowledgement serve for synchronization of a NC program sequence with machine functions, which are triggered by these M functions. The time reference for the synchronization is always the just processed NC block in which the M function stands. The triggering time (before or after NC block processing) and the expected acknowledgement time (also before or after block) can be assigned. The different acknowledgement mechanisms are assigned to fixed input areas in the PS input image. I.e. by assigning a PS input to a M number, apart from the place in the input image both the QM and also the place of the acknowledgement in the PS output image are determined for this number. 16 M functions can be defined for each QM. It must be observed that certain M numbers are reserved for internal processes. Use of the M function tables (see Appendix) is recommended for configuring the M functions in a NC system. The following table shows an overview of all acknowledgement mechanisms and their assignment to the PS input areas:

Abbr.	Input chan.1	Input chan.2	Meaning	Offsets*)
MvSSvS	E64..E65	E96..E97	M output before block, acknowledgement before block	32..47
MvSSnS	E66..E67	E98..E99	M output before block, acknowledgement after block	48..63
MnSSnS	E68..E69	E100..E101	M output after block, acknowledgement after block	64..79
MoS	E70..E71	E102..E133	M functions without acknowledgement	80..95

Table 3.1: Overview of the acknowledgement mechanisms

3.1.1 Example of the QM

If a M function with QM stands in a NC block, it is entered in the PS input image before or after processing the block (according to QM). The PS performs the assigned machine function (e.g. switch on coolant) and acknowledges the function in the PS output image. The NC then resets the function in the input image and continues the program run. The PS must then again reset the function acknowledged in the output image. Thus the M function is completely processed.

```
:U      E64.4     ; M11 Coolant On (from the NC)
:S      A0.3      ; Output for setting coolant (relay)
:U      E0.3      ; Coolant acknowledgement
:S      A64.4     ; M function acknowledgement to NC
:UN     E64.4     ; Resetting the acknowledgement,
:R      A64.4     ; if NC has reset input
```

Example: Acknowledgement sequence (STEP5)

*) see Appendix Section 12.3.3

3.2 M functions for the PS (MvSSvS)

Number: 2 PS input bytes.

Sequence: ⇒ NC enters M function before block processing in the PS input image.
⇒ NC waits for acknowledgement from PS (PS output image).
⇒ NC resets input again and continues NC program.
⇒ PS must subsequently reset acknowledgement output again.

M No.	PS input Chan.1/Chan.2	Acknowledg. Chan.1/Chan.2	Meaning	Offset *)
06 (ex)	E64.0/E96.0	A64.0/A96.0	Tool change (example)	32
xx	E64.1/E96.1	A64.1/A96.1		33
	../..	../..		..
xx	E65.7/E97.7	A65.7/A97.7		47

3.3 M functions for the PS (MvSSnS)

Number: 2 PS input bytes.

Sequence: ⇒ NC enters M function before block processing in the PS input image.
⇒ NC performs block.
⇒ NC waits for acknowledgement from PS (PS output image).
⇒ NC resets input again and continues NC program.
⇒ PS must then reset the acknowledgement output again.

M No.	PS input Chan.1/Chan.2	Acknowledg. Chan.1/Chan.2	Meaning	Offset *)
xx	E66.0/E98.0	A66.0/A98.0		48
	../..	../..		..
xx	E67.7/E99.7	A67.7/A99.7		63

*) see remarks page 6

3.4 M functions for the PS (MnSSnS)

Number: 2 PS input bytes.

Sequence: ⇒ NC performs first block
⇒ NC enters M function after block processing in the PS input image.
⇒ NC waits for acknowledgement from PS via output image.
⇒ NC resets input again and continues NC program.
⇒ PS must then reset the acknowledgement output again.

M No.	PS input Chan.1/Chan.2	Acknowledg. Chan.1/Chan.2	Meaning	Offset *)
xx	E68.0/E100.0	A68.0/A100.0		64
	../..	../..		..
xx	E69.7/E101.7	A69.7/A101.7		79

3.5 M functions for the PS (MoS)

Number: 2 PS input bytes.

Sequence: ⇒ NC enters M function directly in the PS input image.
⇒ M function applies at least one PS cycle.
⇒ M function is overwritten by the following M function (MoS).
⇒ No synchronization with the NC.

M No.	PS input Chan.1/Chan.2	Acknowledg. Chan.1/Chan.2	Meaning	Offset *)
xx	E70.0/E102.0	none/none		80
	../..	../..		..
xx	E71.7/E103.7	none/none		95

3.6 M functions of the NC

Overview of the M functions which are processed in the NC. The integrated PS receives information about the execution of these M functions in the NC status or extended NC status and if necessary also in the input image (see Section 8.1, 8.2).
Examples:

M30	-Signal "NC program started" (NCP_AKT, E88.1) disappears.
M03 S1000	-Information "Direction positive" in spindle1 status (SPL1_INFO,E90.0..3) Additional information about the spindle speed in the S1 word (E80..E83)
M28 S1000	-Axis in synchronous control (SLAVE_AX, E90.5) Additional information about synchronous ratio in the S1 word (E80..E83)

*) see remarks page 6

3.6.1 Fixed NC M functions without PS acknowledgement

Sequence: ⇒ According to acknowledgement mechanism, which is permanently assigned.
⇒ Execution by the NC.
⇒ If necessary entries in the NC status and extended NC status (applies at least 1 PS cycle).

M No.	PS input	Synchr.	Meaning	Offset *)
00		MvSSvS	Programmed stop	-1
01		MvSSvS	Optional stop	-1
02		MnSSnS	NC program end	-1
25		MoS	Parameter transfer from PS	25
26		MvSSvS	Axis group synchr.	-1
29		MnSSnS	Subprogram end	-1
30		MnSSnS	Main program end	30
96		MvSSvS	Acceleration override	-1

3.6.1.1 M25 parameter transfer without synchronization

This M function allows both the complete parameter field of the NC to be overwritten by the contents of a data block of the PS or only a selected parameter. Execution occurs directly, so that the NC program processing is continued and it is possible to work with the new parameters. Refer to Section 10.1 concerning creation of a transfer data block.

Syntax:	M25 S-1	Immediate transfer of all transfer parameters of the PS into the R parameter field of the NC of the numbers R1000, R1001,..
	M25 Sn	Immediate transfer of the transfer parameters from the corresponding data double word of the transfer data block DD[n*2] into R parameters R1000+n of the NC.
Example:	M25 S10	DBxx DD[10*2]➔R1010

3.6.2 Fixed NC M functions with PS acknowledgement (MvSSvS)

Number: 1 PS input byte.

These M functions result in holding the NC block decoder in order to transfer parameters which are used subsequently from the PS, for instance.

Sequence: ⇒ NC enters M function before block processing in the PS input image.
⇒ PS manipulates DB for parameter transfer and then acknowledges.
⇒ NC waits for acknowledgement from PS (PS output image).
⇒ NC resets input again and continues NC program.
⇒ PS must then reset the acknowledgement output again.

*) see remarks page 6

3.6.3 M112 parameter transfer with synchronization

M No.	PS input	PS output	Meaning	Offset *)
112	E86.0/E118.0	A86.0/A118.0	Parameter transfer from PS	112

This M function causes holding of the NC block decoder in order to transfer parameters which are used subsequently from the PS. This is necessary if, for instance, a program branch should occur because of an external signal which the PS only enquires at the time of this M function and enters the result in the data block.

Syntax:	M112 S-1	Waiting for acknowledgement of the PS and subsequent transfer of all transfer parameters of the PS into the R parameter field of the NC starting from R1000, R1001,..
	M112 Sn	Waiting for acknowledgement of the PS and subsequent transfer of the transfer parameter from the corresponding data double word of the transfer data block DD[n*2] into R parameter R1000+n of the NC.

Sequence: ⇒ NC enters M function **before** block processing into the PS input image.
⇒ NC stops block processing
⇒ PS manipulates transfer parameters in the DB and then acknowledges in the PS output image.
⇒ NC continues block processing and deletes M function in the PS input image
⇒ PS must then reset the acknowledgement output again.

3.6.4 Configurable NC M functions

These are M functions which are defined in connection with the configuration of the NC system. For example the M numbers 13, 14, 15, 20, 21, 22 are not applicable for a system with only one spindle. They can thus be used freely for PS-M functions.

