Delem

**MACHINE PARAMETERS
MANUAL**

DA-65 (V7)
DA-69 (V7)
DA-68PL (V7)
DA on Windows (V1)

GENERAL INTRODUCTION

In this machine parameter manual you find the explanation on:

- the input and output signals (X- and Y-axis and general);
- the selection possibilities of the machine parameter menu;
- the value and function of the machine parameters of the X- and Y-axis;
- the auxiliary axes with corresponding parameters.

The first chapter describes the function of the general input and output signals and the input and output signals of the X- and Y-axis and in what way these signals should be connected to the axis module. A DA-60 series control with a DM02 gives the basic machine configuration.

The High Speed Bus (HSB) takes care of the communication between the control and the modules. Via this HSB line the modules are programmed with the appropriate machine parameter values to control the axes. The programmed values of the axes are compared with the actual axes positions and the machine parameter settings. If the 'new' values are within the range the 'new' values become the actual values.
The machine parameters (including all axis parameters) are programmed in the machine parameter menu of the control. Besides the programming of the machine parameters you have several other selection possibilities in this machine parameter menu. These selection possibilities are explained in chapter 2.

The basic machine parameters are to control the Y-axis. In chapter 3 these machine parameters are explained. The explanation comprises the parameter range, the default value, the parameter function and a description.

From chapter 4 until chapter 10 the parameters of the auxiliary axes and special functions are given. The auxiliary axes are grouped per type of axis. The next type of axes and special functions are explained:
- auxiliary axes (chapter 4);
- axes types and parameters (chapter 5);
- crowning (chapter 6);
- digital outputs (chapter 7);
- I-axes (chapter 8);
- part support (chapter 9);
- sensor machine parameters (chapter 10, not yet implemented).

This manual is valid for the following Delem control types:
- DA-65 (V7)
- DA-69 (V7)
- DA-68PL (V7)
- DA on Windows (V1)

Delem

MACHINE PARAMETERS MANUAL
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1 Input and output signals

1.1 Introduction

All input and output signals are indicated with LED's on the front panel of the I/O modules. When an input or output signal is active, the corresponding LED is on. There are three kinds of signals: Y-axis signals, X-axis signals and general signals. In the next sections of this chapter these input and output signals are explained.

There is a strong relation between the Y-axis signals. This relation has been laid down in the timing diagram of the press cycle.

The timing diagram of the CNC-RDY signal has also been included. The numerical control ready signal indicates that the active bend program can be executed. The CNC-RDY signal depends on the status of start button, the position of the Y-axis and the position of the X-axis.

1.2 Y-axis input signals

Symbol   **Function**

↑   Opening command. This input must be active when the beam has to move in the opening direction (Y-axis status 6).

↓   Pressing command. This input must be active to move the press beam during the pressing phase (Y-axis status 3). This input must also stay active during the holding time (dwell time) at bend position and during decompression (Y-axis status 4 and 5).

↓↓   Fast closing command. This input must be active when the beam has to move with high speed in the closing direction (Y-axis status 2).

               Manual. This input must be active when the beam must be moved manually with the handwheel. This is only possible when the control is in Manual mode and the beam is below the mute position. When this input is active this is displayed with the text 'adjust' in the lower right corner of the control screen.

=   Parallelism switch input. See description of Y-axis machine parameter 'parallelism switch'.

1.3   Y-axis output signals

Symbol   Function

    ⊤   Upper dead point. This output is active when the beam is at the programmed upper dead point or higher.

ER   End of decompression. This output becomes active after the beam has reached the bending position, the holding time has elapsed and the decompression distance is completed. It goes low again (inactive) when the opening input (↑) becomes active.

    Mute output. This output becomes active when the beam reached the muting point. This output stays active as long as the beam is below the mute position.

    CNC-started. This output is active when the start button on the DA-control is pressed.

    Special mute output / 2nd mute (for servo hydraulics). An optional mute output can be used to obtain that the beam will stop more accurate at the muting point. This feature can be useful when using servo hydraulics. The optional mute output will be active from a certain distance before the actual muting point.
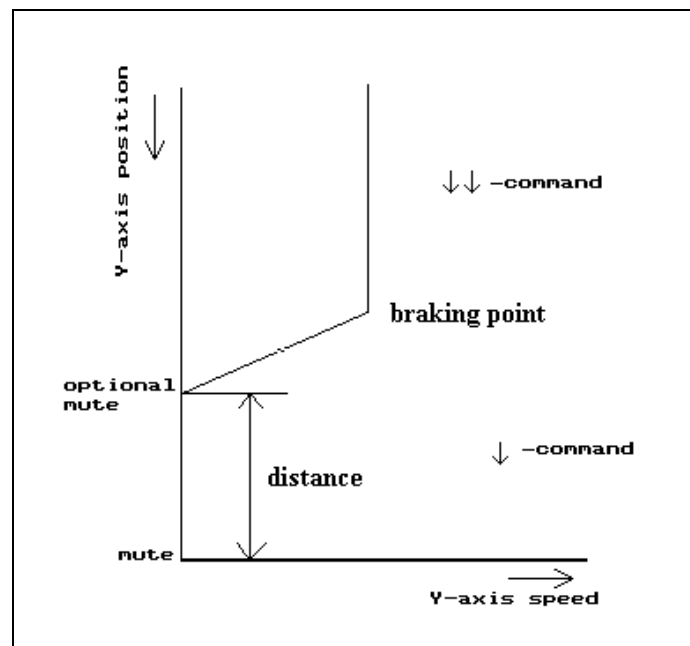
Figure 1.3.a

The braking ramp for stopping at the optional muting point is computed automatically by the control. The distance between the two muting points is fixed in the software. This value can only be changed by Delem on request. The default value is 0 mm. This means that the two mute outputs become active at the same time.
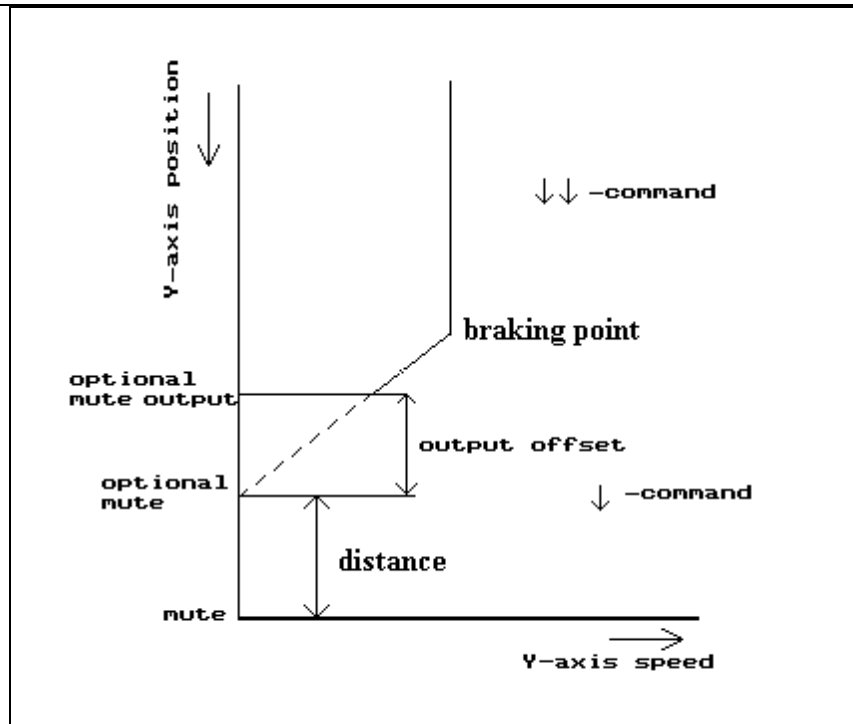
Figure 1.3.b

The point at which the optional mute output becomes active can also be shifted with an offset. This offset does not shift the computed braking point. Just like the distance between the two muting points this offset can only be changed by Delem on request. The default setting is 0.

Clamping (pinching) point output. This output becomes active when the beam reaches the clamping (pinching) point and stays active as long as the beam is below the clamping point.

Lower dead point output. This output becomes active at the end position of the press beam. This output is active during Y-axis status 4.

1.4 X-axis signals

Symbol Function

R-in R-axis positive input. This input must be active (+24V) to have the X-axis moving within the safety zone of the applied die. Otherwise the X-axis will not move within this zone and as a result the CNC-RDY output will never become active!
When the R-axis is negative and the R-in input is active, the R-axis will first move to a positive position before the X-axis will move to a position within the safety zone.
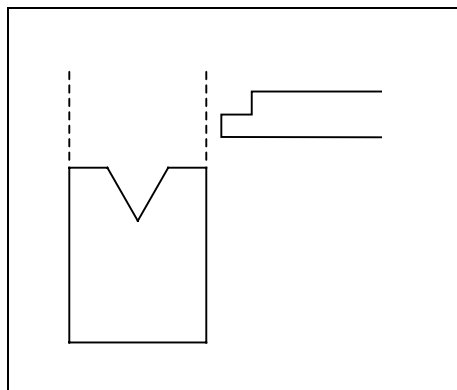
Figure 1.4.a

1.5 Axis signals

Symbol Function

INPOS This output is active when the actual position value of the axis is within the in position tolerance range of the programmed position. This in position tolerance range can be set with the machine parameter 'In position tolerance' (parameter 12).

START Input for an axis module, to signal that equipment is ready and the module can start positioning the axis. Can be used to monitor 'ready' signal from a motor drive.

RSD For taking the reference marker from the encoder you must connect this input to the reference search direction switch. The reference search cycle is then as described at the machine parameter 17 (RSD-switch). Usually the RSD input is taken from the End Of Travel switch.

When you use an RSD-switch for reference search the motor drive does not need any direction sensitive enable/disable input for reference search. You are also free to place this switch anywhere you want. You can also combine the RSD-switch with one of the EOT switches.

Overall you could have a shorter reference search cycle time. Another advantage is that it is not necessary to mount limit switches for reference search.

1.6 Various input and output signals

	Pump started.	This input must be active to be able to press the start button on the DA-control. When this input is not active the start button will not be accepted and the control will display the message **machine not started**.
T	Tandem input.	Tandem input for tandem or robot applications. See description of parameter 10 of the Y-axis parameters menu. For robot applications ask for the special robot function manual.
C	Cycle input.	This input can be used to realise an external step change. This is done by programming the program specific CX-code parameter in the programs.
	CNC-START.	The start command for the control. This output can only be active (start button on control) when the pump start input is active.

FUNCTION OUTPUTS

F1, F2, F3, F4 are general purpose outputs. When you use a motorized deflection unit then output F3 is standardly used for 'A<' and output F4 for 'A>'. In this case you also have to connect the motorized deflection potentiometer between 'REF', '0V' and 'AI1'

CNC-RDY

Numerical control ready. This output is always <u>off</u> when the DA control is in the stop-mode (direct after power on, or after pressing the stop button). This output can only become active when the control is in:

- the manual mode. The start button is pressed <u>and</u> the X-axis is at the programmed position.
- the automatic mode or step-by-step mode. The following conditions must be present:
  - the start button has been pressed <u>and</u>
  - the X-axis is at the programmed position <u>and</u>
  - the press beam is in the upper dead point position.

When these conditions have been answered the CNC-RDY cycle results from the timing diagram.

| OK | Module initialisation ready. | Output signal from a module, to indicate that the module is properly initialised and is ready for action. Can be used as enable signal to e.g. a motordrive. |

Y-AXIS STATUS

| 1= NO COMMAND | 2= FAST CLOSING | 3= PRESSING | 4= DWELL TIME | 5= DECOMPRESSION | 6= FAST OPENING | 1= NO COMMAND |

START BUTTON PRESSED — YES / NO

1

OUTPUT — ON / OFF

X-AXIS AT PROGRAMMED POSITION — YES / NO

NC-RDY OUTPUT — ON / OFF

RETRACT

BEND CHANGE

2   3   4   5   6   7   8   9

NC-RDY off while X-axis moves to retract position
is not default situation, but an option
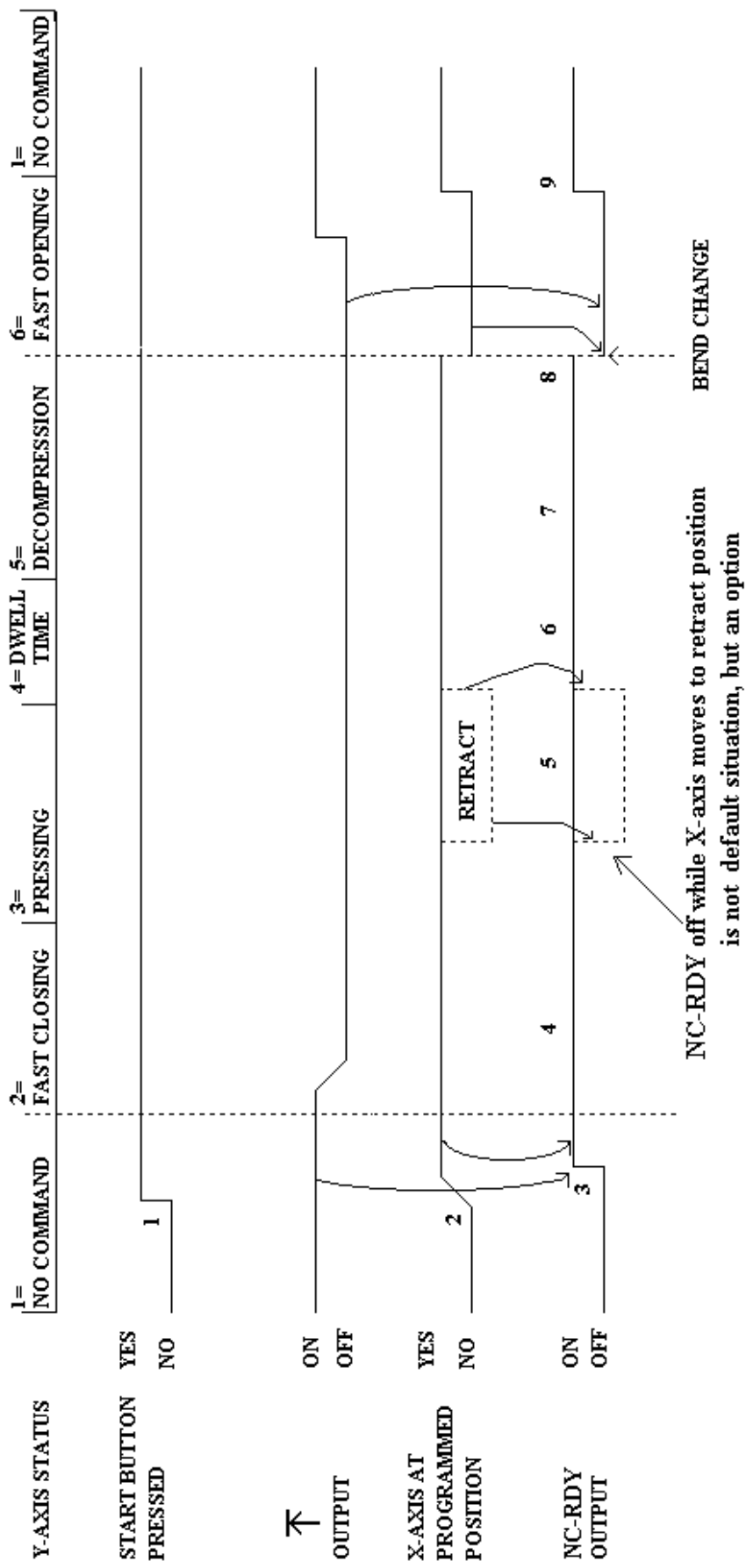
Explanation of CNC-RDY timing diagram
- Y-axis status. The Y-axis status is the number of the Y-axis control program, which depends on the Y-axis command inputs. The number is shown on the service row (when activated) in the header of the screen.