Sequence: ⇒ According to acknowledgement mechanism which is permanently assigned.
⇒ Execution by the NC.
⇒ If necessary entries in the NC status and extended NC status (applies at least 1 PS cycle).

M No.	PS input	Synchr.	Meaning	Offset *)
03		MvSSvS	Spindle 1 clockwise	3
04		MvSSvS	Spindle 1 counterclockwise	4
05		MnSSnS	Spindle 1 stop	5
13		MvSSvS	Spindle 2 clockwise	13
14		MvSSvS	Spindle 2 counterclockwise	14
15		MnSSnS	Spindle 2 stop	15
17		MvSSvS	Spindle 1 speed limit	17
18		MvSSvS	Spindle 1 V const	18
19		MnSSnS	Spindle 1 positioning	19
20		MvSSvS	Spindle 2 speed limit	20
21		MvSSvS	Spindle 2 V const	21
22		MnSSnS	Spindle 2 positioning	22
27		MvSSvS	Master1 synchronous control	27
28		MvSSvS	Master2 synchronous control	28

4 H functions

Number: 2 PS input bytes.

Sequence: ⇒ NC enters H function directly in the PS input image.
⇒ H function applies at least one PS cycle.
⇒ H function is overwritten by following H function.
⇒ No synchronization with NC.

M No.	PS input Chan.1/Chan.2	Acknowledg. Chan.1/Chan.2	Meaning	Offset *)
xx	E76.0/E108.0	none/none		96
	../..	../..		..
xx	E77.7/E109.7	none/none		111

5 T No. for the PS

Number: 2 PS input bytes.

Sequence: ⇒ NC enters T number (1 word, 16 bits) directly in the PS input image.
⇒ T number applies at least one PS cycle.
⇒ T function is overwritten by following T number.
⇒ The synchronization of a tool change is guaranteed by an associated M function e.g. M06 with acknowledgement mechanism.

T No.	PS input Chan.1/Chan.2	Acknowledg. Chan.1/Chan.2	Meaning	Word offset *)
xx	E78/E110	none/none		7
	E79/E111	none/none		..

6 S words for the PS

Apart from the spindle speed and synchronous ratios (see Section 3.6.4) an S word can be provided for each M function for parameterizing the function to be executed.

e.g.: M56 S80 "Clamping with 80% clamping pressure"

*) see remarks page 6

Number: Total of 8 PS input bytes (2 32-bit words)

Sequence: ⇒ NC enters S word directly in PS input image.
⇒ S word applies at least one PS cycle.
⇒ S word is overwritten by the following S word.
⇒ Synchronization with NC via associated M bit (e.g.: M03).

S No.	PS input Chan.1/Chan.2	Meaning	v
01	E80/E112	S1 word	x
	E81/E113		x
	E82/E114		x
	E83/E115		x
02	E72/E104	S2 word	
	E73/E105		
	E74/E106		
	E75/E107		

*) see remarks page 6

7 NC status

7.1 NC readiness

Out of the 2 readiness bytes, the 1st byte is copied cyclically into the global status and thus also made available to a higher-level system (control panel).

7.1.1 NC ready (NC_BRT)

Signal to the PS and to the control panel (global status) that the NC is ready to execute a command. Nevertheless, for a **motion** command the signal AX_QRF (see below) is still required in addition, since otherwise the NC goes immediately into an error state.

7.1.2 NC program active (NCP_AKT)

Signal present as long as a NC program runs. It remains set if the "Hold" command interrupts the NC program (as from V2.03). It is reset with M30 (program end) or the "NC RESET" or "NC program abort" command.

7.1.3 Interpolator active (IPO_AKT)

Signalling to the PS that just at least one axis is being moved by the interpolator.

7.1.4 NC reset (NC_RESET)

NC reset is just being performed. After successful performance, the signal is reset and the NC goes into the "ready" status, see "NC_BRT" signal.

7.1.5 All axes in control (AX_QRF)

The signal is set by the control system if all configured NC axes are in control, i.e. the signal QRF (acknowledgement controller enable) is present for all and they are ready for a motion command.

7.1.6 Feed hold (FEEDHOLD)

Status marker for feed hold. Without feed enable measure (motion influencing: FEEDHOLD) no axis motion command is executed.

7.1.7 Feed limit (LIMFEED)

Status marker for feed limit. As long as the signal is present the feed is limited to the parameterized value in the axis data block (see NC configuration document).

7.1.8 SBUS timeout (SBUS_TIMEOUT)

Signalling to the PS that the command bus at the control panel is interrupted for at least 5 sec. It can be used for conditional triggering of an EMERGENCY STOP.

7.1.9 Battery monitoring (BATT_LOW)

Signal to the PS that the battery voltage is less than 2.5V. A battery replacement is necessary to prevent loss of data. The battery voltage is checked when the system boots.

7.1.10 System error

System error is set in the case of timeout in the NC cycle due to too high computing load.

7.1.11 NC status overview

Number: 2 PS input bytes
Sequence : ⇒ Bits are set event-controlled.
⇒1st byte (Bit 0..7) is copied cyclically into the GLOBAL STATUS (see below).

Bit	Name	PS input Chan.1/Chan.2	Meaning	v
00	NC_BRT	E88.0/E120.0	NC ready for motion orders	x
01	NCP_AKT	E88.1/E120.1	NC program started	x
02	IPO_AKT	E88.2/E120.2	Interpol. active (axes in motion)	x
03	FEEDHOLD	E88.3/E120.4	Feed hold status in NC	x
04	LIMFEED	E88.4/E120.3	Feed limit active	x
05	LIMDRZ	E88.5/E120.4	Speed limit active	x
06	NC_RESET	E88.6/E120.5	Reset algorithm up to NC_BRT	x
07	AX_QRF	E88.7/E120.6	All configured axes in control	x
08	BATTLOW	E89.0/E121.0	Battery monitoring responded	x
09	SYS_ERR1	E89.1/E121.1	System error1	x
10		E89.2/E121.2		
11		E89.3/E121.3		
12		E89.4/E121.4		
13		E89.5/E121.5		
14	SBUS_TIMEOUT	E89.6/E121.6	Sbus timeout	
15		E89.7/E121.7		

7.2 Extended NC status

7.2.1 Spindle information (SPLx_INFO)

Code information to the PS about the current spindle status of spindle 1 and 2. See overview of extended NC status.

7.2.2 Speed limit (LIMDRZ)

Status marker to the PS for speed limit. As long as the signal is present the speed of the spindles is limited to the parameterized value in the axis data block (see NC configuration document).

7.2.3 Handwheel active (HANDRAD)

Status marker to the PS that at least one axis is in handwheel operation.

7.2.4 Synchronous mode (SLAVE_AX)

Status marker to the PS that at least one axis is in synchronous mode to a master axis.

7.2.5 Overview of extended NC status

Number: 2 PS input bytes
Sequence : ⇒ Bits are set event-controlled.

Bit	Name	PS input Chan.1/Chan.2	Meaning	v
00	SPL1_INFO	E90.0/E122.0	001 Positioned 101 Speed 0	x
01	(3-Bit-	E90.1/E122.1	011 Direction pos. 000 C axis mode	x
02	Code)	E90.2/E122.2	100 Direction neg. 101 V const	x
03		E90.3/E122.3		
04	LIMDRZ	E90.4/E122.4	Speed limit active	x
05	HANDRAD	E90.5/E122.5	Handwheel active	x
06	EILGANG	E90.6/E122.6	G0 programmed	-
07	SLAVE_AX	E90.5/E122.7	At least 1 axis in synchronous mode	x
08	SPL2_INFO	E91.0/E123.0	001 Positioned 101 Speed 0	x
09	(3-Bit-	E91.1/E123.1	011 Direction pos. 000 C axis mode	x
10	Code)	E91.2/E123.2	100 Direction neg. 101 V const	x
11		E91.3/E123.3		
12		E91.4/E123.4		
13		E91.5/E123.5		
14		E91.6/E123.6		
15		E91.7/E123.7		

7.3 Axis status

7.3.1 Axis active

Marking of all active axes in the NC. These include all drives (AWs) assigned in the NC configuration of the NC. This marking takes place after the first time the drives are switched on in control (V2.03).