- Upper dead point. Y-axis output indicating that press beam is in the upper dead point position.

- X-axis at programmed position. This line shows the actual X-axis position. This is the same as the programmed position.

The start button must be pressed (1). When in this case the press beam is in the upper dead point (output active) <u>and</u> the X-axis reaches the programmed position (2) the CNC-RDY output becomes active (3). The CNC-RDY output stays active during fast closing of the press beam (4), pressing (5) (when no X-axis retraction is programmed), dwell time (6) and decompression (7). The CNC-RDY becomes <u>inactive</u> after decompression of the beam (ER output active) at the step change position where the X-axis moves to the next programmed position. Depending on the X-axis code this can take place at:
- end of decompression;
- mute (passed in opening direction);
- upper dead point.

The CNC-RDY signal becomes active again (9) when the X-axis is at its programmed position <u>and</u> the Y-axis is in the upper dead point.

CNC-RDY signal during pressing with retraction programmed
There are two situations during pressing <u>with rectraction</u> programmed (point 5 of CNC-RDY cyclus).
- The press beam does not wait at the pinching point for X-axis retraction to complete (X-axis code < 10). The CNC-RDY output stays active while the X-axis moves to the retract position.
- The press beam stops at the pinching point and waits until X-axis retraction is completed (X-axis code > 10). The CNC-RDY output stays active while the X-axis is moving to the retract position. The press beam moves again when the X-axis has reached the retract position.

There is also a third situation, but this is an option.
- The press beam stops at the pinching point and waits until the X-axis rectraction has been completed (X-axis code > 10). The CNC-RDY output is **off** while the X-axis is moving to the retract position. The CNC-RDY output becomes active again when the X-axis has reached the retract position.

IN : Pump Start

OUT : CNC Start

UDP

Y-AxisPosition

Mute

Pinching
Bending

Holding Time

End of decompression

Pressure

Max

Programmed pressure

Opening pressure

0

Status Number

| 1 | 2 | 3 | 4 | 5 | 6 | 1 |

OUTPUTS

UDP

Mute

Pinching

LDP

End of decompression   ER

INPUTS

Fast Closing

Pressing

Opening

Note :

A : Pressure during closing is value in EPROM.
(Only with differential hydraulics)

B : Upper dead point ramp is EPROM preset.

C : ER output goes inactive when opening command is ON.

D : Opening speed ramp is EPROM preset.

E : The opening speed of the Y-axis at first time start-up
is limited to a maximum of 125 $^{mm}/_s$ or to the value
of the parameter opening speed (parameter 34) if
the value of thes parameter is lower than 125 $^{mm}/_s$

20
59
Refers to machine parameter number at which point
in the press cycle it is active

Note 1 : Leave unconnected pins open.

Note 2 : Cut off yellow/brown wire (0-10V P) if cable DK-02VSW/VA-HBG-1.0 is used.

Note 3 : Diodes across valves (D) must be a BYV36E (Philips) or equivalent for currents 0-800mA or a BYM36E (Philips) or equivalent for currents 0-1500mA.

Note 4 : * = 1.5 Ampere over all outputs. Maximum of 9 Ampere over all outputs

Note 5 : 24V relais supply must be separated from 24V supply

T	=	Tandem
CNC-RDY	=	CNC-ReaDY signal
C	=	step Change
R-in	=	R axis positive input
RSD	=	Reference Search Direction switch
UDP	=	Upper Dead Point
ER	=	End of Relaxation
LDP	=	Lower Dead Point
X - I P	=	X-axis In Position
F1,2,3,4	=	Function output 1,2,3,4

24V relais — COM — OUT

INPUT/OUTPUT

galvanic insulation
9+7+9 Pole Male connectors

galvanic insulation

0V relais — COM — IN

OUT		
14	PUMP	
15	FAST CLOSING	
16	OPENING	
17	PRESSING	
18	MANUAL	
19	PARALLEL	
20	RSD-X	
21	T	
22	C	
23	R-in	

INPUT

IN		
13	F4	A< A>
12	F3	
11	F2	
10	F1	
9	CNC-RDY	
8	X-IP	
7	LDP	
*6	CLAMP	
*5	2 nd MUTE	
*4	CNC START	
*3	MUTE	
*2	ER	
*1	UDP	

OUTPUT

In case motorized deflection is used

In case motorized Deflection unit is used

Potentiometer 10K

4-Pole Male connector

REF	AI1	0	AI2
10V	0-10V	0V	0-10V

P I · P II

Y2-Encoder Input — 12-Pole Connector — MALE

Linear Scale Y2

Valve Y2

A Y2	16	S2 D
0V Y2	17	S1 D
B Y2	15	
LVDT Y2	21	LVDT Y2
0VT Y2	20	
24V Y2	14	

System Pressure

0V P	25	
0-1.5A P	12	0-1500mA
24V P	13	

Valve Y1

A Y1	3	S2 D
0V Y1	4	S1 D
B Y1	2	
LVDT Y1	11	LVDT Y1
0VT Y1	10	
24V Y1	1	

Linear Scale Y1

Pressure
25-Pole Female connector
Pen 5-7,10-11,18-19,22-24
of 25-Pole connector
are not connected

X-Encoder Input — 9-Pole Connector — MALE

In case hydraulic Deflection unit is used

DF-OUT — 0-10V — 0V — Amplifier

X-OUT — +/-10V — 0V — Servo Amplifier — E / M

6-Pole Male connector

SUPPLY — 0V — 24V — 230V/400V

DM02

DA6X

HSB — H — L

HSB — H — L

Shunt 120E

H — T — L

GND 24V 0V

24V 0V

Y1-Encoder Input — 12-Pole Connector — MALE

In case 12VSE bridge pins 6,7,8 and 9

ENCODER IN 12 POLE	5VSE	5VDE	ENCODER IN 9 POLE	5VSE	5VDE	12VSE	5VSE	5VDE
1	$\overline{T2}$ (B)	/	$\overline{T2}$	1	/	T0 (REF)	T0	T0
2	+5V	/	(+5V)	2	/	$\overline{T2}$ (B)	T2	T2
3	T0 (REF)	T0	$\overline{T0}$	3	T0	T1 (A)	T1	T1
4	$\overline{T0}$ (REF)	/	T0	4	/	+12V		
5	T1 (A)	/	T1	5	/	GND	GND	GND
6	$\overline{T1}$ (A)	T1	$\overline{T1}$	6	T1	$\overline{T0}$ (REF)	$\overline{T0}$	$\overline{T0}$
7		T2	T2	7	T2	$\overline{T2}$ (B)	$\overline{T2}$	$\overline{T2}$
8	GND	shield	shield	8	shield	$\overline{T1}$ (B)	$\overline{T1}$	$\overline{T1}$
9	GND	GND	GND	9	GND	+ 5V	+5V	+5V
10	GND	(GND)	(GND)					
11								
12	+ 5V	+5V	+5V					

Note 1 : Leave unconnected pins open.

Note 2 : Cut off blue/red wire (0-10V P) if cable DK-02VSW/VA-BSH-1.0 is used.

Note 3 : Diodes across valves (D) must be a BYV36E (Philips) or equivalent for currents 0-800mA or a BYM36E (Philips) or equivalent for currents 0-1500mA.

Note 4 : * = 1.5 Ampere outputs. Maximum of 9 Ampere over all outputs

Note 5 : 24V relais supply must be separated from 24V supply

T	= Tandem
CNC-RDY	= CNC-ReaDY signal
C	= step Change
R-in	= R axis positive input
RSD	= Reference Search Direction switch
UDP	= Upper Dead Point
ER	= End of Relaxation
LDP	= Lower Dead Point
X - I P	= X-axis In Position
F1,2,3,4	= Function output 1,2,3,4

INPUT

PUMP · FAST CLOSING · OPENING · PRESSING · MANUAL · PARALLEL · RSD-X · T · C · R-in

OUTPUT

F4 · F3 · F2 · F1 · CNC-RDY · X-IP · LDP · CLAMP · 2 nd MUTE · CNC START · MUTE · ER · UDP

galvanic insulation
9+7+9 Pole Male connectors

galvanic insulation

In case motorized deflection is used

In case motorized Deflection unit is used

Potentiometer 10K

REF AI1 0 AI2
0-10V · 0V · 0-10V · 10V

4-Pole Male connector

P I · P II

Linear Scale Y2 · AMPLIFIER · Valve Y2
0V Y2 17 · +/- 10V Y2+ 19 · 0V Y2- 18 · 24V Y2 14

Y2-Encoder Input · 12-Pole Connector · MALE

System Pressure
Pressure 25-Pole Female connector
0V P 25 · PC 12 · 24V P 13
0-1500mA
Pen 2-3,5,8-11,15-16,20-24 of 25-Pole connector are not connected

Linear Scale Y1 · AMPLIFIER · Valve Y1
0V Y1 4 · +/- 10V Y1+ 7 · 0V Y1- 6 · 24V Y1 9

Y1-Encoder Input · 12-Pole Connector · MALE

DM02

X-Encoder Input · 9-Pole Connector · MALE

In case hydraulic Deflection unit is used
DF-OUT · 0-10V · 0V · Amplifier

X-OUT · +/-10V · 0V · Servo Amplifier · E · M

SUPPLY · 0V · 24V · 230/400V

DA6X

HSB · H L · Shunt 120E

24V 0V · GND 24V 0V · 24V 0V

ENCODER IN 12 POLE		5VSE	5VDE
1	T2(B)	/	T2
2	+5V	/	(+5V)
3	T0(REF)	T0	T0
4	T0(REF)	/	T0
5	T1(A)	/	T1
6	T1(A)	/	T1
7	T2(B)	T2	T2
8	T2(B)	/	/
9	GND	shield	shield
10	GND	GND	GND
11	GND	(GND)	(GND)
12	+5V	+5V	+5V

ENCODER IN 9 POLE		12VSE	5VSE	5VDE
1	T0 (REF)	T0	T0	T0
2	T2 (B)	T2	T2	T2
3	T1 (A)	T1	T1	T1
4	+12V	+12V		
5	GND	GND	GND	GND
6	T0 (REF)			T0
7	T2 (B)			T2
8	T1 (A)			T1
9	+5V		+ 5V	+ 5V

In case of 12VSE bridge pins 6,7,8 and 9

2 Machine parameters menu

2.1 Introduction

In this chapter the selection possibilities of the machine parameters menu are explained. The next selection possibilities are discussed:
- selection procedure machine parameters menu (section 2.2);
- a brief introduction on the Y-axis and general parameters (section 2.3);
- a brief introduction on the auxiliary axes (section 2.4);
- notes about module configuration and module software (section 2.5);
- update control procedure (section 2.6);
- machine parameters backup procedure (section 2.7);
- changing the menu name (section 2.8);
- changing the access code (section 2.9);
- enabling and disabling options (section 2.10).

2.2 Selection procedure of machine parameters menu

The selection procedure of the machine parameters menu is the same for each type of control of the DA-60 series.

Do the following to get access to the machine parameter menu:

1. Select the programming mode.

2. Enter 19 to select the machine parameter menu.

3. Enter the access code.
   The default access code is 14753 for changing a basic set of machine parameters. The machine parameters followed by (2) can not be changed with this code. When you want to change all the machine parameters you require the special factory code. This code may only be used by authorised people.

4. Press the enter key.

In the machine parameter main menu you also find the versions of the current KO-table and the sequencer file. For detailed information upon the KO-table and Sequencer file version please contact Delem.

In figure 2.2.a you see the main machine parameter menu of the control.

```
MACHINE CONSTANTS                    KO-207 Version:  31
                                     Sequencer file version :   0
_____

                    Y-axis and general parameters..: 1

                    Auxiliary axis.................: 2

                    Module configuration...........: 3

                    Update controller.............: 4

                    Machine parameter backup.......: 5

                    Change menu name...............: 6

                    Change access code.............: 7

                    Options........................: 8



enter number: =  0                                           19.0
```
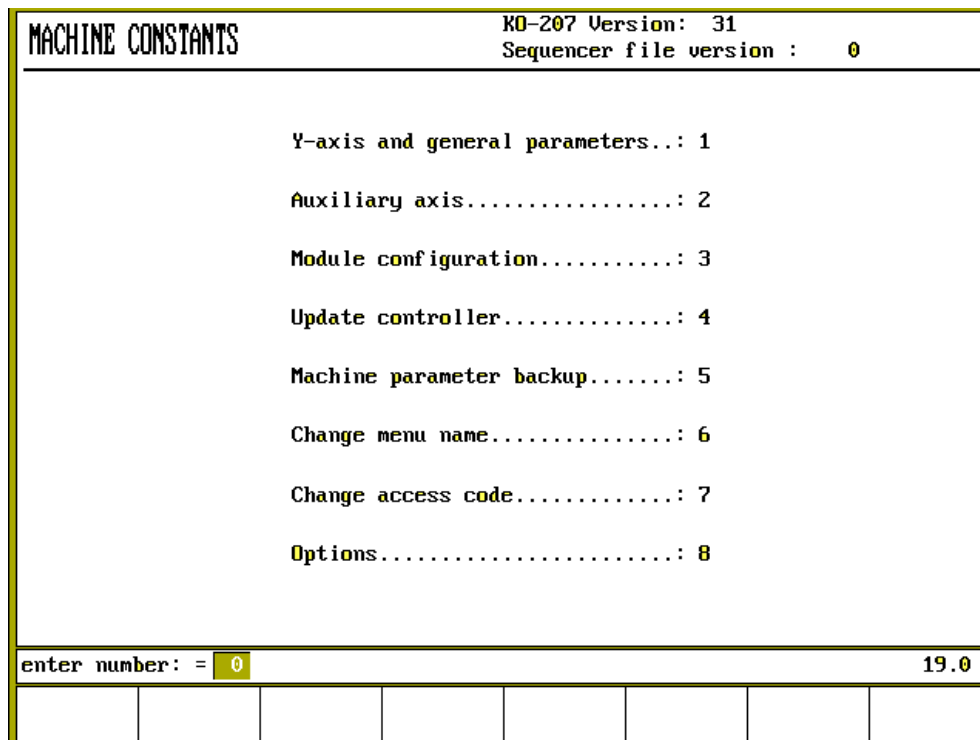
Figure 2.2.a

2.3   Y-axis and general parameters

Behind this selection possibility you find the basic machine parameters to control the Y-axis.
This menu also includes the parameters to program the press brake specifications, such as
dimensions. See also section 2.7 for parameters backup and chapter 3 for full explanation upon
the parameters.

2.4   Auxiliary Axes

Per type of control you can activate a number of auxiliary axes. An auxiliary axis is not active
when it is disabled in the axes menu. The required function of an auxiliary axis is determined by
the combination of 'axis type' and 'drive type'. Not all combinations are permitted.

Based on the allowed combinations the chapters 4 until 9 have been defined. In these chapters
you find explanation on the parameters in more detail. In this section some attention points are
mentioned with respect to:
• configuration and enabling auxiliary axes;
• the use of 'dummy axes';
• using an input/output module.

Configuration of axes
To install an axis, two steps must be taken:
1. the module must be selected through menu 3: 'module configuration'. See the next paragraph.
2. the intended axis must be selected through menu 2: 'auxiliary axis'.

'Dummy axis'
There is a situation in which you have to use the auxiliary menu, but you do not have a 'real' axis to control: a so-called 'dummy axis'.
For example, you have a mechanical Z-axis. The control can not automatically control that axis, but you still want the control to calculate the Z-axis positions. In this case you can simulate a Z-axis. The control calculates the positions and you can manually adjust your Z-axis.
To do so, enable an axis and select 'No control' in the axis menu. For such a dummy axis, there is no need to configure a module.

Using an I/O module
For some applications it is only necessary to have extra I/O's and you do not want to control an axis. These extra I/O's can be supplied by a DM04. To add a DM04 to your configuration you can follow the standard procedure of module configuration and selecting an axis in the auxiliary axis menu. Choose the axis type 'IO'.
As the DM04 does not control an axis, no parameters are displayed in the user menus of the programming mode and the execution modes.

2.5   Module configuration

This function serves to select the connected modules in the system and assign the proper axes to those modules.
Chapter 4 contains a detailed description of axis configuration. This should be done first, because otherwise no axis can be controlled.

Futhermore, A new software version for the modules can be loaded directly from floppy disk via the control. Obtain from DELEM a floppy disk with the latest module software. When in the menu 'module configuration' do the following steps:
Step 1: Press the softkey 'update software'.
Step 2: The control checks the files on floppy. When the files have been read the files are displayed on the control screen. An example of this screen:

FILES AVAILABLE ON FLOPPY
DM05   V2.2

MODULE	ID	Boot	Flash
DM05	200766	V1.2	V1.8

Step 3:   Check whether the version numbers of the files on floppy have correct version number.

Step 4: Select with the cursors keys the module you want to upgrade and press S1. Or press S2 to upgrade all the modules at once.
Step 5: The control displays the message 'are you sure 1/0'. Press 1 to confirm.
Step 6: The upgrading process starts. When the upgrading process has been finished the message appears 'update successful'.

Illegal DM application
When for some reason illegal DM application software is present in one of the DM modules (meaning you cannot work with the module) then you have to follow the next procedure:
Step 1: Put a floppy with the application file in the disk drive.
Step 2: Go to the machine parameters menu and go to the update screen.
Step 3: Reset the modules by removing and connecting the power supply of the modules.
Step 4: Select the module to be upgraded and press S1 'update module'.

Causes of possible illegal DM application software in the DM module are:
• Switching off the power supply while upgrading the software.
• Corrupted file with a correct checksum.

2.6   Update control

A new software version for the controls can be loaded directly from floppy disk.

When you load a new software version you also load the language files. Every application floppy contains 12 european and 4 asian languages. Which language files are really loaded, depends on the copy commands in the appl.cmd file. You find this file on the application disk. The following subjects are discussed in this section:

- update control;
- emergency procedure software installation;
- the files on the application floppy;
- loading language sets (european, asian).

Update control procedure

Step 1:   Obtain from DELEM a floppy disk with the latest control (application) software.
Step 2:   Turn the power of the control ON.
Step 3:   Put the floppydisk in the diskdrive of your control.
Step 4:   Go to the machine parameter menu (menu 19).
Step 5:   Enter the access code 14753. The main screen of the machine parameter menu appears.
Step 6:   Select '4' in the machine parameter menu. The next screen appears.

```
UPDATE SOFTWARE
┌─────────────────────────────────────────────────────┐
│              BACKUP CURRENT SOFTWARE                 │
│ Before updating your software it is strongly recommended to use the │
│ S1 key to create a backup. This gives you the ability to recover     │
│ your current software version in case of a malfunction. You need a   │
│ floppy disk for this option. This will take approximately 3 minutes. │
│ WARNING : don't use the floppy with your new software update for this ! │
└─────────────────────────────────────────────────────┘

┌─────────────────────────────────────────────────────┐
│                  UPDATE SOFTWARE                     │
│ A new software version can be installed by using the S2 key. After the │
│ floppy disk with the new software is inserted a check will be performed │
│ on this software version. If this check is successfully finished your   │
│ controller will start loading the new software. This will take          │
│ approximately 7 minutes.                                                │
└─────────────────────────────────────────────────────┘
                                              19.1
  create  | update   |   |   |   |   |   |
  backup  | software |   |   |   |   |   |
```

Figure 2.6.a

Make a backup of the current control software with 'create backup'. It is very important to create a backup, because the new software overwrites the current software. Without a backup you might loose valuable information.

Note
When loading a new software version the new software is checked first. If the size of the files on the floppy is **not** correct, the message appears: ** new software too large for memory **.

Note
Starting the control after the update procedure results in the following message:
** parameters in manual mode have been set to initial values **.
This means that the programmed data in the manual mode are lost. This also includes that the previous selected program in the auto mode is not active anymore.

Emergency procedure software installation

In case the above described procedure for updating the control software did not succeed, you can always install the new software following the next procedure. The main difference is that there is no check and there is no backup created.

Step 1: Put the floppy disk in the diskdrive of your control.

Step 2: Switch the power OFF.

Step 3: Switch the power ON.

Step 4: Press '7' immediately after switching the control on. Software is automatically loaded.

The files on the application floppydisk

APPL.CMD	Installation batch file. Contains information for the control how to install the files that are included in this file. You can easily edit this file with a DOS-editor or ASCII-editor.
D*.A00	Application program file: Contains the application for the control.
KO-NNN.BIN	KO-table file (the number NNN differs for each machine supplier). Contains the specification for the unique parameters of the machine. For example: type of hydraulic valve.
PRESS.DEF	Text file with text definitions of the numbers in the sequencer file. Contains definition macro's for use in sequencer source.
SEQ_INP.TXT	Sequencer file: Contains information on the mapping of the internal I/O of the control to the outside I/O (PLC-functionality).
TXT_NNN.BIN	Language text file (for each language a separate file): Contains the text strings of the menus of the control per language. For example: NNN = GB than the language file is english, NNN = I than the language file is italian, etc.

Loading languages

The floppy with the control application contains language text files. There are 16 different languages available: 12 european languages and 4 asian languages. These languages can be divided in two language sets. The european language set contains:

- TXT_GB.BIN (english, compulsory)
- TXT_DK.BIN (danish)
- TXT_D.BIN (german)
- TXT_F.BIN (french)
- TXT_I.BIN (italian)
- TXT_NL.BIN (dutch)
- TXT_S.BIN (swedish)
- TXT_CS.BIN (czech, slovak)
- TXT_ESP.BIN (spanish)
- TXT_FI.BIN (finnish)
- TXT_PL.BIN (polish)
- TXT_LI.BIN (lithuanian)

The asian language set contains:

- TXT_GB.BIN (english, compulsory)
- TXT_CHI.BIN (chinese)
- TXT_CHT.BIN (chinese traditional)
- TXT_JAP.BIN (japanese)
- TXT_KO.BIN (korean)

To load a language the file "appl.cmd" must contain the following command:
COPY A:\TXT_NNN.BIN C:\TXT_NNN.BIN
This command is necessary for each language you want to load.

When you want to load one or more asian languages, you must also add the following command:
COPY A:\ASIA.IMG C:\ASIA.IMG. This file is necessary to load the special asian character font.

You can add these strings to the appl.cmd file using a DOS-editor.
- Type the command 'EDIT APPL.CMD' behind the DOS-prompt.
- Add the required language files (and the asia.img file, if necessary).
- Save the changes.
- Load the application.

It is possible to load all language files at once, but this is not recommended. When you load all languages you occupy too much memory. It is advised to load the european set (default situation) **or** the asian set.

Possible problems

- There are no text string on the screen after loading the application. You have forgotten to add the TXT_GB.BIN file (english language) to the APPL.CMD file. The control always starts up in the english language.
- The asian languages have been loaded, but there are no asian characters. You have forgotten to add the ASIA.IMG file to the APPL.CMD file.

Correction tables

A correction table is used to define axis setpoints required by the user. This way, positioning inaccuracies or mechanical errors can be corrected.

There are two table types that are supported by the DA-65/DA-69 controls:
- spindle correction tables;
- bend-allowance tables;

Both tables have a pre-defined format. The spindle correction table is described in section 4.7, the bend-allowance table is described in a separate manual[1].

Loading a spindle correction table

Each axis can have its own spindle correction file. There are three ways to load the spindle correction tables into the control:

- copy the file in the 'appl.cmd' during installation. The concerning files must be copied to b:\tools\mpsupp.
- use a softkey 'load cor. table' in the machine parameter menu page of the particular axis.
- restore the machine parameters from floppy.

When such a table is loaded for a particular axis this is indicated in the machine parameter menu. A backup of the machine parameters will also backup the correction files.

2.7 Machine parameters backup

It is very important to make a backup of the machine parameters each time they have been changed.

- backup parameters (S1) To save the machine parameters on floppy disk.
- restore parameters (S2) To load the machine parameters from floppy disk.
- format disk (S4) You can format a floppy disk with the control to be sure you can always read from and write to the floppy disk. Keep the floppy disks formatted with the control separate from the disks formatted with your PC. Only use 3.5" 1.44Mb disks.

2.8 Changing the menu name

The menu name text is displayed in the header of the main menu of the programming mode. You can change this name using the numerical keys of the frontpanel and the function keys ('alphanumeric'). Press the enter key to accept the new value or name. The maximal length of the menu name is 20 characters.

After 'init memory' in the diagnostic mode the original text string (DELEM) appears again. See also section 2.9 'changing the access code'

2.9   Changing the access code

You can change the access code of the machine parameters menu. The procedure is as follows:
- enter old code;
- enter new code;
- (re)enter new code;
- press the enter key to accept the new value.

Without the correct access code it is impossible to enter the machine parameters menu. Therefore, be sure if you want to change the default access code (14753). There is one option to reset the access code to its default code. After 'initialise memory' in the diagnostic mode the access code is again reset to the default code.

2.10 Options

A new option can only be used when the option has been enabled in the control. There are seven options to be enabled. For each option that has not been enabled (**not** yet proceeded by √ - sign) you have to contact Delem for the unique code. The options with the √ - sign are already enabled in the control and can be used.

```
OPTIONS                    opt. id : 022560
─────────────────────────────────────────────────────

              Part support.......................: 1

              X1-X2 difference...................: 2

              Ethernet...........................: 3

              Flash disk.........................: 4

              Sensor support.....................: 5

          √   Remote Diagnosis...................: 6

              Bar code reader....................: 7




─────────────────────────────────────────────────────
enter number: =  0                               19.1
```

Figure 2.10.a

Obtaining the option code
The option code can be obtained by ordering the required option. The ordering information must always include the option ID-number. The option id-number of your control is indicated in the header of the option screen. In figure 2.10.a the option id is 022560.

Entering the option code
The option code consist of 16 digits. The 16 digits are divided in 4 groups of 4 digits. The groups are separated by a slash '/'. For each option you require another code.

Example: you have bought the ethernet option. After you have installed this option you have to enable the ethernet option.
- Enter 3 for enabling the ethernet option.
- Enter the Delem code. An example code is 1234/5678/9012/3456. Do not forget the slashes, becauce these are necessary. You can enter a slash by pressing the frontpanel key with the '.'-sign.

Disabling software options

The software option can simply be disabled by selecting the software option number and entering the option code. This is the same option code as you have used to enable the software option. The '√'-sign will disappear.

2.11   Leaving the machine parameters menu

When leaving the machine parameters menu, beware of two things.

- The control checks if all programmed axes are properly assigned to DM modules. If this is not the case, the control issues a warning. See also chapter 4.
- If no machine parameter has been changed, the control returns to the main menu. If any parameter has been changed, the control will reset. If 'enter' is pressed while the cursor is on a machine parameter, the control will assume this parameter has been changed and will reset itself when the menu is left.

3   Y-axis and general parameters

In this chapter the general machine parameters and parameters of the Y-axis are described. Each parameter explanation comprises the following items:

- Parameter number. Each parameter has a unique number or code.
- Parameter name. Each parameter has a unique name.
- Range. The maximal value and minimal value that can be programmed.
- Default. The initial value of this parameter. This is also the value after an initialisation.
- Units. The unit of the parameter (s, mm, kg, DA-points, etcetera).
- Function. The function of the parameter.
- Description. Full description of the use and meaning of the parameter.

Standardly all parameters are valid for all controls mentioned in this manual. If there are exceptions then this is indicated.

Parameter 1: **Service row 1/0**

Range : 0-1
Default : 0
Units : -

Function
To display the actual Y-axis linear scale readings, status and cycle numbers on the screen. There are two possibilities:

    1 = Service row present
    0 = Service row not present

Press the key ⬜ to select the required setting.

Description
The service row is displayed on the upper row of the screen. When switched on the actual Y-axis linear scale readings, the status and cycle numbers are displayed on the screen.

On the control the following line is displayed.

Y1 = 123.15 Y2 = 123.21 status= 1 cyclus = 0 Idle

The service row contains 5 information fields:

    Y1 = left side linear scale reading
    Y2 = right side linear scale reading
    Status = status number
    Cyclus = cycle number
    Idle = communication information

The fields status, cyclus and communication information can have several values:

- The status number gives information about the Y-axes servo valve control.
  - 1 = no valve control
  - 2 = fast closing
  - 3 = pressing (working stroke)
  - 4 = holding at bending position
  - 5 = decompression
  - 6 = fast opening
  - 7 = manual mode
  - 8 = reference opening Y-axis
  - 9 = reference closing Y-axis

- The cyclus number gives information about the backgauge status.
  - 0 = No movement control of X-axis
  - -1 = Manual mode
  - -2 = Control waits until X-axis reference is passed
  - 1 = Control waits until backgauge is in position, the beam is in UDP, and the opening command is released
  - 2 = Control waits until beam is at muting
  - 3 = Control waits until beam is at clamping point
  - 4 = Control waits until retract of backgauge is completed
  - 5 = Control waits until beam is at bending position, and decompression is completed
  - 6 = Control waits until beam is at muting point after bending (in opening direction of beam)
  - 7 = Control waits until upperbeam has moved from muting to UDP in opening direction
  - 8 = Control waits in UDP until dwell time in UDP has been expired.
  - 11 = Wait until beam is in UDP in case of step-by-step mode when no auto-step-change is selected.
  - 12 = Waiting for C-input active in case step-change code CX = 4 or 5 is selected.
  - 20 = Waiting until all axes have been started.

Note:
When an optional second servo axis is enabled, this will have consequences for cycle numbers -2, and -1:
- -2 = Control waits until X-axis and second servo-axis references are passed. (e.g. X2- or R-axis)
- -1 = Control waits until X-axis and second servo axis are both in position, the beam is in UPD and the opening command is released.