Bit	Name	PS input Chan.1/Chan.2	Meaning	v
00	AX1_AKT	E92.0/E124.0	Axis active (configured as NC axis)	x
01	AX2_AKT	E92.1/E124.1		x
02	AX3_AKT	E92.2/E124.2		x
03	AX4_AKT	E92.3/E124.3		x
04	AX5_AKT	E92.4/E124.4		x
05	AX6_AKT	E92.5/E124.5		x
06	AX7_AKT	E92.6/E124.6		x
07	AX8_AKT	E92.7/E124.7		x

7.3.2 Reference point known

Marking of the drive (AWs) for which the NC has successfully performed a homing cycle.

Bit	Name	PS input Chan.1/Chan.2	Meaning	v
00	RFP_AX1	E93.0/E125.0	Reference point of axis known	x
01	RFP_AX2	E93.1/E125.1		x
02	RFP_AX3	E93.2/E125.2		x
03	RFP_AX4	E93.3/E125.3		x
04	RFP_AX5	E93.4/E125.4		x
05	RFP_AX6	E93.5/E125.5		x
06	RFP_AX7	E93.6/E125.6		x
07	RFP_AX8	E93.7/E125.7		x

8 PS outputs

8.1 NC influencing

8.1.1 ENABLE NC program start

Preventing the start of a NC program as long as the bit PS_ENCPS = 0.

8.1.2 ENABLE NC block start

Preventing the start of a NC block as long as the bit PS_ENCSS = 0.

8.1.3 EMERGENCY STOP

Preventing all axis movements if the bit PS_NOTHALT = 0 and abort of all axis movements if the bit PS_NOTHALT is set to 0. The NC goes into the error status, i.e. the signal "NC ready" (NC_BRT see Section 7.1 “NC readiness”) goes to status 0.
After elimination of the EMERGENCY STOP condition, the EMERGENCY STOP signal must be reset by the PS and then a NC RESET must be performed so that the NC is brought into the "ready" status.

8.1.4 Axis enables

Prevention or abort of all axis movements if the axis enable bit of a **just moved** axis is removed. The NC goes into the error status, i.e. the "NC ready" signal (NC_BRT see Section 7.1 “NC readiness”) goes to status 0.

8.1.5 Overview of NC influencing

Bit	Name	PS output Chan.1/Chan.2	Meaning	v
00	PS_ENCPS	A72.0/A104.0	ENABLE NC prog. start	x
01	PS_ENCSS	A72.1/A104.1	ENABLE NC block start	x
02	PS_NOTHALT	A72.2/A104.2	EMERGENCY STOP	x
03		A72.3/A104.3	Reserve	
04		A72.4/A104.4	Reserve	
05		A72.5/A104.5	Reserve	
06		A72.6/A104.6	Reserve	
07		A72.7/A104.7	Reserve	
08		A73.0/A105.0		
09		A73.1/A105.1		
10		A73.2/A105.2		
11		A73.3/A105.3		
12		A73.4/A105.4		
13		A73.5/A105.5		
14		A73.6/A105.6		
15		A73.7/A105.7		
16	AX1_FREIGABE	A74.0/A106.0	Enable AW1 for movement by NC	x
17	AX2_FREIGABE	A74.1/A106.1	Enable AW2 for movement by NC	x
18	AX3_FREIGABE	A74.2/A106.2	Enable AW3 for movement by NC	x
19	AX4_FREIGABE	A74.3/A106.3	Enable AW4 for movement by NC	x
20	AX5_FREIGABE	A74.4/A106.4	Enable AW5 for movement by NC	x
21	AX6_FREIGABE	A74.5/A106.5	Enable AW6 for movement by NC	x
22	AX7_FREIGABE	A74.6/A106.6	Enable AW7 for movement by NC	x
23	AX8_FREIGABE	A74.7/A106.7	Enable AW8 for movement by NC	x

8.2 PS setpoint value sources

Setpoint value of these sources can be superimposed after activation (see Section 11.3.8:"Handwheel / PS setpoint setting") arbitrary NC axis movements (machine axes).

Name	PS output Chan.1/Chan.2	Meaning	v
PS_USR_SWQ1	A88..89/A120..121	1. 16Bit setpoint of PS	x
PS_USR_SWQ2	A90..91/A122..123	2. 16Bit setpoint of PS	x

9 GLOBAL STATUS

The global status serves on one hand to provide NC statuses and functions for accessory (further NC subscribers to a FOC ring) and higher-level systems (PC control panels). On the other hand it allows the global status mechanism to make available functions of higher-level systems (e.g. key functions of the PC control panel) to a local NC-PS.
The global status is entered by the NC cyclically into the transport level and updated with every token transmission in the higher-level and accessory system (control pane and accessory subscriber). Just as the own global status is entered cyclically into the transport level, the global statuses of all other subscribers of the higher-level and accessory system are available to the local PS. The global statuses are located in a field which is numbered consecutively with the number of the individual SBUS subscribers. In the case of 2-channel NCs the global status of the 1st channel always has an even number and the 2nd channel the next higher (uneven) number. The PS has reading access through data blocks. The own global status is written via an area of the PS output image.

9.1 NC global status

Structure of the own global status and of the global status of accessory subscribers (NCs):
The 1st byte of the NC status stands in the 1st byte (see Section 7.1 ”NC readiness”).
The bit **G3.0 "Reference points of structure known**” serves for communicating to the control panel that a NC program can be started, because all axes relevant for the program run are referenced. (This enquiry can be deactivated by configuration). The PS programmer decides which axes belong to this. If the bit is not set at a NC program start, then the control panel reports "Structure not referenced".

No.	Designation	Source Chan.1/Chan.2	Meaning
G1.0	NC_BRT	NC1/NC2	NC ready
G1.1	NCP_AKT	NC1/NC2	NC program active
G1.2	IPO_AKT	NC 1/NC2	Interpolator active
G1.3	FEED_HOLD	NC1/NC2	Feed hold status
G1.4	LIM_FEED	NC1/NC2	Feed limit status
G1.5	LIM_DRZ	NC1/NC2	Speed limit status
G1.6	NC_RESET	NC1/NC2	Status transition at NC reset
G1.7	AX_QRF	NC1/NC2	All config. axes in control
G2.0			
G2.1			
G2.2			
G2.3			
G2.4			
G2.5			
G2.6			
G2.7			
G3.0	AX_RFP	A76.0/A108.0	Reference points of structure known
G3.1		A76.1/A108.1	
G3.2		A76.2/A108.2	
G3.3		A76.3/A108.3	
G3.4		A76.4/A108.4	
G3.5		A76.5/A108.5	
G3.6		A76.6/A108.6	(Example: Bad part)
G3.7		A76.7/A108.7	(Example: Empty part)

Continuation of NC global status:

No.	Designation	Source Chan.1/Chan.2	Meaning
G4.0		A77.0/A109.0	PS output image
G4.1		A77.1/A109.1	
G4.2		A77.2/A109.2	
G4.3		A77.3/A109.3	
G4.4		A77.4/A109.4	
G4.5		A77.5/A109.5	
G4.6		A77.6/A109.6	
G4.7		A77.7/A109.7	
G5.0		A78.0/A110.0	
G5.1		A78.1/A110.1	
G5.2		A78.2/A110.2	
G5.3		A78.3/A110.3	
G5.4		A78.4/A110.4	
G5.5		A78.5/A110.5	
G5.6		A78.6/A110.6	
G5.7		A78.7/A110.7	
G6.0		A79.0/A111.0	
G6.1		A79.1/A1111	
G6.2		A79.2/A111.2	
G6.3		A79.3/A111.3	
G6.4		A79.4/A111.4	
G6.5		A79.5/A111.5	
G6.6		A79.6/A111.6	
G6.7		A79.7/A111.7	

9.2 Control panel global status

The control panel global status (BDE) can be read like the global statuses of the other subscribers through a data block (DBxx). In this way the control information can be transmitted from the control panel directly to the NC-PS for processing. The contents of this global status can be defined via the IO programming (see description: NC operation).

No.	Designation	Source	Meaning
G1.0	AFB_NR_0	BDE	Structure number code 0..31
G1.1	AFB_NR_1	BDE	
G1.2	AFB_NR_2	BDE	
G1.3	AFB_NR_3	BDE	
G1.4	AFB_NR_4	BDE	
G1.5			Reserved for BDE
G1.6			
G1.7			
G2.0			
G2.1			
G2.2			
G2.3			
G2.4			
G2.5			
G2.6			
G2.7			

Continuation of control panel global status.