When the second servo axis is configured as X2-axis also cycle number 4 is affected.
- 4 = Control waits until retraction of X-axis and X2-axis are both completed.

- Communication information

The communication information indicates the status of the serial link. The three possible states are:
- Idle: there is no communication
- Busy: communication takes place
- Error: an error has been detected.

The following errors are reported:
- parity error
- overrun error
- framing error

The occurrence of one of these errors is indicated by a number which is displayed on the service row. A combination is also possible. The error numbers are:
16 = parity error
32 = overrun error
64 = framing error
When a combination of errors occur the sum of the error numbers is displayed.

Example:
When a parity and an overrun error occur at the same time the error number will be 16 + 64 = 80.

code	parity	overrun	framing
16	X		
32		X	
48	X	X	
64			X
80	X		X
96		X	X
112	X	X	X

If you have an error message in the service row, check first whether the specification parameters for serial communication are equally programmed in the control and in the connected computer.

Parameter 2: **Y-max**

Range : 0.00 - 9999.99
Default : 150.00
Units : mm

Function
Maximal Y-axis value

Description
The maximum position the beam can be moved to. This value is used as a soft limit.When the start button on the control is pressed, the control checks all Y-axis parameters, which are programmed or computed. If a programmed or computed Y-axis value is greater than Y-max the value is limited at the Y-max value and the following error message appears on the screen:

** Y-axis >>limit **

The following causes for this error message are possible:
- programmed or computed bending position >Y- max
- programmed or computed mute point > Y-max
- computed clamping point > Y-max

Parameter 3: **Y-min**

Range   : 0.00-9999.99
Default   : 10.00
Units   : mm

Function
Minimal Y-axis value

Description
The minimum position the beam can be moved to. This value is used as a soft limit. When the start button on the control is pressed the control checks all Y-axis parameters, which are programmed or computed. If a programmed or computed Y-axis value is smaller than Y-min the value is limited at the Y-min value and the following error message appears on the screen.

        ** Y-axis << limit **

There are the following causes possible for this error message:
- programmed or computed bending position < Y-min
- programmed or computed mute point < Y-min
- computed clamping point < Y-min

Note
Make sure that the beam can reach this minimum value for the Y-axis. For example, when the beam is in the mechanical top dead centre and the Y-axis value is 5 mm, Y-min must be bigger than 5 mm.

Parameter 4: **Y-direction +/- (1/0)**

Range : 0-1
Default : 1
Units : -

Function
Y-axis counting direction

Description
When you have programmed '1', the Y-axis value on the user screen counts up when the beam closes. When you have programmed '0', the Y-axis value on the user screen counts down when the beam closes.

Press the key ⌂ to select the required setting.

Note
The definition of all the Y-axis machine parameters such as 'Y-max' and 'Y-min' is always in the count up direction.

Example
Y-max = 150.00 mm
Y-min = 10.00 mm
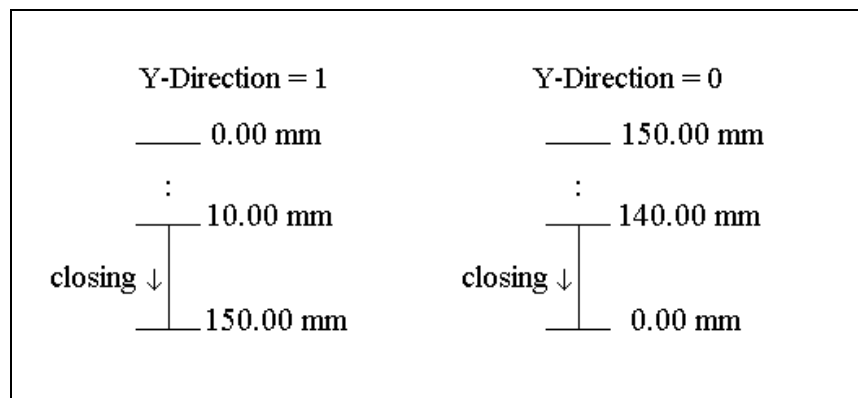
Figure 4.a

Parameter 5: **Linear Scale Ref. left (Y1)**

Range   : 0.00-9999.99
Default   : 25.00
Units   : mm

Function
Y-axis left side linear scale reference position and parallelism adjustment.

Description
This value is displayed on the screen when the reference on the linear scale is passed. When the reference marker on the linear scale is passed, a reference impulse is given to the electronics. (To see left and right side separately switch service row on).

Note
This value must be greater than the mechanical travel distance on the scale from reference point position to the scale end. This travel distance must also be greater than the mechanical travel of the cylinder from reference point position to the upper dead point mechanical in the cylinder. Make sure that when the cylinder is on the mechanical upper dead stop the Y-axis value read-out is between 5 and 10 mm.

Parameter 6: **Linear Scale Ref. right (Y2)**

Range   : 0.00-9999.99
Default   : 25.00
Units   : mm

Function
Y-axis right side linear scale reference position and parallelism adjustment.

Description
See description 'Linear scale Ref.left'.

Parameter 7: **Tool Reference**

Range   : 0.00-9999.99
Default : 320.00
Units   : mm

Function
The reference height for the computation of the Y-axis bend position in case you have selected angle programming. This value is used in the computation of the bending depth, mute point and clamping point.

Description
Maximal opening of the machine measured between beam and table.

Tool reference is Y-axis position without uppertools and undertools
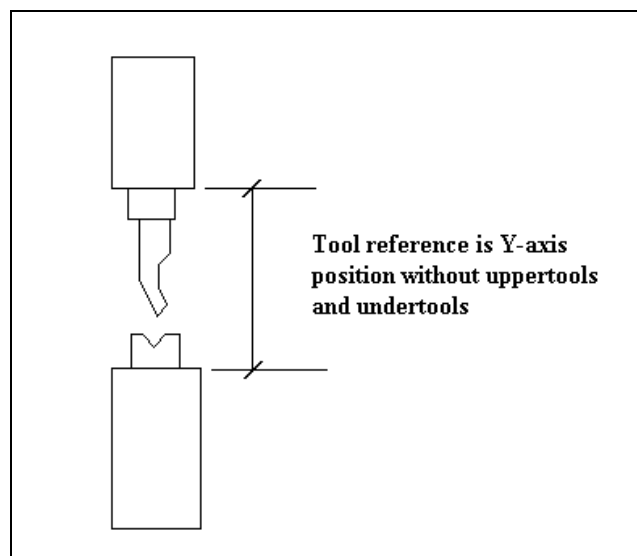
Figure 7.a

Parameter TR: **Tool Reference correction**

Range   : 0.00-9.99
Default   : 0.00
Units   : mm

Function
A correction of the Tool Reference value for head mounted punches.

Description
The control can make a distinction between 'head mounted' punches and 'shoulder mounted' punches.
In case of a shoulder mounted punch (default situation), the control uses the Tool reference and the Tool height to compute the correct Y-axis position. Since the Tool height is measured from the punch' shoulder, this leads to accurate positioning.
In case of head mounted punches, the punch' shoulder might not correspond with the lower edge of the pressbeam. In that case, the position of the Y-axis is no longer accurate.
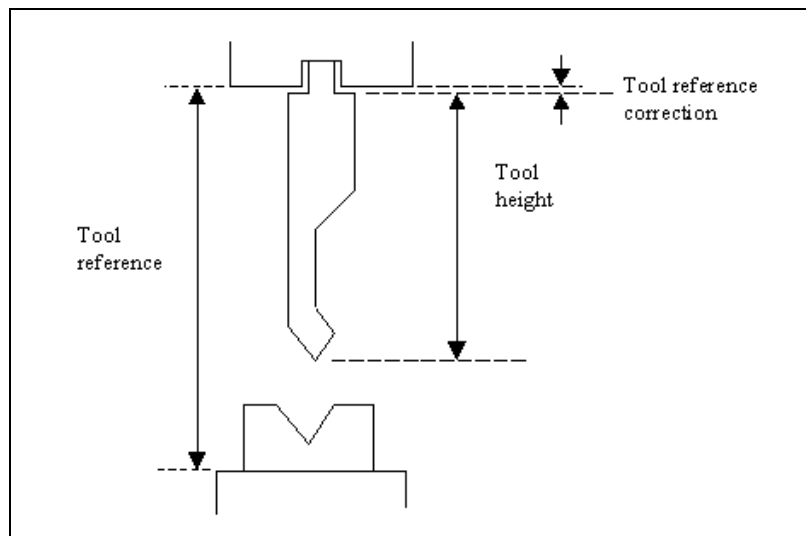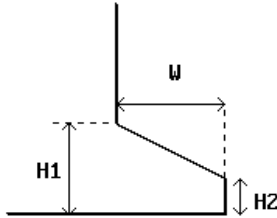
Figure 7.b

In such case, a correction of the Tool Reference value can be programmed.

Parameter TR: **Tool Reference correction (continued)**

The Tool reference correction is only taken into account, when a head mounted punch is used in a bend program. Otherwise, it is ignored. The type of punch can be programmed at the punch parameters in programming mode:

```
PUNCHES                              No  :   5
                                     Code:   REF PUNCH-0105/DLA

        CODE............................. C=   REF PUNCH-0105/DLA

        RESISTANCE....................... R=      51.23  kN/mm

        LENGTH........................... L=      453    mm

        Z POSITION....................... Z=      128    mm

        RADIUS...........................RA=       1.56  mm

        FLATTENING HEIGHT................FH=     175.00  mm

        SUPPORT TYPE SHOULDER/HEAD 0/1....ST=       0
                                                               W
        HEIGHT 1.............H1=     20.0   mm

        HEIGHT 2.............H2=     15.0   mm               H1

        WIDTH................ W=     15.0   mm                    H2

    C=    REF PUNCH-0105/DLA                                   7.2

                                        alphanum.
```

Figure 7.c

0 = shoulder mounted (default)
1 = head mounted
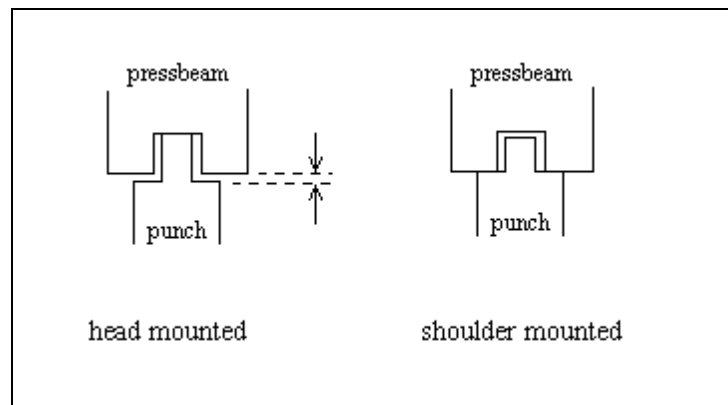
Figure 7.d

Parameter 8: **Linear scale direction Y1 (0/1)**

Range　　　: 0-1
Default　　: 0
Units　　　: -

Function
To change the counting direction of the linear scale encoder pulses of Y1.

Description
Generally the position counting of Y1 should be upcounting when the beam is moving down. With this parameter the counting direction can be inversed to have it correct.

Press the key ⬚ to select the required setting.

Parameter 9: **Linear scale direction Y2 (0/1)**

Range : 0-1
Default : 0
Units : -

Function
To change the counting direction of the linear scale encoder pulses of Y2.

Description
Generally the position counting of Y2 should be upcounting when the beam is moving down. With this parameter the counting direction can be inversed to have it correct.

Press the key ⬚ to select the required setting.

Parameter 10: **Tandem 1/0**

Range   : 0-2
Default   : 0
Units   : -

Function
You have to program this parameter '1', if the tandem option has been installed. When you program this parameter to '2', you can use the tandem input to stop the beam for robot-interfacing.

Description
There are two possible values:

1. One of the outputs of the optional Tandem card, type DBT-01 which has to be used in case of 'tandem', must be connected to the tandem input of the control.
    T-input active means that there is no Y-axis speed control. Program this parameter '0' if tandem option is not installed. When you want to apply the tandem function, please ask for our general Tandem description.

2. The same 'tandem' T-input can be used when you have your machine in a robot application.
    In this case the beam will be stopped in the pressing phase as long as the T-input is active and will continue the pressing movement when the T-input is no longer active.
    Programming this parameter to the value 2 will create the clamp output to be active as well on the clamp position as well on the bending position, after the holding time has been elapsed. With help of this clamp-output signal you can create a T-input signal to keep the beam at the bend position till the robot handling has been finished.
    When you want to apply the robot interfacing, please ask for out general robot interfacing description.

Press the key ⬘ to select the required setting.

Parameter 11: **Parallel switch 1/0**

Range : 0-1
Default : 0
Units : -

Function
Parallelism indication switch mounted to use before Y-axis references are passed.

Description
You have to program '1', if you want to use the parallelism switch option. The parallelism switch must be connected to the '='-input of the control. With this input the control has an indication of the parallelism of the upperbeam. When this input is active (switch closed) the left side cylinder is higher than the rightside cylinder. When this input is not active (switch opened) the right side cylinder is higher than the left side cylinder.

When the control gets a fast opening (↑) or fast closing (↓↓) command the first time after power on, only one cylinder moves until the '='-input changes from open to closed or vice versa. In this situation the beam is parallel and both cylinders will move to pass the Y-axis references.

When the parallel switch is not mounted (program 0) the control will not use this input before the references are passed.

Press the key ⬆ to select the required setting.

After giving a fast opening or fast closing command the relative parallelism of the left side and the right side cylinder will be maintained until references of both linear scales are passed.

See also included drawing.