No.	Designation	Source	Meaning
G3.0			
G3.1			
G3.2			
G3.3			
G3.4			
G3.5			
G3.6			
G3.7			
G4.0			
G4.1			
G4.2			
G4.3			
G4.4			
G4.5			
G4.6			
G4.7			
G5.0			
G5.1			
G5.2			
G5.3			
G5.4			
G5.5			
G5.6			
G5.7			
G6.0			
G6.1			
G6.2			
G6.3			
G6.4			
G6.5			
G6.6			
G6.7			

Remarks: The input bytes of the operating unit can be allocated freely to the global status through the IO programming.

10 NC-specific data blocks

10.1 Data block as transfer parameter field for the NC

The transfer parameters of the PS are written into a data block. The data block number and the number of the transfer parameters must be stated in the system data block DB0. In the system initialization, these data blocks are generated automatically with the length (number *2). In 2-channel systems, data blocks with the same number are generated for both channels if a No. ≠ 0 is stated for both. If the data block No. is = 0, no data block is created for transfer parameters for this channel.

Structure of the DB0:

Data	High word		Low word	
double word	High byte	Low byte	High byte	Low byte
0	Reserve		Cycle monitoring time	
...	...		...	...
26	**Number of parameters**		**DB-No. Chan. 2**	**DB-No. Chan. 1**
28	**Reserve = 0**			

Formats:

Number of parameters: 1..100 (NC processes maximum 100 parameters)
If the number is stated negative, then the DB is created as remanent data block for the parameter transfer.

Parameter format: Data double word (32bit), -2147483648 to 2147483647

DB-No.: 0 - deselected, 1..63

11 NC commanding (FB-NC)

11.1 General

Apart from the operation of the NC on the PC operating panel AB-110C, the NC can also be commanded by the integrated PS (e.g. NC program start/stop, homing cycle, etc.). For this purpose, the **F**unction **B**locks (**FB**s) described below are made available.

11.2 Basic structure of the FBs

The function blocks for commanding and operating the NC (**FB-NC**) are operated via the momentarily active data block. This must be filled out correspondingly and activated (:A DBx) **before** calling up the FB. It must be observed that the required FB must be called only **once** per required action. The following FBs are available for operating the NC:

FB 250 "NC commanding"
FB 249 "NC influencing"
FB 248 "NC parts program"
FB 247 "NC display"

The **FB 250 "NC commanding"** is used to command the NC core in the different operating modes. Data such as spindle or feed override can be changed and the NC program sequence can be influenced with the **FB 249 "NC influencing"** (e.g. single block, optional stop). The **FB 248 "NC parts program"** can read and write parts program parameters. Setpoint, actual and status values can be read with the **FB 247 "NC display"**.

The FBs are controlled via bits in **flag bytes**, which mark processing and error statuses of the FBs. The processing status =1 signals that the corresponding FB is in work. The FB is ready to execute a new order only if the processing status has become =0.

The processing status of the FBs is displayed in the following flag bytes:

	Processing status: Bit = 1		Error status: Bit = 1	
Function block	Channel 1	Channel 2	Channel 1	Channel 2
FB 250 NC commanding	MB230.0	MB225.0	MB229.0	MB224.0
FB 249 NC influencing	MB230.1	MB225.1	MB229.1	MB224.1
FB 248 NC parts program	MB230.2	MB225.2	MB229.2	MB224.2
FB 247 NC display	MB230.3	MB225.3	MB229.3	MB224.3

CAUTION ! The first command must always be initializing of the system via the INITIALIZE function of the FB "NC commanding".

11.3 FB 250 "NC commanding"

The **FB 250 "NC commanding"** contains the following commands with which apart from initializing and resetting, also motion functions of the NC can be started:

-Initializing
-Start/hold/continue/abort NC program
-Homing cycle
-Activate/deactivate handwheel
-JOG mode
-STEP mode
-NC reset
-Log off control panel
-Referencing

CAUTION !	The following applies for motion commands for safety reasons: If the FB is used together with an AB-110C operating panel, then only one system can always execute the motion commands. To provide the other system access to the NC command interface, the FB must log off from the motion function of the NC with the command "Log off control panel".

11.3.1 Structure of the data block

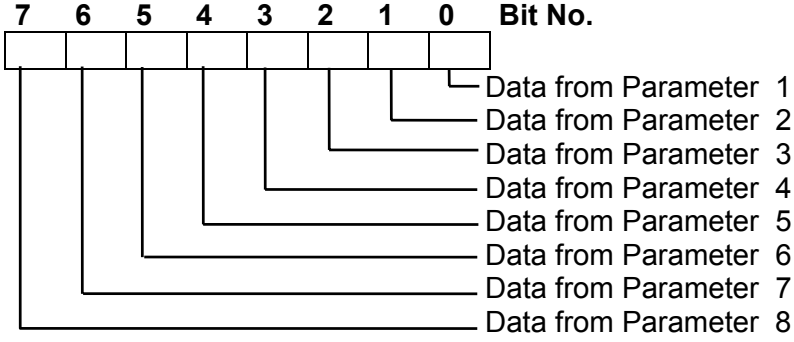
The data block for selecting the **FB 250 "NC commanding"** contains a head consisting of the data double word (DD) 0 and 2 and the connecting transfer parameters, which have to be completed according to selected command. It has the following structure:

Data double word (DD)	High word (DW)		Low word (DW)	
	High byte (DB)	Low byte (DB)	High byte (DB)	Low byte (DB)
0	Reserve	Reserve	Reserve	Axis code
2	Parameter valid	Chan. index	Command funct	Command code
4	Parameter 1			
6	Parameter 2			
8	Parameter 3			
10	Parameter 4			
12	Parameter 5			
14	Parameter 6			
16	Parameter 7			
18	Parameter 8			

The meaning of the individual data bytes is defined as follows:

Channel index:	0,1	0=Channel 1, 1=Channel2 ➔ Set the channel index always to 0 for single-channel NCs.
Axis code:	0	global, i.e. applies for all axes or NC in total.
	'X', 'Y', 'Z',...	Axis name (ASCII code)
Command function:	1	Initialize
	2	NC program
	3	Homing cycle
	4	Step
	5	Jog
	6	Handwheel
	7	NC reset
	8	Log off control panel
	9	Referencing
Command code:	0	No commanding
	1	Start
	2	Abort
	3	Hold
	4	Continue

Valid parameters:



The individual bit information can be superimposed additively.

Set all not required parameters to 0!

11.3.2 Basic information on the FB 250

The command functions of the **FB 250 "NC commanding"** contain functions with very different effects on the NC system. It should be noted that some commands are mutually exclusive. Thus for instance, it is not expedient to command a homing cycle for an individual axis during a NC program run. The commands can be classified into booting, manual, automatic and reset commands. Observing the following list should help to avoid unallowed statuses.

Item	Command function	Use, classification	To be observed
1	Initialization	One time on booting	Not in operation
2	NC program	Automatic	Not during an axis movement (manual mode) Firstly stop axis
3	Homing cycle	Manual mode	Not during NC program run (NCP_AKT=1), first abort program ➔(NCP_AKT=0)
4	Handwheel mode 0,1	Manual mode/Automatic	see Item 3
5	Handwheel mode 2/ Activate PS Userswq.	Manual mode/Automatic	Possible parallel to the NC program
6	JOG mode	Manual mode	see Item 3
7	STEP mode	Manual mode	see Item 3
8	NC reset	Error reset	Aborts every axis movement
9	Log off control panel	Relinquishing command supremacy	Apart from direct EMERGENCY STOP see Section 8.1.3 NC influencing no longer possible
10	Referencing	Manual mode	see 3

11.3.3 "Initializing" command

At "Power On" or after "PS reset", the **FB 250 "NC commanding"** is in the original condition. The "Initialize" command must be given **mandatorily before the first motion command** and has the task of supplying the FB with the following basic data:

- **Axis number** and **axis name** of the NC as well as
- **Software limit switch** positive and negative of every NC axis from the axis machine data block.
- **Fast** and **slow speed** for the feed movements (e.g. JOG)
- Preparation of the manual records for the commands JOG, STEP and HOMING CYCLE.

The FB reads these data from the NC configuration and axis data blocks in order to make them available for the commands of the **FB 250 "NC commanding"**.

The DB for the **"Initialize"** command has the following contents:

DB axis code	=	0	(command not axis-specific)
DB command function	=	Initialize	
DB command code	=	0	(no commanding)
DB parameter valid	=	3	
DD parameter 1	=	Fast speed [mm/min]	
DD parameter 2	=	Slow speed [mm/min]	

After processing this command the **FB 250 "NC commanding"** is in the basic status and can be commanded with a motion command.

11.3.4 "NC program" command

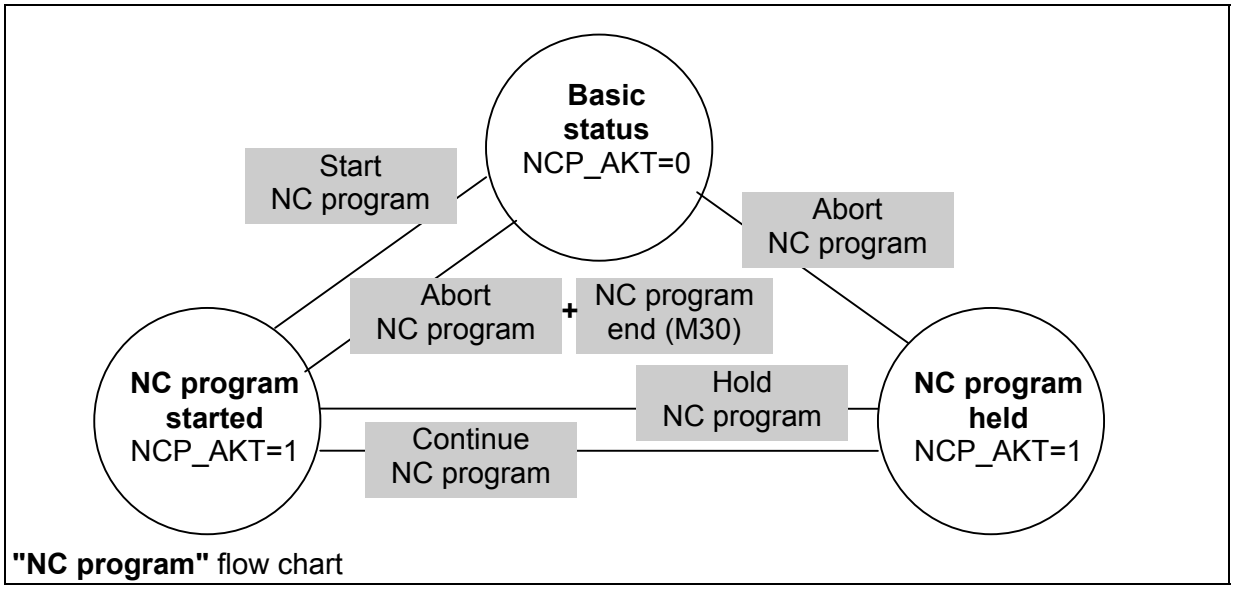
A NC program is controlled with this command. The following commands are possible:

⇒ Start NC program
⇒ Hold NC program (stop)
⇒ Continue NC program
⇒ Abort NC program

The data block must be completed as follows:

DB axis code	=	0	(command not axis-specific)
DB command function	=	NC program	
DB command code	=	Start/hold/continue/abort	
DB parameter valid	=	1	
DD parameter 1	=	Parts program number (1..99999999)	

The parts program number in the DD parameter 1 must be transferred only for the **"Start"** command. It is ignored by the PS for the other commands (**"Hold", "Continue", "Abort"**). The same DB can therefore always be used, only the command code has to be modified. The **program status** is indicated in the NC status bit **"NCP_AKT"** (see Section 7.1.2).



"NC program" flow chart

11.3.5 "Homing cycle" command

With the "Homing cycle" command, all or also every individual axis can be moved into the reference position. If the command is given for all axes, then a homing cycle sequence of the axes can be transferred as parameter. If no sequence is determined, then the axes all start at the same time.

Command for all axes :

DB-DB axis code	=	0
DB command function	=	Homing cycle
DB command code	=	Start/abort
DB parameter valid	=	Per DB parameter
DD parameter n HW	=	Axis name e.g. 'X', 'Y', 'Z', 'A',...
DD parameter n LW	=	Index for sequence
DD parameter n+1 HW	=	Axis name e.g. 'X', 'Y', 'Z', 'A',...
DD parameter n+1 LW	=	Index for sequence

Axis-related command :

DB axis code	=	Axis name e.g. 'X', 'Y', 'Z', 'A',...
DB command function	=	Homing cycle
DB command code	=	Start/abort

Example: Global homing cycle with selectable sequence, firstly Z, then X and Y simultaneously, finally C

DB axis code	=	0
DB command function	=	Homing cycle
DB command code	=	Start
DB parameter valid	=	Fh
DD parameter 1 HW	=	'Z'
DD parameter 1 LW	=	1
DD parameter 2 HW	=	'X'
DD parameter 2 LW	=	2
DD parameter 3 HW	=	'Y'
DD parameter 3 LW	=	2
DD parameter 4 HW	=	'C'
DD parameter 4 LW	=	3

11.3.6 "Step" command (currently not yet available)

With the "Step" command, axes are moved by a relative prescribable distance. The distance to be stated has the unit [µm]. Only 1,10,100,1000,10000 are allowed as values to be entered. These correspond to metric travel distances per step command of 0.001, 0.01, 0.1, 1, 10mm. In the case of rotary axes the input value has the unit [0.001°].
Furthermore the speed must be selected and the travel direction stated, whereby 0 means positive and 1 negative direction. If the speed is selected according to DD parameter1, then the selection of fast/slow speed in DD parameter2.HW is ignored.

Axis-related command :

DB axis code	=	Axis name e.g. ‘X’, ‘Y’, ‘Z’, ‘A’,...
DB command function	=	Step
DB command code	=	Start
DB parameter valid	=	7h: Parameter 1 (speed setting) Parameter 2 (direction) Parameter 3 (distance) 6h: Parameter 2 (fast or slow speed and direction) Parameter 3 (distance)
DD parameter 1	=	Speed in [mm/min]
DD parameter 2 HW	=	0: fast speed 1:slow speed
DD parameter 2 LW	=	Direction (0=pos., 1=neg.)
DD parameter 3	=	Distance 1,10,100,1000,10000 [µm]

11.3.7 "JOG" command

The **"JOG"** command is used to move an axis in one direction as long as a corresponding direction key is pressed. Therefore when pressing the key the **"JOG"** command must be given with the **"Start"** code, and when releasing the key with the **"Abort"** code. In the case of abort the transfer parameters are ignored by the PS. The axis is moved as a maximum up to its software limit switch. The speed can be selected between the parameterized fast and slow speed (see command) or prescribed numerically in [mm/min]. Also the direction must be stated. The parameters have no meaning for aborting the command and are ignored by the PS.

Axis-related command :

DB axis code	=	Axis name e.g. ‘X’, ‘Y’, ‘Z’, ‘A’,...
DB command function	=	Jog
DB command code	=	Start/abort
DB parameter valid	=	3h: Parameter 1 (speed setting) Parameter 2 (direction) 2h: Parameter 2 (fast or slow speed and direction)
DD parameter 1	=	Speed in [mm/min]
DD parameter 2 HW	=	0: fast speed 1:slow speed
DD parameter 2 LW	=	Direction (0=pos., 1=neg.)

Example of jog mode of the Y axis with fast speed in negative direction:

1.) Press key (start)

DB axis code	=	‘Y’
DB command function	=	Jog
DB command code	=	Start
DB parameter valid	=	2h: Parameter 2 (fast or slow speed and direction)
DD parameter 1	=	0
DD parameter 2 HW	=	0
DD parameter 2 LW	=	1

2.) Release key (abort)

DB axis code	=	‘Y’
DB command function	=	Jog
DB command code	=	Abort
DB parameter valid	=	2h (is ignored by the PS)

11.3.8 "Handwheel / PS setpoint setting" command

A handwheel connected to an axis or the PS setpoint setting is activated by the command "Handwheel / PS setpoint setting".
Additional travel distances of different sources such as the user program itself or through the so-called "Fast functions" can be fed by the PS setpoint setting through the PS.
Dependence of x turns of the handwheel to the travel distance of the axis can be created by parameterizing the gear ratio x:y. The parameters have no meaning for the "Abort" and "Hold" commands and are ignored by the PS.