FIGURE 1

Closed

Open

A

B

Note	Redrawn	Date
Description		

Note	Redrawn	Date
Description		

| Measures in mm,unless otherwise specified | Drawn MI | Date 22-01-1999 |
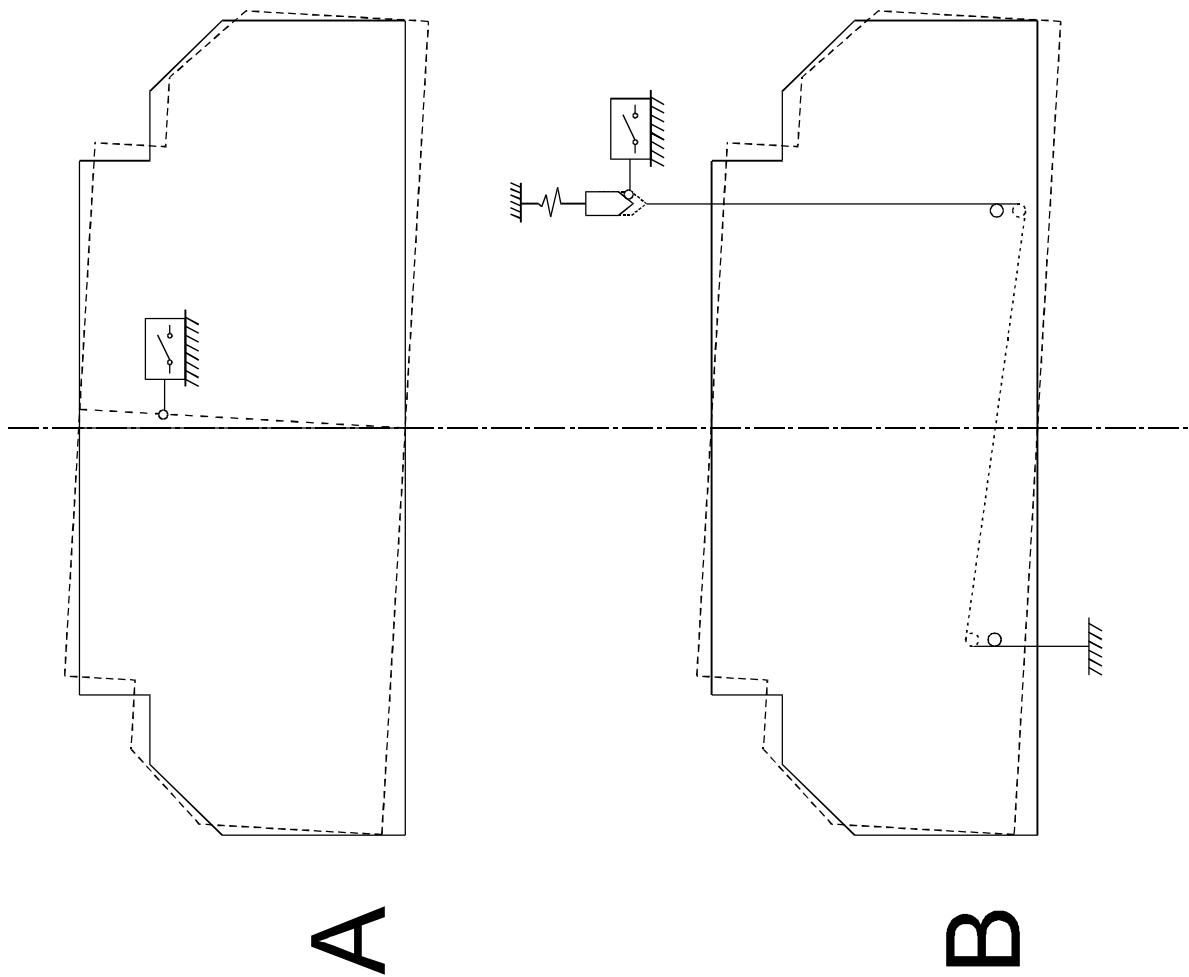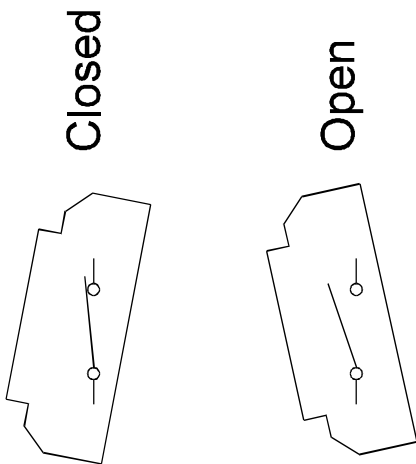
Delem
Luchthavenweg 42, 5657 EB
Eindhoven, the NETHERLANDS

Mounting example of
Parallelism Indication Switch

Format		Number	Issue
A4		9056-901	-
		Scale	

Parameter 12: **Max. Parallelism**

Range : 0.00-50.00
Default : 2.00
Units : mm

Function
Total maximum allowed parallelism of the beam.

Description
The parallelism is the difference between the left hand cylinder (Y1) and the right hand cylinder (Y2). For the controls there are two parameters that influence the beam parallelism:

1. Parallelism programmable under the programming parameters. This value has effect over the entire stroke of the beam.
2. Parallelism programmable in data preparation, data editing and manual mode. This value is taken into account when the beam reaches the clamping point and stays active until the opening command (↑) becomes active.

The total parallelism is the sum of the values described under 1 and 2. When in automatic mode a total parallelism that is greater than the max. parallelism is detected the control goes to stop and the following warning is displayed on the screen:

     ** Parallelism > max. parallelism **

Parameter 13: **Y-opening default**

Range   : -9999.9 - + 9999.9
Default   : 20.0
Units   : mm

Function
Default Y-axis opening value.

Description
The value programmed here is used as initial value for the parameter 'Y-axis opening' in the Data Preparation menu of the programming mode.

Parameter 14: **Braking time max**

Range : 0-200
Default : 0
Units : 5 ms

Function
Maximal allowed braking time of the beam.

Description
Every time the control is switched on, the braking time of the beam can be measured. This measurement is initiated the first time a closing command ($\downarrow\downarrow$) becomes active after power on. The beam starts moving in the closing direction. The control goes to stop 4 mm after both references have been passed and the CNC start output goes low.

This means that the beam must stop. The CNC start output should be connected in such a way that the fast closing command will be switched off and the height retaining valves are closed. When the 'braking time max' has elapsed the speed of the beam must be 2 mm/s or less.

When the speed of the beam is lower than 2mm/s within the allowed time the following message appears on the screen:

       ** BRAKING DIST ok, press start to cont. **

After the start button is pressed again the bending can be continued.
When the beam does not stop within the allowed time the following message appears on the screen:

       ** BRAKING DIST too large, cannot continue **

In this situation it is not possible to continue with bending. If you try to press the start button again the following message appears on the screen:

       ** not possible, BRAKING DIST too large **

Note:
When this parameter is programmed zero the braking distance measurement is disabled.

Parameter MP: **Mute programmable per bend step 1/0**

Range   : 0-1
Default   : 0
Units   : -

Function
Enable or disable the mute parameter for the operator in the data edit mode.

Description
In the standard situation (OFF), the mute point for each bend is calculated from the mute distance of the die. In some situations, it is desired that the operator can change the mute point for a bend. When this parameter is switched ON, the mute point can be changed for each individual bend of a program.

Press the key to select the required setting.

Parameter 15: **Calibrate valves 1/0**

Range   : 0-1
Default   : 0
Units   : -

Function
To adjust the valve offset of the servo valves in the manual mode (not for Hoerbiger hydraulics application).

Description
For valve types that use the ±10V output of the DM02, there are two ways to adjust the offset:

- In the diagnostic mode (without using this parameter).
  It is possible to adjust the offset of these valves on the valve deflection page in the DM02 module test menu. If the cursor on the screen is set at one of the offsets, it can be adjusted using the handwheel. The range is between -127 and +127. This corresponds with an offset in the range between -600 and +600 mV.
- In the manual mode.
  It is also possible to adjust the position of the beam in manual mode with the handwheel. The best way to do this is during the dwell time (status 4) and by programming a long dwell time. This adjustment mode must be enabled with this machine parameter.

When you have programmed this parameter to '1', the sofkey 'Y1/Y2 cal. select' appears in the manual mode. With this softkey you select Y1 or Y2 for offset adjustment. The selected side is highlighted on the service row. The selected side can now be adjusted with the handwheel. The corresponding valve offset will be memorized in the DM02 when the other side is selected or on exit of the manual mode.

After the offset adjustment has been finished, this parameter must be reset to zero again.

Press the key ⬓ to select the required setting.

Note 1
Offset adjustment for Hoerbiger valves must always be adjusted in the diagnostic program. They cannot be adjusted with the manual mode.

Parameter 16 - 19: **Not used**

Parameter 20: **Relaxation Stiffness**

Range : 0.000-99.900
Default : 0.300
Units : µm/kN

Function
Stiffness of frame used to compute decompression.

Description
The stiffness of the frame is used to compute the decompression distance.This value will be multiplied with computed force to obtain decompression distance.

Parameter 21: **Stiffness of frame**

Range   : 0.0-100.0
Default   : 0.0
Units   : %

Function
Stiffness of frame, used for Y-axis depth computation.

Description
When you program bending angles, the corresponding bending depth is computed automatically. Stiffness of frame is used to compute a correction for this bending depth due to the deflection of the frame.
The deflection compensation arm will not fully compensate the deflection of the side frame in order to compensate the Y-axis bend position. Bending the same metal with length of 0,5 meter must have the same angle when bending it with a length of 1 meter or longer.

The difference between the two bends is the tonnage. With 1 meter length the frame will deflect more because it requires more tonnage when bending 0,5 meter.
The value programmed for this parameter must be the deflection of the side frame which is not compensated by the compensation arm. This value is programmed as a percentage of the value programmed for the machine parameter 'Relaxation Stiffness'.

Parameter 22: **Calibration 1/0**

Range : 0-1
Default : 0
Units : -

Function
Pressure valve calibration.

Description

Program '1' if you want to calibrate proportional pressure valve control. Press the key to select the required setting. The units at the force parameter in manual mode will be in points from 0 to 255 max. in stead of tons. (0 = 0 mA, 255 = 800 mA)

Calibration procedure:
1. Set parameter to '1';
2. Leave the machine parameter menu;
3. Go to the manual mode;
4. Program e.g. 200 points at the tonnage parameter;
5. Select bottoming;
6. Mount pressure gauge on hydraulic block (pump pressure);
7. Programm Dwell time = 5 s;
8. Perform a working stroke with the press. The tools are now pressed together (punch in die) (Note: Only use punch and die which may work on max. pressure)
9. When tools are pressed together read pressure gauge. In case the pressure is not sufficient for max. tonnage, reprogram DA-output (max. 255) at tonnage parameter. Repeat until your max. tonnage is reached. Remember output value. The value must be programmed at machine parameter 'output- max'.
10. Program a small value at tonnage parameter, e.g. 30 points. Now find min.value at which the beam begins to move in the pressing mode. Make note of this minimum value. This value must be programmed at machine parameter 'output-min'.
11. Select again the machine parameters menu.
12. Now you must program at machine parameters 'Force max.' and 'Force min.' the maximum and minimum tonnage of your press which corresponds with the force units (0-255) at machineparameters 'output -max' and 'output- min'.
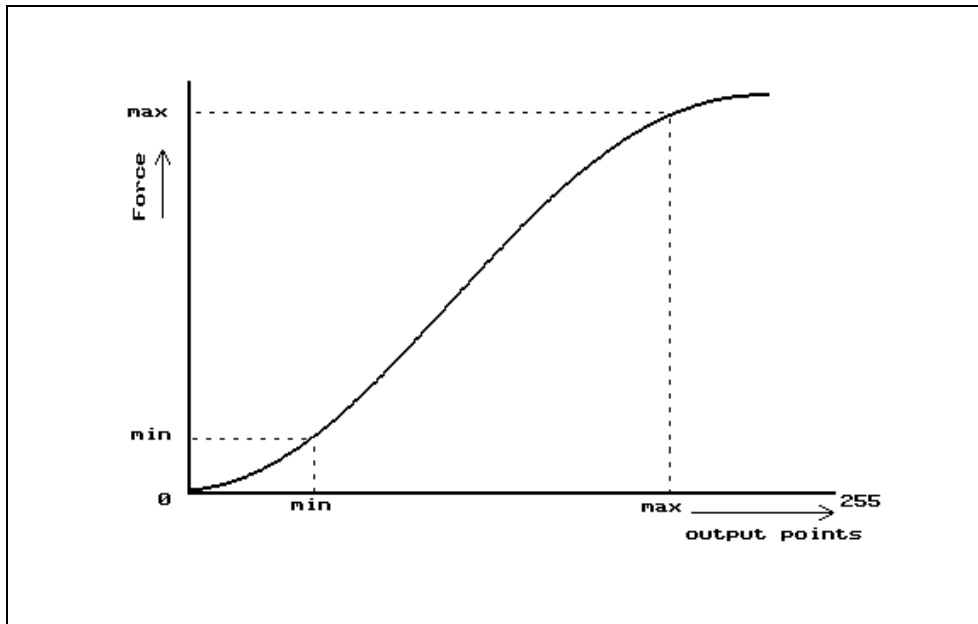
Figure 22.a

Note
The mechanical adjustment of the pressure valve has to be done before this calibration procedure.

Parameter 23: **Force max.**

Range : 0-32000
Default : 1100
Units : kN

Function
Maximal tonnage of press brake

Description
Maximal tonnage of the press brake is used to compute the pressure valve output deflection. It is also used to check the programmed and computed values for the force. If the computed force is greater than force max. the following error message will be displayed on the screen.

** computed force > force max. **

The message can also appear when the decompression distance is computed because the control needs to compute the force before computing the decompression. When the start button is pressed in manual mode or automatic mode, and the programmed force > force max then the following error message will appear on the screen.

** programmed force > force max. **

The value programmed for force is limited at force max. See also calibration procedure described with machine parameter calibration (parameter 22).

Parameter 24: **Force min.**

Range   : 0-32000
Default : 100
Units   : kN

Function
Minimal tonnage of press brake.

Description
Minimal tonnage of the press brake is used to compute the pressure valve output deflection. It is also used to check the programmed force value. When the start button is pressed and the programmed force is less than force min, the force is limited at force min. See also calibration procedure described with machine parameter calibration.

Parameter FM: **Force Middle**

Range   : 0 - 32000
Default : ___
Units   : kN

Pressure valve calibration enhancement
When the relation betwee the output deflection and the pressure is linear then you only have to program force max. and force min. In case the relation between the output deflection and the pressure is not linear you can program force middle.
The default value for this middle parameter is '___', meaning that this parameter is not active.

Parameter 25: **Output max.**

Range   : 0-255
Default   : 255
Units   : DA-points

Function
Pressure valve deflection for max. force.

Description
Output deflection for proportional pressure valve in DA-points to give max. force. There are two ranges of pressure valves:

- 800 mA. These valves can be programmed to max. 136 DA-points.
- 1500 mA. These valves can be programmed to max. 255 DA-points.

See also calibration procedure with machine parameter Calibration.

Parameter 26: **Output min.**

Range : 0-255
Default : 48
Units : DA-points

Function
Pressure valve deflection for minimal force.

Description
Output deflection for proportional pressure valve in DA-points to give min.force.
There are two ranges of pressure valves:

- 800 mA. These valves can be programmed to max 136 DA-points.
- 1500 mA. These valves can be programmed to max 255 DA-points.

See also calibration procedure with machine parameter Calibration.

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Parameter OM: **Output middle**

Range   : 0 - 255
Default : ___
Units   : DA-points

Pressure valve calibration enhancement
When the relation betwee the output deflection and the pressure is linear then you only have to program output max. and output min. In case the relation between the output deflection and the pressure is not linear you can program output middle.
The default value for this middle parameter is '___', meaning that this parameter is not active.

Parameter 27: **Pressure ramp**

Range   : 0 - 255
Default : 255
Units   : DA-points

Function

To program a ramp with which you control the pressure output.