In the start command one can choose between three operating modes:

Mode 0: Only handwheel function. The handwheel cannot be operated parallel to the NC program.

Mode 1: Setpoint source can be a handwheel or a PS function. The mode 1 behaves compatible to mode 0.

Mode 2: The handwheel or the PS setpoint setting can be operated parallel to the NC program. Due to the additional travel distance during the program processing, a type of reference point offset is performed for the relevant axis. With the command code "Abort" this offset is cancelled and the setpoint source blocked. "Hold" is available as additional command code. In this order the setpoint source is blocked, but the reference point offset is retained.

The modes 0, 1 and 2 are differentiated by the parameter "DB parameter valid". Only the mode 0 is available for NC versions ≤ 2.06.

In the case of transformations the "Handwheel / PS setpoint setting" command is permitted only for machine axes.
The "Abort" command must not be given in the running NC program.

Command structure for mode 0:

DB axis code	=	Axis name	e.g. ‘X’, ‘Y’, ‘Z’, ‘A’,...
DB command function	=	Handwheel	
DB command code	=	Start / abort	
DB parameter valid	=	3	
DD parameter 1	=	x	Pulses per handwheel revolution (denominator)
DD parameter 2	=	y	y * 0.1mm/rev. (numerator)

Command structure for modes 1 and 2:

DB axis code	=	Axis name e.g. ‘X’, ‘Y’, ‘Z’, ‘A’,...
DB command function	=	Handwheel
DB command code	=	Start/abort/hold
DB parameter valid	=	7
DD parameter 1	=	x Pulses per handwheel revolution (denominator)
DD parameter 2	=	y y * 0.1mm/rev. (numerator)
DD parameter 3 LW	=	1 Mode compatible to mode 0
		2 Extended mode
DD parameter 3 HW	=	0 Source AZ user message 1
		1 Source AZ user message 2
		2 Source AZ user message 3
		3 Source AZ user message 4
		4 Source PS user setpoint source 1 [1])
		5 Source PS user setpoint source 2 [1])

[1]) see Section: 8.2 "PS setpoint value "

11.3.9 "NC-Reset" command

The NC system is brought back into its basic status with the **"NC Reset"** command and errors in the NC and in the drive system are reset. The following must be observed here:

- With drive errors (group ready on the AZ was withdrawn), NC RESET is permitted only with inactive converter on signal (UE) and inactive controller enable (RF). Otherwise NC RESET is aborted with error message.
- The NC can be reset only with active drives (drives in control) so that it goes back into the "READY" status.
- A **"NC Reset"** produces the following behaviour in the NC:
  - -Spindle stop
  - -Synchronous axes are switched off ➔ feed axes
  - -In kinematic transformations, transformation axes are switched active.
- The sequence of the NC RESET is displayed to the PS in the NC status bit NC_RESET (see Section 7.1.4). After performance this signal is reset and the signal NC_BRT (see Section 7.1.1) is set.
- In systems with kinematic transformation, the transformation axes (Cartesian axes) are always active after NC RESET.

DB axis code	=	0
DB command function	=	NC reset
DB command code	=	Start
DB parameter valid	=	0

11.3.10 "Log off control panel" command

With the "Log off control panel" command the FB is logged off as motion command giver by the NC. This must always occur if a second control panel (e.g. AB-110C) should have access to the motion functions of the NC.

DB axis code	=	0
DB command function	=	Log off control panel
DB command code	=	Start
DB parameter valid	=	0

11.3.11 "Referencing" command

In the "Referencing" command an axis is set anew onto the actual value system of coordinates. Here it must be noted that when commanding machine or transformation axes with a command, all transformation or all machine axes are set simultaneously. Continuous path axes are set individually.

DB axis code	=	Axis name e.g. ‘X’, ‘Y’, ‘Z’, ‘A’,...
DB command function	=	Referencing
DB command code	=	Start
DB parameter valid	=	0

11.4 FB 249 "NC influencing"

The **FB 249 "NC influencing"** is able to influence or to limit movement sequences of the NC. The following commands are available for this:

- -Writing the feed override
- -Writing the spindle override
- -Setting or resetting the spindle speed limit
- -Setting or resetting the movement influencing bits

11.4.1 Structure of the data block

The structure of the data block, which is required for selecting the FB "NC data manipulation" looks as follows:

Data double word (DD)	High word (DW)		Low word (DW)	
	High byte (DB)	Low byte (DB)	High byte (DB)	Low byte (DB)
0	Reserve	Reserve	Spindle number	Axis code
2	Parameter valid	Channel index	Command function	Command code
4	Parameter 1			

The meaning of the individual data bytes is defined as follows:

Axis code:	0	global
	1,2,..	Axis group number (see below)
Spindle number:	1,2	Spindle 1, 2 (if 2nd spindle is configured)
Channel index	0,1	0=Channel 1, 1=Channel 2
Command function:	1	Feed override
	2	Spindle override
	3	Spindle speed limit
	4	Movement influencing bits
Command code:	0	No commanding
	1	Start
	4	Continue
Parameter valid:	1	Data from parameter 1 valid

The individual bit information can be superimposed additively. The contents of the individual parameters are command-specific. All cells not used shall be filled with zero.

11.4.2 "Feed override" command

With the "Feed override" command a new speed in per thousand of the momentarily programmed speed is transferred to all feed axes.

DB axis code	=	0	
DB command function	=	Feed override	
DB parameter valid	=	1	
DD parameter 1	=	Override in [0.1%]	Value 0..1200

11.4.3 "Spindle override" command

With the "Spindle override" command, a new speed in per thousand of the speed valid at the time is transferred to a spindle.

DB axis code	=	0	
DB spindle number	=	Spindle number	1 or 2, if 2 spindles present
DB command function	=	Spindle override	
DB parameter valid	=	1	
DD parameter 1	=	Override [0.1%]	Value 0..1200

11.4.4 "Spindle speed limit" command

With the "Spindle speed limit" command the spindle speed can be limited to the parameter LIM_DRZ of the axis data block (file AX04n.MDS) (parameter = 1) or set back to the programmed value (parameter = 0). The activated speed limit is indicated in the NC status bit "LIM_DRZ" (see Section 7.2.2)

DB axis code	=	0
DB spindle number	=	Spindle number 1 or 2, if 2 spindles present
DB command function	=	Spindle speed limit
DB parameter valid	=	1
DD parameter 1	=	Parameter (0=off, 1=on)

11.4.5 "Movement influencing bits" command

Movement influencing bits can trigger the following functions in the NC:

Name	Bit code	Function	Axis gr.	NC status
FEEDHOLD	0001H *)	All interpolation axes are ramped down to speed 0.	0	see Section 7.1.6
EMERGENCY STOP	-	To be executed via bit see Section 8.1.3	-	
SINGLE BLOCK	0004H	Holding the NC program before the next block. Continuing with "Continue" command	0	
OPTIONAL HOLD	0008H	Holding the NC program at M01. Continuing with "Continue" command	0	
LIMFEED FEED LIMIT	0400H	Feed limit to parameterized value in the axis data block. Effect only in the next NC block.	0	see Section 7.1.7
CUT_NC_SATZ	1000H	"Cut" NC block of the stated axis group.	>0	
CUT_CONTINUE	2000H	Start next NC block after CUT_NC_SATZ. The CUT_NC_SATZ bit is deleted automatically. As long as axis is still not stationary, there is negative acknowledgement.	>0	

*) H = Hexadecimal code

The **attribute** decides whether the bits are set (=1) or deleted (= 0).
The **axis group number** has the following meaning:

0 - Command applies globally for all axis groups (continuous path+line motion)
1..n - Command applies only for the axis group with the stated number (axis group 1= continuous path, 2= line motion1, 3= line motion2,.. - if configured)

Commands in the table with axis group statement 0 always apply globally.
Commands in the table with axis group statement >0 **must** always be assigned to an axis group. Refer to the NC CONFIGURATION description regarding to term of axis group.

DB axis code/group	=	0,>0
DB command function	=	Movement influencing bits
DB command code	=	Start
DB parameter valid	=	1
DD parameter 1 HW	=	Attribute 0 (delete bit),1 (set bit)
DD parameter 1 LW	=	Bit code see table

Examples:

1.) DB for single block on

DB axis code / group	=	0	
DB command function	=	Movement influencing bits	
DB command code	=	Start	
DB parameter valid	=	1	
DD parameter 1 HW	=	1	Attribute "Set bits"
DD parameter 1 LW	=	0004	Single block bit combination

2.)DB for single block off

DB axis code / group	=	0	
DB command function	=	Movement influencing bits	
DB command code	=	Start	
DB parameter valid	=	1	
DD parameter 1 HW	=	0	Attribute "Delete bits"
DD parameter 1 LW	=	0004	Single block bit combination

11.4.5.1 Single block/optional hold sequence

With single block set, the program stops absolutely at the block end, with set optional hold conditionally (with programmed M01). To continue the NC program (starting the next NC block) the FB249 with the command function "Movement influencing bits" and the command code "Continue" must be selected. All other transfer parameters are ignored by the PS. The "Continue" command results in no change of influencing bits. It is also necessary if after holding the corresponding influencing bit is deleted.

Example of continuing after hold because of single block/optional hold (M01):

DB axis code / group	=	0	is ignored by the PS
DB command function	=	Movement influencing bits	
DB command code	=	Continue	

11.5 FB "NC parts program"

The FB "NC parts program" contains the following commands with which one can influence the register of a parts program.

- Write R parameters into parts program
- Read R parameters from parts program

The FB reads the required parts program (No. in the data block) from the data management of the NC and writes or reads the R parameters. For this purpose the parameters can stand at arbitrary places in the program. The first "found" parameter of the corresponding number is always used.

CAUTION !
- If a subprogram stands in the parts program before the main program, then the R parameters which stand in this part are already handled. The parts program is then transferred again to the data management of the NC.
- In the software version 2.02 and 2.03, the data block must be created for the full length of 63 parameters (corresponds to length of 256 words).

The data block for selecting the FB "NC parts program" has the following structure:

Data double word (DD)	High word (DW) High byte (DB)	High word (DW) Low byte (DB)	Low word (DW) High byte (DB)	Low word (DW) Low byte (DB)
0	Parts program number			
2	Number of parameters	Channel index	Command function	Reserve
4	Places after decimal point	Reserve	Parameter number	Reserve
6	Value 1			
8	Places after decimal point	Reserve	Parameter number	Reserve
10	Value 2			
248	Places after decimal point	Reserve	Parameter number	Reserve
250	Value 62			
252	Places after decimal point	Reserve	Parameter number	Reserve
254	Value 63			

The meaning of the individual data bytes is defined as follows:

Parts program number:	0 .. 99999999	
Command function:	1	Write R parameters in parts program
	2	Read R parameter from parts program
Number of parameters:	1 .. 63	
Places after decimal point n:	1..4	Statement of the places after decimal point of parameter n
Parameter number n:	1..255	Number of the required parameter
Value n:	-2147483648 .. 2147483647	Value range

The contents of the individual parameters are command-specific. All reserve cells shall be occupied with zero.

11.5.1 "Write R parameters in parts program" command

With the "Write R parameters in parts program" command, parameters of the NC programs can be changed. For this purpose the parts program number, the number of the parameters to be written (maximum 63), the parameter numbers, the places after the decimal point (maximum 4) and the contents (signed long = 32 bits) must be stated.

DD parts program number	=1...99999999
DB command function	=Write R parameters in parts program
DB number of parameter	=1..63
DB places after decimal point n	=0..4
DB R parameter number n	=1..255
DD value n	=R parameter contents of the stated number
DB places after decimal point n+1	=0..4
DB parameter number n+1	=1..255
DD value n+1	=R parameter contents of the stated number

11.5.2 "Read R parameters from parts program" command

With the "Read R parameters from parts program" command parameters of the NC programs can be read. For this purpose the parts program number, the number of the parameters to be read (maximum 63) and the parameter number must be stated. The contents and the places after the decimal point are written as return value in the data block to be transferred on selection.

DD parts program number	=1...99999999
DB command function	=Read R parameters from parts program
DB number of parameters	=1..63
DB parameter number n	=1..255
DB parameter number n+1	=1..255

11.6 FB "NC display"

The FB "NC display" is able to display the setpoint, actual values and status information of the individual axes of the NC system. The "NC display" command is available for this.

11.6.1 Structure of the data block

The data block for selecting the FB "NC display" has the following structure:

Data double word (DD)	High word (DW) High byte (DB)	High word (DW) Low byte (DB)	Low word (DW) High byte (DB)	Low word (DW) Low byte (DB)
0	Channel index	Axis code	Reserve	Command code
2 4 6 8 10	Data			
12	Reserve	Axis code	Reserve	Command code
14 16 18 20 22	Data			
142	Reserve	Axis code	Reserve	Command code
144 146 148 150 152	Data			

The meaning of the individual data bytes is defined as follows :

Axis code:		'X', 'Y', 'Z',... Axis name (ASCII code)'A' - 'Z'
Command code:	0	No commanding
	1	NC display

11.6.2 "NC display" command

With the "NC display" command the setpoint, actual and status values of a logical NC axis are displayed. The value generated by a superimposed movement of the handwheel or another user source is available as setpoint.
The contents of the individual data are defined as follows for this command.

Data double word (DD)	High word (DW)		Low word (DW)	
	High byte (DB)	Low byte (DB)	High byte (DB)	Low byte (DB)
2	Setpoint value			
4	Actual value			
6	Status			
8	Reserve			
10	Reserve			

The status is bit-coded and has the following meaning:

Bit 0 Axis is referenced
Bit 1 Axis is in position
Bit 2 Positive axis direction is blocked
Bit 3 Negative axis direction is blocked
Bit 4 .. 31 Reserve

12 Appendix

12.1 M function tables

The M functions tables stated here serve as configuring aid for the machine functions of a NC machine.

12.1.1 Fixed NC M functions

The following M numbers are assigned to fixed NC functions and may not be used in the following tables.

M No.	Synchr.	PS input	PS ack.	Meaning
M00	MvSSvS			Programmed hold
M01	MvSSvS			Optional hold
M02	MnSSnS			Main program end
M25	MoS			Parameter transfer from PS without synchronization
M26	MvSSvS			Axis group synchronization (continuous path and line motion)
M29	MnSSnS			Subprogram end
M30	MnSSnS			Main program end
M96	MvSSvS			Acceleration override
M111	MvSSvS			Acceleration override
M112	MvSSvS	E86.x/ E118.x	A86.x/ A118.x	Parameter transfer from PS with synchronization

12.2 Configured NC functions

The following M numbers are assigned to configurable NC functions and may not be used in the following tables.

M No.	Synchr.	PS input	PS ack.	Meaning
M03	MvSSvS			Spindle 1 positive rotation direction
M04	MvSSvS			Spindle 1 negative rotation direction
M05	MnSSnS			Spindle 1 hold
M13	MvSSvS			Spindle 2 positive rotation direction
M14	MvSSvS			Spindle 2 negative rotation direction
M15	MnSSnS			Spindle 2 hold
M17	MvSSvS			Setting speed limit for spindle 1 at V const
M18	MvSSvS			Selection of constant spindle 1 cutting speed
M19	MnSSnS			Spindle 1 positioning
M20	MvSSvS			Setting speed limit for spindle 2 at V const
M21	MvSSvS			Selection of constant spindle 2 cutting speed
M22	MnSSnS			Spindle 2 positioning
M27	MvSSvS			Synchronous axis of master 1
M28	MvSSvS			Synchronous axis of master 2

12.2.1 M functions MvSSvS (M before block synchronization before block)

M No.	Synchr.	PS input	PS ack.	Meaning
	MvSSvS	E64.0	A64.0	
	MvSSvS	E64.1	A64.1	
	MvSSvS	E64.2	A64.2	
	MvSSvS	E64.3	A64.3	
	MvSSvS	E64.4	A64.4	
	MvSSvS	E64.5	A64.5	
	MvSSvS	E64.6	A64.6	
	MvSSvS	E64.7	A64.7	
	MvSSvS	E65.0	A65.0	
	MvSSvS	E65.1	A65.1	
	MvSSvS	E65.2	A65.2	
	MvSSvS	E65.3	A65.3	
	MvSSvS	E65.4	A65.4	
	MvSSvS	E65.5	A65.5	
	MvSSvS	E65.6	A65.6	
	MvSSvS	E65.7	A65.7	