Description

It is possible to program a ramp with which the pressure output will be activated. A lower value will give a large ramp. This parameter is activated at every pressure change.
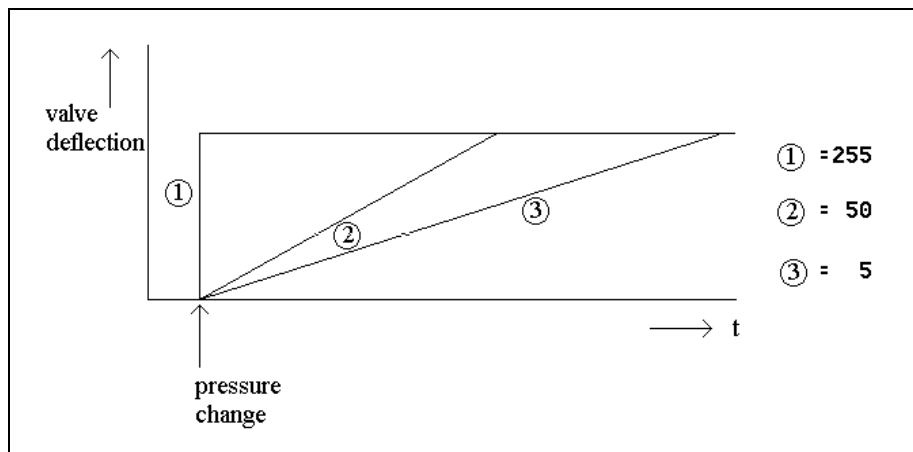
Figure 27.1 Low-high pressure change
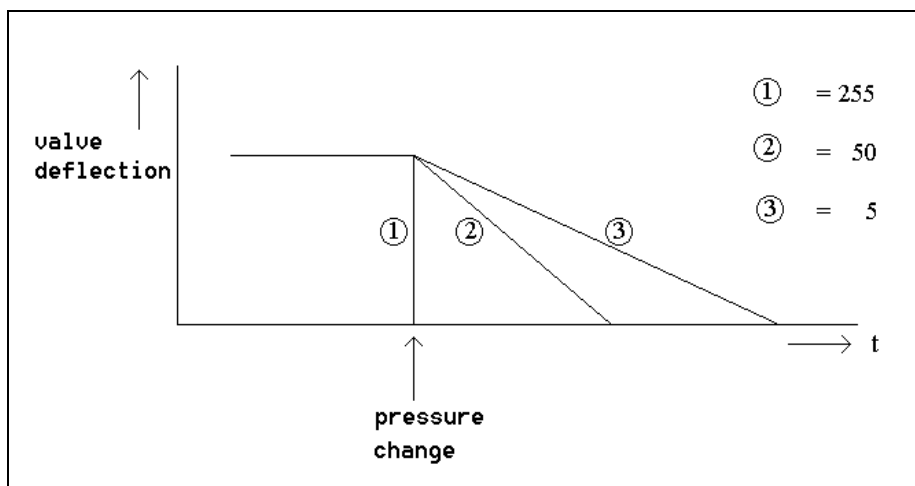
Figure 27.2 High-low pressure change

Parameter 28: **Not used**

Parameter 29: **Not used**

Parameter 30: **Closing speed**

Range   : 0 - 250
Default   : 80
Units   : mm /s

Function
Fast closing speed

Description
Y-axis speed during fast closing (status = 2, see service row).
The control regulates the closing speed to the value of this parameter.

Parameter 31: **Closing speed incr.**

Range   : 0.0 - 200.0
Default   : 100.0
Units   : Steps per 5ms.

Function
Y-axis closing acceleration

Description
Acceleration of the Y-axis during closing.
When the beam is in the upper dead point, it accelerates with this value when the closing command becomes active (status = 2, see "service row") until the value "closing speed" is reached.
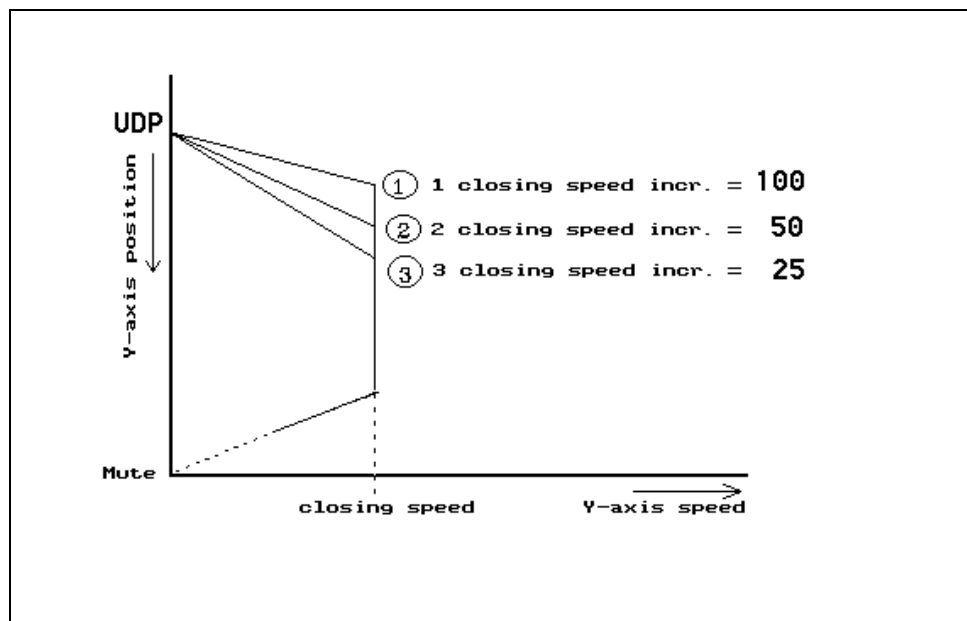
Figure 31.a

Parameter 32: **Closing ramp offset**

Range : -9.99 -+ 9.99
Default : 2.50
Units : mm

Function
Offset to adjust beam at mute position.

Description
When the beam approaches the mute point it starts braking. The braking ramp is computed by the control. With the parameter "closing ramp offset" the start of the braking ramp can be set relative to the mute position.
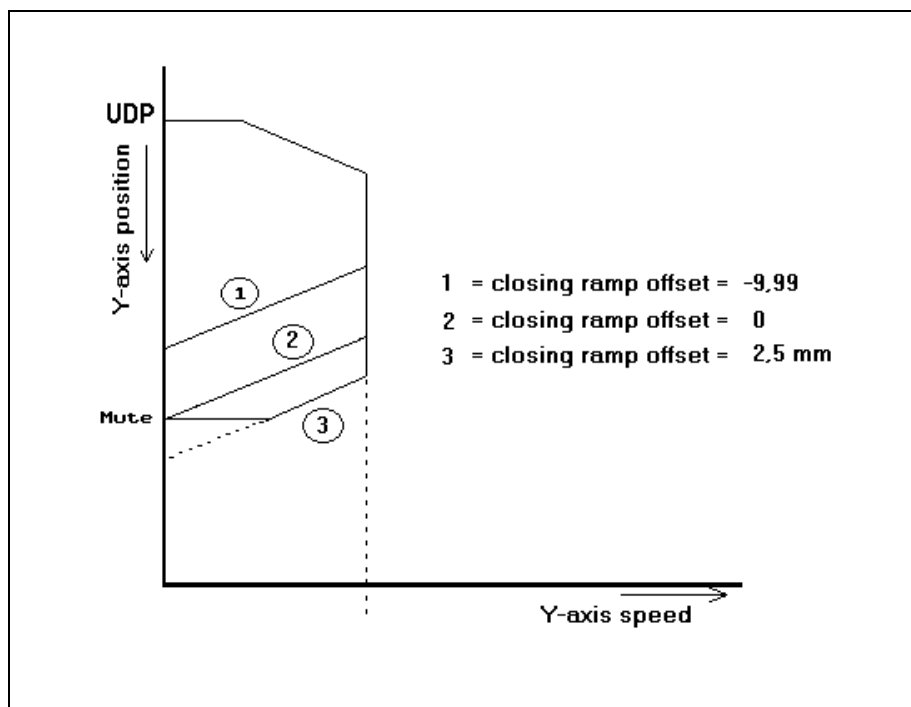
Figure 32.a

Parameter 33: **Del. before closing**

Range   : 0-200
Default : 0
Units   : 5 ms

Function
Synchronised start of beam speed.

Description
When the fast closing command (↓↓) becomes active, the proportional valves will not be opened until this delay time has elapsed.

This time is needed to open the height retaining units before the proportional valves are opened.

Parameter 34: **Opening speed**

Range : 0 - 250
Default : 80
Units : mm /s

Function
Fast opening speed.

Description
Y-axis speed during fast opening (status=6, see service row).

The control regulates the beam speed during opening of the beam.

Parameter 35: **Opening ramp offset**

Range   : - 9.99 - +9.99
Default   : - 1.50
Units   : mm

Function
Offset to adjust stop position in UDP.

Description
When the beam is opening with fast speed (status = 6, service row) it starts braking when it approaches the upper dead point. The braking ramp is computed by the control. With this offset the start of the braking ramp can be set relative to the UDP.
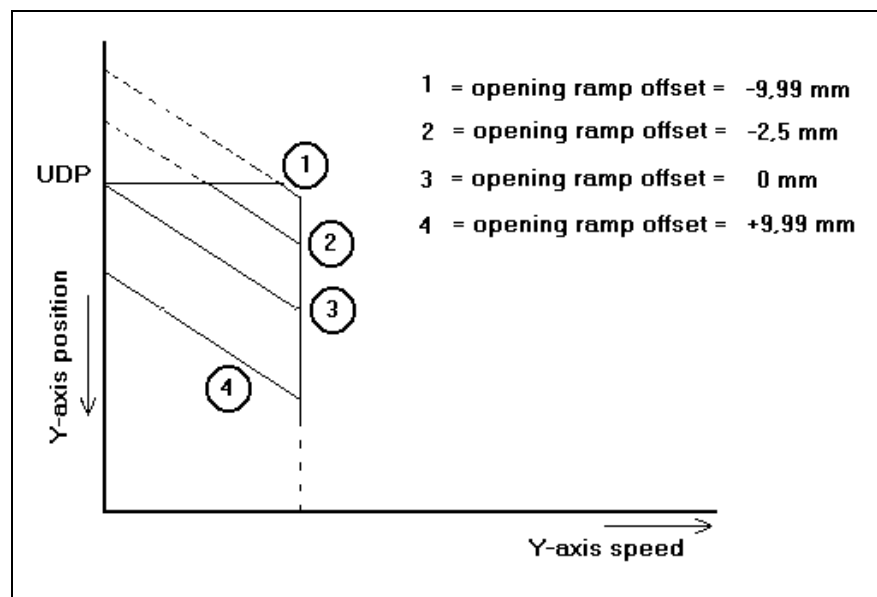
Figure 35.a

Parameter 36: **Del. before opening**

Range   : 0 - 200
Default : 10
Units   : 5 ms

Function
Synchronised start of beam speed

Description
When the opening command (↑) becomes active the proportional valves are not opened until this time delay has elapsed. During this time delay the suction valves must be opened and/or high retaining valves must be closed.

Parameter 37: **Max. pressing speed**

Range   : 0.0 - 30.0
Default   : 30.0
Units   : mm/s

Function
Maximum pressing speed programmable by the operator.

Description
Maximum programmable pressing speed in data preparation, data editing and manual mode.

Parameter 38: **Delay before pressing**

Range : 0 - 200
Default : 40
Units : 5 ms

Function
Synchronised start of press speed.

Description
When the beam is at the mute point and the pressing command ($\downarrow$) becomes active the proportional valves are not opened until this time delay has elapsed. During this delay the suction valves must be closed.

Parameter 39: **Delay before pressing force**

Range : 0 - 9999
Default : 0
Units : kN

Function
Pressure during delay before pressing.

Description
During the time delay before pressing the proportional valves are closed (See machine parameter delay before pressing). The pressure valve has a deflection during this time delay which corresponds with the force programmed here.
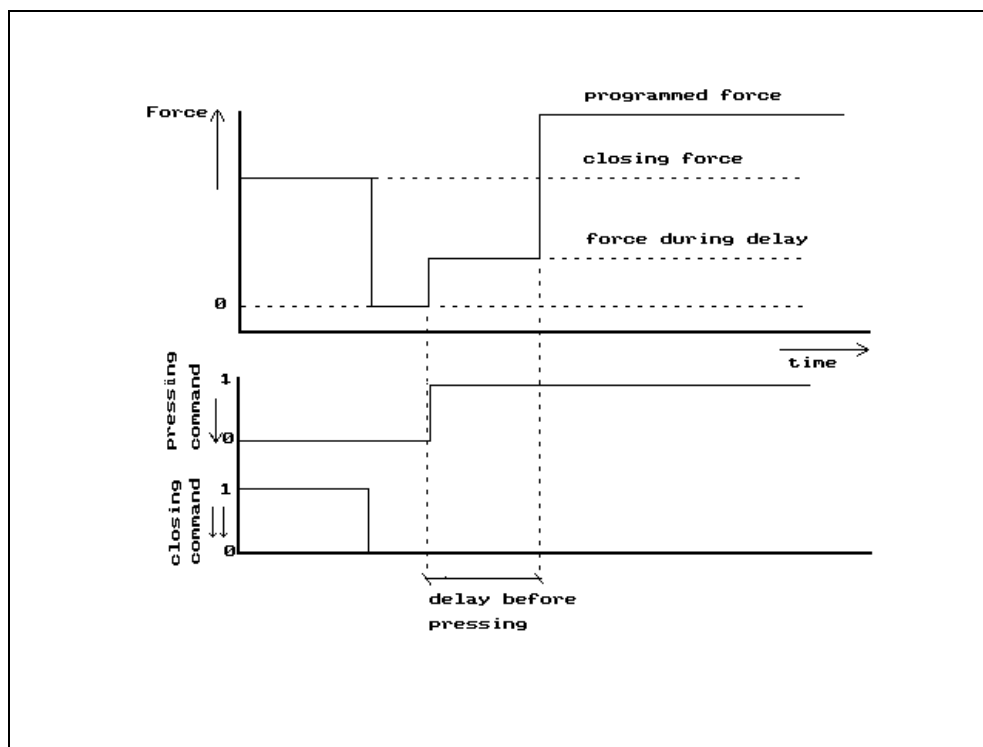
Figure 39.a

Parameter 40 - 41: **Not used**

Parameter 42: **Y-ref search speed**

Range   : 10.0 - 250.0
Default : 125.0
Units   : mm/s

Function
Setting of the Y-axis speed during reference search.

Description
This is the speed with which the beam is controlled in the upward direction during the reference search cycle.
When the reference search cycle of he Y-axis is started, the beam is controlled in the upward direction with the speed which is programmed here. The sequence of the complete reference cycle depends on the position of the beam:
- if the beam was positioned below the reference point, the Y-axis will reach the reference point and set the position;
- if the beam was positioned above the reference point, the beam will also move upwards with the programmed speed. When the beam reaches the mechanical upper dead point, the control will detect after a short period that there is no movement and will stop the movement. As soon as a closing command is generated, the beam is controlled downwards with closing speed (parameter 30). The beam should now find reference.

Parameter 43 - 45: **Not used**

Parameter 46: **Closing brake ramp trim**

Range : -2.0 - +2.0
Default : 0.0
Units : -

Function
To adjust the ramp to brake the beam from the fast closing phase to mute.

Description
For large machines it is sometimes desired to adjust (or trim) the brake ramp during closing.
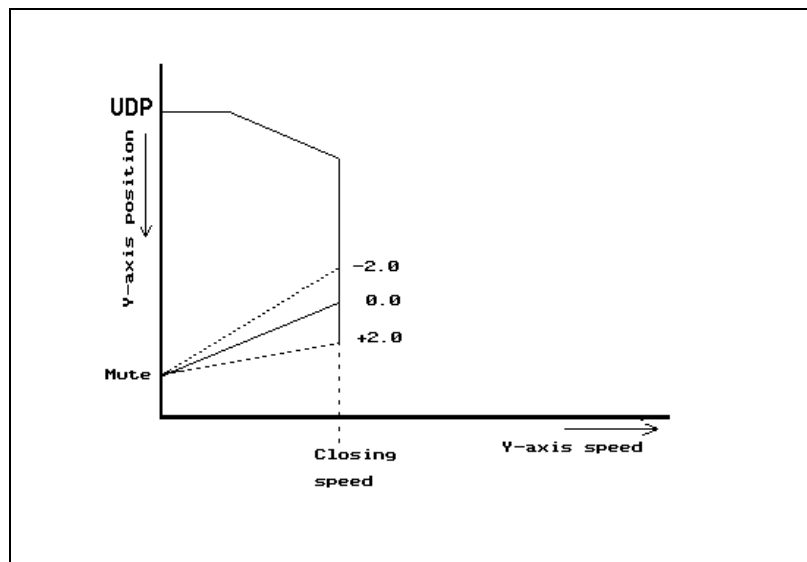
Figure 46.a

The recommended way to adjust this parameter

- Program the closing speed lower or equal to the hydraulic closing speed.
- Program machine parameter 32 (closing ramp offset) to 0 (zero).
- Set the machine to 'adjust' mode (hand input active).
- Adjust parameter 46 until you get a smooth stop of the beam at the mute point.
- Program then machineparameter 32 to a value that the beam stops about 0.5 - 1 mm lower than the programmed mute position.

Note
This parameter is related to machine parameter 47 (= gain trim for closing movement), increasing this parameter will also result in steeper braking and vice versa.

Parameter 47: **Closing gain trim**

Range   : -1.0 - +1.0
Default   : 0.0
Units   : -

Function
To adjust the gain in fast closing phase of the beam.

Description
It is sometimes desired to adjust (trim) the preset gain of the pressbrake movement during the closing phase. Especially when you have some vibrations in the closing phase, you can decrease the gain.
Programming 0.0 will give the preset standard value for the gain.

Parameter 48: **Opening gain trim**

Range   : -1.0 - +1.0
Default   : 0.0
Units   : -

Function
To adjust the gain in the opening phase of the beam.

Description
It is sometimes desired to adjust (trim) the preset gain of the pressbrake movement during the opening phase. Especially when you have some vibrations in the opening phase you can decrease the gain.
Programming 0.0 will give the preset standard value for the gain.

Parameter 49: **Pressing gain trim**

Range : -1.0 - +1.0
Default : 0.0
Units : -

Function
To adjust the gain in the pressing phase of the beam.

Description
It is sometimes desired to adjust (trim) the preset gain of the pressbrake movement during the pressing and decompressing phase. Especially when you have some vibrations in the pressing phase you can decrease the gain. But also the positioning at the programmed position must be correct.
Programming 0.0 will give the preset standard value for the gain.

Parameter 50: **Machine length between the cylinders**

Range   : 0 - 15000
Default   : 2000
Units   : mm

Function
The length of machine table between the cylinders will be used to compute the table deflection.

Description
This parameter is used to compute the machine table deflection. The table deflection is only computed when a crowning adjustment device is connected. (See chapter 6).
You have to program the machine length between the mid position of the 2 cylinders. See also machine parameters 'Inertia under beam', and 'Inertia upper beam'.
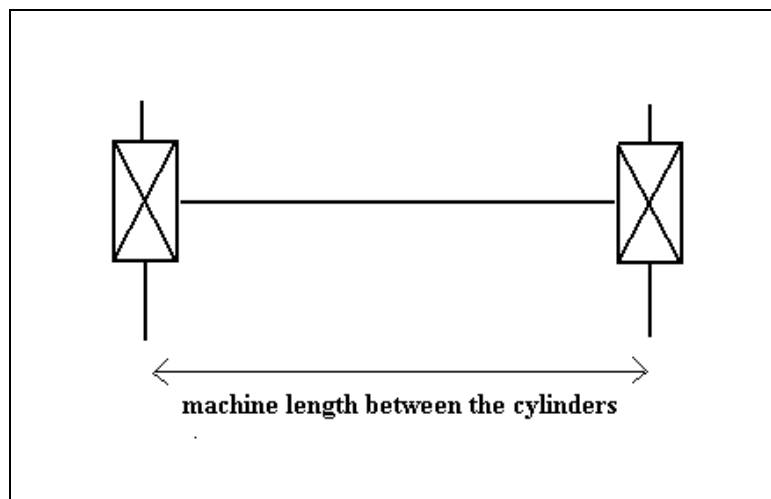
Figure 50.a

Parameter 51: **Inertia under beam**

Range : 0 - 99999
Default : 624
Units : 1000 cm^4

Function
The inertia of the machine table is used to compute table deflection.

Description
This parameter is used to compute the machine table deflection. The table deflection is only computed when a crowning adjustment device is connected (see chapter 6).
See also machine parameters 'Machine length between the cylinders' and 'Inertia upper beam'.

Example
Inertia = 1349000
Program: 1349

Parameter 52: **Inertia upper beam**

Range : 0 - 99999
Default : 776
Units : 1000 cm^4

Function
The inertia of the machine upper beam is used to compute table deflection.

Description
This parameter is used to compute the machine table deflection. The table deflection is only computed when a crowning adjustment device is connected. (See chapter 6).

See also machine parameters 'Inertia under beam' and 'Machine length between the cylinders'.

Example
Inertia = 1349000
Program: 1349

Parameter 53: **Not used**

Delem

Parameter 54: **Total machine length**

Range   :   0 - 15000
Default :   2000
Units   :   mm

Function
Total machine length for check in relation with the product length.

Description
When the operator programs a bending length longer than the programmed total machine length a warning appears on the screen.

Parameter 55: **Punch clamp pressure**

Range   : 0-255
Default : 0
Units   : DA-points

Function
Pressure setting for correct punch clamping.

Description
It is possible to control the pressure valve output for the hydraulic system, specifically meant for the punch-clamp application. This can only be achieved by means of the sequencer file.

Parameter 56: **Die clamp pressure**

Range : 0-255
Default : 0
Units : DA-points

Function
Pressure setting for correct die clamping.

Description
It is possible to control the pressure valve output for the hydraulic system, specifically meant for the die clamp application. This can only be achieved by means of the sequencer file.

Parameter 57: **Valve ramp closing**

Range : 0 - 255
Default : 255
Units : DA-points / 5 ms

Function
To program a valve deflection ramp at the start of status closing (status 2).

Description
When you program 255 than you have no ramp. The lower the value you program the longer the ramp will be.
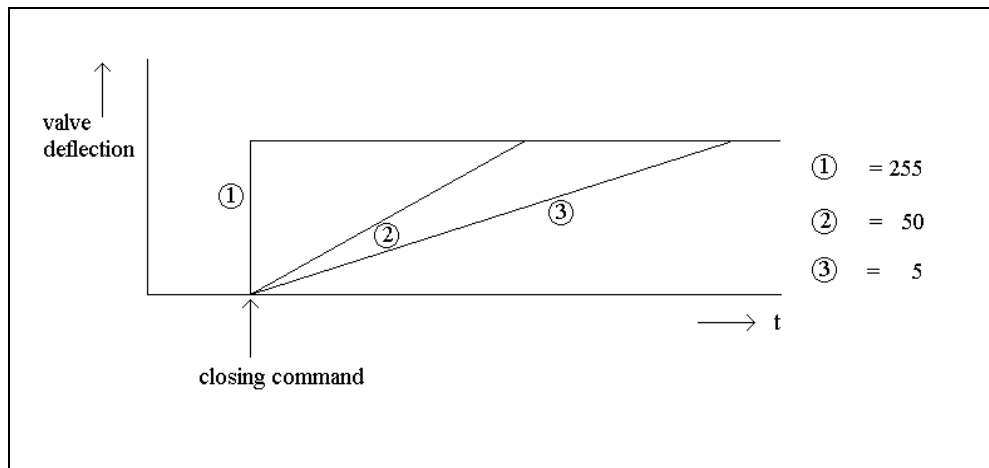
Figure 57.a

Parameter 58: **Not used**

Parameter 59: **Opening pressure**

Range   : 35 - 100
Default   : 100
Units   : %

Function
Pressure setting during the opening phase.

Description
You can adjust the pressure during the opening movement of the beam. This value is a percentage of the maximum pressure (machine parameter 25).

Note
Make sure that the value for this parameter is high enough! If it is too low the beam will not move. This is a dangerous situation! When after switching on the pump the beam does not move upwards, the control sets the output signal UDP active.
When the beam is below its reference point it will come down without finding its reference when a closing command is given. This can damage the tools!

Therefore the minimum value is set to 35%.

Parameter 60 - 119: **Not used**

Parameter 120: **KO-table from floppy on/off 1/0**

Range   :   0 - 1
Default :   0
Units   :   -

Function
To read the KO-table from floppy.

Description
During development and testing of KO-tables it can be helpful to read this file from floppy instead of loading a complete new application.
0 = using KO-table from the internal application;
1 = loading KO-table from floppy.
Press the key ⬚ to select the required setting.

With this parameter set to 1 the KO-table is only read from floppy during start up.

After testing the KO-tables you should set this parameter to 0 again. Make sure the required KO-table is on the application floppy with the other files and execute the normal application load procedure.

Parameter 121: **Sequencer from floppy on/off 1/0**

Range : 0 - 1
Default : 0
Units : -

Function
To read the sequencer file from floppy.

Description
During development and testing of sequencer files it can be helpful to read this file from floppy instead of loading a complete new application.
0 = using sequencer file from the internal application
1 = loading sequencer file from floppy
Press the key to select the required setting.

With this parameter set to 1 the sequencer file is only read from floppy during start up.

After testing the sequencer file you should set this parameter to 0 again. Make sure the required sequencer file is on the application floppy with the other files and execute the normal application load procedure.

Parameter 122: **Sequencer debug on/off 1/0**

Range　　: 　0 - 1
Default　　: 　0
Units　　 : 　-

Function

To activate the sequencer debug facility. Press the key ⬚ to select the required setting.

Description

When the sequencer debug facility has been switched on (=1) a soft key appears in the manual mode. Activating this key will generate a test row on top of the screen. In this row you can check the equations of the sequencer. This test row overwrites the service row (in case the service row is active).

```
MANUAL
┌──────────────────────────────────────────────────────────┐

     Y =    __.__              X =    __.__

        punch........UP=     5      X-AXIS........X =    500
        die..........UN=     5      retract.......DX=     0
        mat..........MA=     1
        thickness.....TH=    1.00
        length.......BL=   300      R-axis........R =   -55

        Method.......BM=     0
        corr.α........Cα=    0.00
        ANGLE.........α =   90.00
        Y-AXIS.......Y =    93.77   open.........DY=    20.0
        mute.........M =    85.00   speed........S =    10.0
                                    backpr. speed.BS=   10.0
        backpr.......BP=     0.00   d-time.......T =     0.1
        force........P =    15      parallelism...Y2=    0.00

 UP=    5                                               20.1
┌──────────┬────┬────┬────────┬────┬────┬────┬──────────┐
│sequencer │    │    │ zoomed │    │    │    │          │
│  debug   │    │    │ values │    │    │    │ MORE >>  │
└──────────┴────┴────┴────────┴────┴────┴────┴──────────┘
```
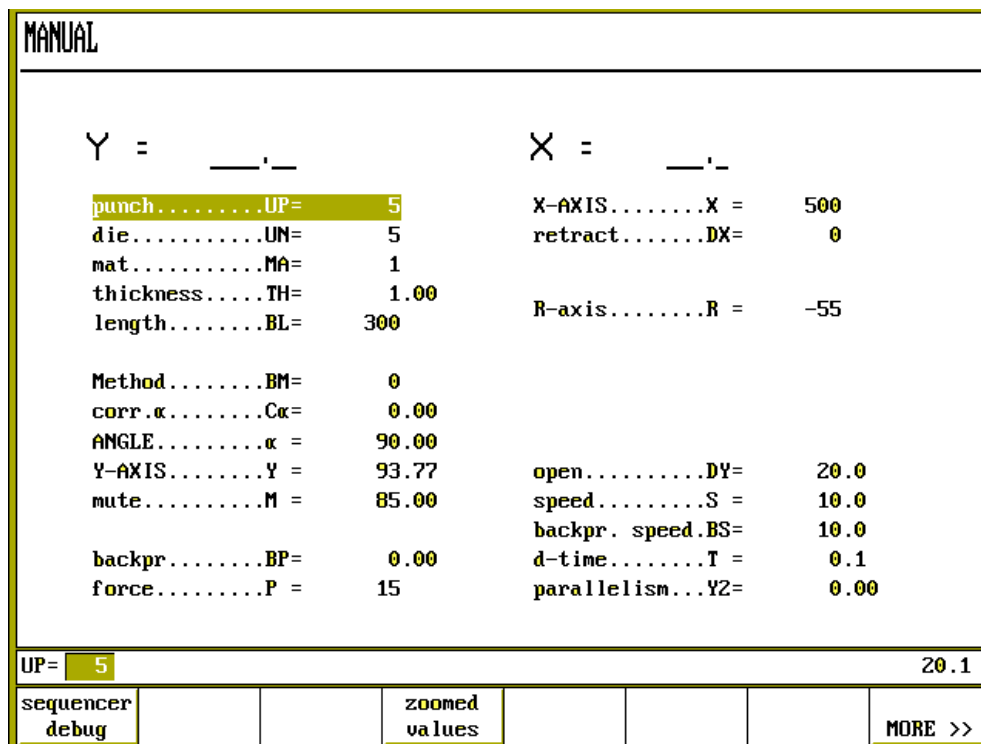
Figure 122.a

Parameter 123-130: **Sequencer options**

Range : 0000 - 1111
Default : 0000
Units : -

Function
To set general purpose sequencer option flags.

Description
You can set 4 flags per sequencer option parameter. Each flag can have the value 0 or 1.
- sequencer option flags   4..1   123 = 0000
- sequencer option flags   8..5   124 = 0000
- sequencer option flags   12..9   125 = 0000
- sequencer option flags   16..13   126 = 0000
- sequencer option flags   20..17   127 = 0000
- sequencer option flags   24..21   128 = 0000
- sequencer option flags   28..25   129 = 0000
- sequencer option flags   32..29   130 = 0000

To set option flag 1 and 2 you should program parameter 123 as 0011. Pay attention that you count **from right to left**. The lowest flag of each parameter is the most right digit.

These option flags are mapped on the flags 7664 - 7695. These flags have also been added to the press.def file. Therefore with parameter 123 set to 0011 the flags 7664 and 7665 will be set to 1.

Variable	Flag
M-OPTION1	7664
M-OPTION2	7665
...	...
M-OPTION32	7695

Note 1
If you are using the standard Delem sequencer and <u>not</u> creating your own sequencer, then these parameters have no function.

Note 2
For more information about working with the sequencer file please refer to the sequencer manual. This manual can be requested at Delem.

Parameter 131: **UAP from floppy on/off 1/0**

Range : 0 - 1
Default : 0
Units : -

Function
To read the UAP.CMD file from floppy.