12.2.2 M functions MvSSnS (M before block synchronization after block)

M No.	Synchr.	PS input	PS ack.	Meaning
	MvSSnS	E66.0	A66.0	
	MvSSnS	E66.1	A66.1	
	MvSSnS	E66.2	A66.2	
	MvSSnS	E66.3	A66.3	
	MvSSnS	E66.4	A66.4	
	MvSSnS	E66.5	A66.5	
	MvSSnS	E66.6	A66.6	
	MvSSnS	E66.7	A66.7	
	MvSSnS	E67.0	A67.0	
	MvSSnS	E67.1	A67.1	
	MvSSnS	E67.2	A67.2	
	MvSSnS	E67.3	A67.3	
	MvSSnS	E67.4	A67.4	
	MvSSnS	E67.5	A67.5	
	MvSSnS	E67.6	A67.6	
	MvSSnS	E67.7	A67.7	

12.2.3 M functions MnSSnS (M after block synchronization after block)

M No.	Synchr.	PS input	PS ack.	Meaning
	MnSSnS	E68.0	A68.0	
	MnSSnS	E68.1	A68.1	
	MnSSnS	E68.2	A68.2	
	MnSSnS	E68.3	A68.3	
	MnSSnS	E68.4	A68.4	
	MnSSnS	E68.5	A68.5	
	MnSSnS	E68.6	A68.6	
	MnSSnS	E68.7	A68.7	
	MnSSnS	E69.0	A69.0	
	MnSSnS	E69.1	A69.1	
	MnSSnS	E69.2	A69.2	
	MnSSnS	E69.3	A69.3	
	MnSSnS	E69.4	A69.4	
	MnSSnS	E69.5	A69.5	
	MnSSnS	E69.6	A69.6	
	MnSSvS	E67.7	A69.7	

12.2.4 M functions MoS (M without synchronization)

M No.	Synchr.	PS input	PS ack.	Meaning
	MoS	E70.0	none	
	MoS	E70.1	none	
	MoS	E70.2	none	
	MoS	E70.3	none	
	MoS	E70.4	none	
	MoS	E70.5	none	
	MoS	E70.6	none	
	MoS	E70.7	none	
	MoS	E71.0	none	
	MoS	E71.1	none	
	MoS	E71.2	none	
	MoS	E71.3	none	
	MoS	E71.4	none	
	MoS	E71.5	none	
	MoS	E71.6	none	
	MoS	E71.7	none	

12.3 Global status

12.3.1 Global status NC

No.	Designation	Source	Meaning
G1.0	NC_BRT	NC	NC ready
G1.1	NCP_AKT	NC	NC program active
G1.2	IPO_AKT	NC	Interpolator active
G1.3	FEED_HOLD	NC	Feed hold status
G1.4	LIM_FEED	NC	Feed limit status
G1.5	LIM_DRZ	NC	Speed limit status
G1.6	NC_RESET	NC	Status transition at NC reset
G1.7	AX_QRF	NC	All config. axes in control
G2.0			
G2.1			
G2.2			
G2.3			
G2.4			
G2.5			
G2.6			
G2.7			
G3.0	AX_RFP	A76.0	Reference points of structure known
G3.1		A76.1	
G3.2		A76.2	
G3.3		A76.3	
G3.4		A76.4	
G3.5		A76.5	
G3.6		A76.6	(Example: Bad part)
G3.7		A76.7	(Example: Empty part)
G4.0		A77.0	
G4.1		A77.1	
G4.2		A77.2	
G4.3		A77.3	
G4.4		A77.4	
G4.5		A77.5	
G4.6		A77.6	
G4.7		A77.7	
G5.0		A78.0	
G5.1		A78.1	
G5.2		A78.2	
G5.3		A78.3	
G5.4		A78.4	
G5.5		A78.5	
G5.6		A78.6	
G5.7		A78.7	
G6.0		A79.0	
G6.1		A79.1	

No.	Designation	Source	Meaning
G6.2		A79.2	
G6.3		A79.3	
G6.4		A79.4	
G6.5		A79.5	
G6.6		A79.6	
G6.7		A79.7	

12.3.2 Control panel global status

No.	Designation	Source	Meaning
G1.0	AFB_NR_0	BDE	Structure number code 0..31
G1.1	AFB_NR_1	BDE	
G1.2	AFB_NR_2	BDE	
G1.3	AFB_NR_3	BDE	
G1.4	AFB_NR_4	BDE	
G1.5			
G1.6			
G1.7			
G2.0			
G2.1			
G2.2			
G2.3			
G2.4			
G2.5			
G2.6			
G2.7			
G3.0			
G3.1			
G3.2			
G3.3			
G3.4			
G3.5			
G3.6			
G3.7			
G4.0			
G4.1			
G4.2			
G4.3			
G4.4			
G4.5			
G4.6			
G4.7			
G5.0			
G5.1			
G5.2			
G5.3			
G5.4			

No.	Designation	Source	Meaning
G5.5			
G5.6			
G5.7			
G6.0			
G6.1			
G6.2			
G6.3			
G6.4			
G6.5			
G6.6			
G6.7			

12.3.3 M functions input (sda_mds)

Representing the input of acknowledgement mechanism and PS input assignment (offset) directly in the **M**achine **D**ata block (**MDS**) of the NC decoder or control data preparation module (**SDA**). These input masks may be used only in the basic configuration or in a change of the basic configuration. The NC interface offers a dialog menu for the M function definition by the user.

Allocating the acknowledgement mechanism:

The acknowledgement mechanism (QM) can be allocated to the selected M number (M) with the following numerical values and entered in the following table:

0 = not defined, or QM fixed in the NC
1 = MOS (M without synchronization)
2 = MvSSvS (M output before block, synchronization before block)
4 = MvSSnS (M output before block, synchronization after block)
8 = MnSSnS (M output after block, synchronization after block)

M:QM	M:QM	M:QM	M:QM	M:QM	M:QM	M:QM	M:QM	M:QM	M:QM	M:QM	M:QM
0:0	1:0	2:0	3:2	4:2	5:8	6:	7:	8:	9:	10:	11:
12:	13:	14:	15:	16:	17:	18:	19:	20:	21:	22:	23:
24:	25:	26:	27:	28:2	29:0	30:	31:	32:	33:	34:	35:
36:	37:	38:	39:	40:	41:	42:	43:	44:	45:	46:	47:
48:	49:	50:	51:	52:	53:	54:	55:	56:	57:	58:	59:
60:	61:	62:	63:	64:	65:	66:	67:	68:	69:	70:	71:
72:	73:	74:	75:	76:	77:	78:	79:	80:	81:	82:	83:
84:	85:	86:	87:	88:	89:	90:	91:	92:	93:	94:	95:
96:	97:	98:	99:								

Assignment of the offset to PS input image:

The selected M number can be assigned to the corresponding PS input image via the following offsets. The associated QM is linked permanently with the offset and must be entered correspondingly in the above table.

Offset	PS input image	Acknowledgement mechanism
-1	M function not defined for PS	0 (not defined)
32..47	E64.0..E65.7	2 (MvSSvS)
48..63	E66.0..E67.7	4 (MvSSnS)
64..79	E68.0..E69.7	8 (MnSSnS)
80..95	E70.0..E71.7	1 (MoS)

Entry of the offset in SDA table:

M:O	M:O	M:O	M:O	M:O	M:O	M:O	M:O
0:-1	1:-1	2:-1	3:	4:	5:	6:	7:
8:	9:	10:	11:	12:	13:	14:	15:
16:	17:	18:	19:	20:	21:	22:	23:
24:	25:	26:	27:	28:	29:-1	30:	31:
32:	33:	34:	35:	36:	37:	38:	39:
40:	41:	42:	43:	44:	45:	46:	47:
48:	49:	50:	51:	52:	53:	54:	55:
56:	57:	58:	59:	60:	61:	62:	63:
64:	65:	66:	67:	68:	69:	70:	71:
72:	73:	74:	75:	76:	77:	78:	79:
80:	81:	82:	83:	84:	85:	86:	87:
88:	89:	90:	91:	92:	93:	94:	95:
96:	97:	98:	99:				

13 Impressum

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- System configuration and application
- Description of problem and presumed cause of failure
- Diagnostic message (error code)

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