Description
During development and testing it can be helpful to read the UAP.CMD file from floppy instead of loading a complete new application.
0 = use the internal UAP file, if valid.
1 = load UAP.CMD from floppy
Press the key to select the required setting.

With this parameter set to 1 the UAP.CMD file is read from floppy during start up.
The file UAP.CMD can be compared with the file APPL.CMD: it is a short text file with instructions for the control to copy UAP files from floppy to the control. Make sure the intended UAP (User Application) is present on the floppy disk.

After testing the UAP.CMD file you should set this parameter to 0 again. Once the UAP has been tested and approved, the instructions of the UAP.CMD file can be integrated in the normal application loading procedure. Therefore you should modify the APPL.CMD file on the application floppy. Make sure the required UAP file is on the application disk with the other files.
For more information about UAPs please contact Delem.

4 Auxiliary axes

4.1 Introduction

In this chapter the configuration procedure of axes is explained. This procedure is valid for all axes, except the Y-axis.

Typical parameters for servo drives or AC drives are explained in chapter 5. Special axes and their parameters are explained in the chapters 6 through 9.

The following axis types can be programmed on a control:
- X-axis
- X2-axis
- R-axis
- R1-axis
- R2-axis
- R3-axis
- R4-axis
- Z-axis
- Z1-axis
- Z2-axis
- ZM-axis
- I-axis (chapter 8)
- general purpose, X1-axis
- general purpose, X2-axis
- general purpose, X3-axis
- general purpose, X4-axis
- Part support and additional axes (chapter 9)
- Crowning (chapter 6)
- Digital axes (chapter 7)

4.2 Configuration procedure of axes

An axis is configured in two steps:

1. select and configure the correct module for an axis,
2. enable an axis and program its parameters.

The only exception to this rule is the Y-axis. Once a module is configured to control the Y-axis, the parameters for the Y-axis can immediatly be programmed through option 1: Y-axis and general parameters.

Step 1 is done with option 3 of the parameter menu: Module configuration. The following screen appears:


```
DM CONFIGURATION

    BOX      ID BOOT     FLASH     AXIS
     20  305528  V1.3     V3.8      Y       X       _____ _____
     10 2012313  V1.4     V3.4      R               _____ _____ _____
     50  205132  V1.2     V2.8     X2               _____ _____ _____
      0       0                                     _____ _____ _____
      0       0                                     _____ _____ _____
      0       0                                     _____ _____ _____
      0       0                                     _____ _____ _____
      0       0                                     _____ _____ _____
      0       0                                     _____ _____ _____
      0       0                                     _____ _____ _____
      0       0                                     _____ _____ _____
      0       0                                     _____ _____ _____
      0       0                                     _____ _____ _____
      0       0                                     _____ _____ _____
      0       0                                     _____ _____ _____

BN=  20                                                              19.0
        next                                alphanum.        update
        page                                                 software
```

Figure 4.2.a

- In the first column, the box number of the module must be entered.
- In the second column, the DM-identifier of the module must be chosen with the key ⌂. Select the correct DM-identifier from the list of numbers.
- From the fifth up to the eighth column, the axis types can be chosen. Press the key ⌂ to select the required setting.
- Any mistake in assignments can be corrected by moving the cursor to the relevant field and press softkey S5: 'clear entry'.
- When all assignments are carried out, press 'END' to leave this menu. If any errors are detected in the assignments, a warning is given. Press '1' to leave the menu or '0' to return to the menu and correct the error.

Box number The boxnumber consists of 2 digits. The first digit indicates the type of connected module and the second digit indicates the sequence number of the same types of modules. The box number helps you organize your relay cabinet.

Box Number = X X
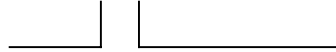
Module type **Sequence number 0 - 9**

DM01 = 1
DM02 = 2
DM04 = 4
DM05 = 5

Example:
A DA-65 connected with 1x DM02, 1x DM05 and 3x DM01 will have box numbers 20, 50, 10, 11 and 12 to be programmed at the box number parameters at the respective axes.

By default, 8 modules can be connected to the control through the HSB link.
On the DA-65 and DA-69 it is possible to create two additional HSB links with option cards, which makes it possible to connect a total of 24 modules to a control.
If more than ten modules of the same type are present in the system, the second digit of the box number may also be an alphanumerical character. For example, for more than ten DM01 modules the box numbers are: 10..19, 1A, 1B, etc. The alpha-numerical input can be done in the standard way.

DM-identifier Every module has been foreseen with a sticker, indicating the unique identifier. When the cursor is placed on the identifier parameter it will therefore be possible to list the identifier numbers of the connected modules.The number is also known in the board computer of the module. The control communicates via the high-speed bus with the connected modules.

NOTE
The CNC control and the connected modules must get their power supply at the same time for correct communication and initializing. The modules within 1 second after switching on the control.

Step 2 is done with option 2 of the parameters menu: Auxiliary axis. The following screen appears:

```
MACHINE CONSTANTS                                       mach.no:        1


         AXIS:  1    ███enabled███        X               Servo

         AXIS:  2      enabled            X2              Servo

         AXIS:  3      enabled            R               Servo

         AXIS:  4      disabled           R               No Control

         AXIS:  5      disabled           R               No Control

         AXIS:  6      disabled           R               No Control

         AXIS:  7      disabled           R               No Control

         AXIS:  8      disabled           R               No Control


                                                                    19.0
┌──────────┬──────────┬─────────┬─────────┬──────────┬──────────┬────────┬────────┐
│ previous │ next     │         │         │ change   │ enable/  │        │        │
│ page     │ page     │         │         │ par.     │ disable  │        │        │
└──────────┴──────────┴─────────┴─────────┴──────────┴──────────┴────────┴────────┘
```

Figure 4.2.b

A maximum of 24 axis can be configured through this menu.
- In the first column is indicated whether an axis is switched on or off. Use the softkey S6 'enable/disable' to change its setting.
- In the second column the axis type is selected with the key ⌂. A pop-up menu appears, in which all known axis types are listed. Select the correct type.
- In the last column the drive type for the axis is selected. Available choices are Servo, AC or No Control. If 'No Control' is selected, the axis values are calculated and displayed in the user screens, but no 'real' axis is controlled: a so-called 'dummy axis'.

Once an axis has been configured in this menu, press softkey S5 'change par.' to program the parameters of the axis.

When the machine parameters menu is left, the control checks if the axes are configured properly. If this is not the case, the control will issue a warning:

   ** Warning: Not all axes are mapped on a module. **

   Continue ? 1/0:

Press 1 to continue or 0 to return to the machine parameters menu. To solve this issue, repeat steps 1 and 2 and check your axis/module configuration.

4.3　　R-axis specific parameters

The following R-axis specific parameters are explained:
- backgauge-die collision detection with R-axes;
- automatic R-axis adjustment.

Backgauge-against-die collision detection
When you have enabled a R-axis (also R1 and R2) then the collision detection for backgauge-against-die is active. A collision can occur when the R-axis position is negative. This means that the backgauge finger lower is than the die height.

There are three critical situations. For all these situations a necessary condition is that the **R-in** input has to be active to be able to move the X-axis into the safety zone!
- The X-axis has to move into the V-die safety zone. The R-axis will first move to a positive position before the X-axis moves to the programmed position.
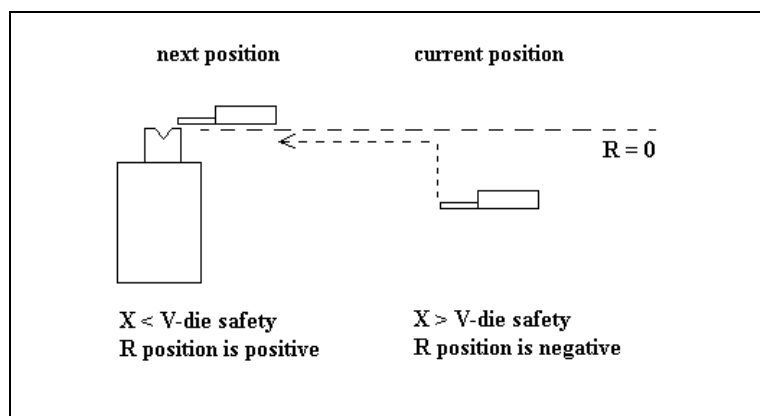
Figure 4.3.a

- When the R-axis has to move from positive to negative, the X-axis must move out of the V-die safety zone. The X-axis starts moving backwards but the R-axis does not move until the X-axis is out of the safety zone.
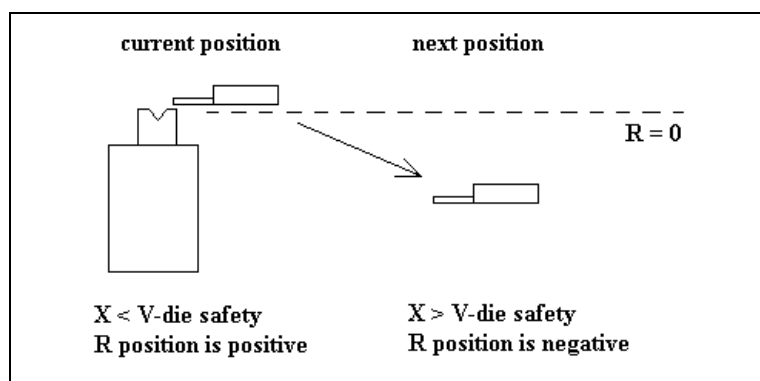
Figure 4.3.b

- When the next R-position is negative and within the V-die safety this will always give collision. The control will give a warning and the "start" button will not be accepted.
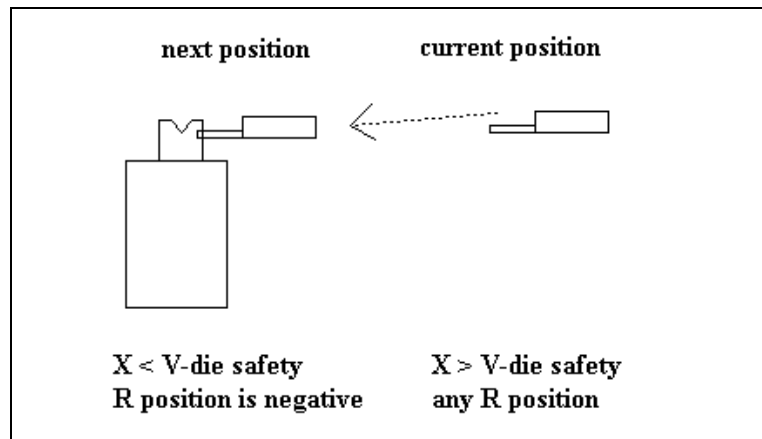

Figure 4.3.c

Automatic R-axis adjustment

The zero position of the R-axis always corresponds with the position (height) of the upper side of the die. When the height of the die changes - you have selected a die with another height - the zero position of the R-axis is automatically adjusted to the height of the new programmed die.

In the machine parameters menu of the R-axis it is also necessary to program the R-axis reference value (parameter 5, only in case of encoder position measurement). This parameter is necessary to be able to adjust the R=0 position to the top of the die. The reference value you have to program is the distance between the R-axis position at the reference pulse (of the encoder) and the top of the die.
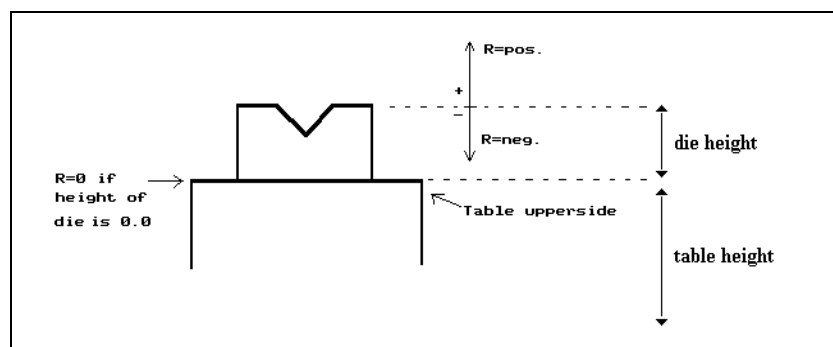
Figure 4.3.d

Besides the zero position adjustment you also have to program in the machine parameters the maximum and minimum value of the R-axis. These values are related to the absolute R-axis values. These R-axis values have to be determined without tools. The maximum value of the R-axis is the mechanical stroke length above the table and the minimum value of the R-axis is the mechanical stroke length below the table. So the Rmax. and the Rmin. parameter are related to the top of the table.

The value of the R-axis on the control screen always relates to the top of the die!

4.4 Z-axis specific parameters

There are two types of Z-axis:
- A single Z-axis. In this case both fingers move symmetrically from and to eachother from the middle of the machine. The sheet is also always positioned from the middle of the machine.
- A Z1-axis and a Z2-axis. In this case the fingers are separately controlled by an auxiliary axis. Default the middle of the sheet is positioned in the middle of the machine, but also other positions can be programmed.

A single Z-axis
The Z-axis position is automatically computed. To compute these positions the parameter Z-distance is necessary. You can find the Z-distance parameter in the program constants menu of the programming mode. The Z-distance is the distance from the end of the sheet to the middle of the Z-axis finger.
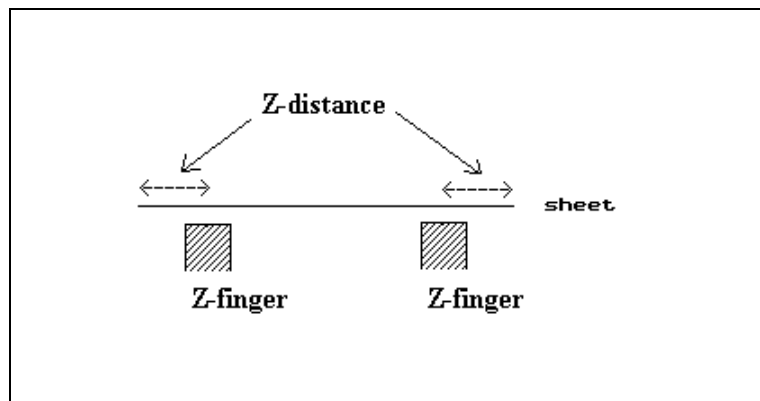
Figure 4.4.a

In data preparation and data editing the Z-value is automatically computed during postprocessing. The Z-axis value is computed according to the formula:

- $Z = L - 2 \times Z\text{-distance}$ (L = programmed product length)

A Z1-axis and Z2-axis
When you have a Z1-axis and a Z2-axis, you have to program four machine parameters:
- Z1min;
- Z1max;
- Z2min;
- Z2max.

To prevent collision of the fingers the following condition is necessary:
- Z2min - Z1min > mechanical distance

This distance should always be taken into account.

Therefore you must program Z1min value and Z2min value with respect to this distance.

Example: if the mechanical distance between the fingers is 25mm and Z1min = 100. Then you have to program Z2min to 125. Furtheron the control will take care that this distance is always respected.

When you press the start button and 'Z2min - Z1min is smaller than the mechanical distance between Z1 and Z2', the message 'Z1 - Z2 axis conflict' appears on the screen. Start is not accepted in this case.

In the automatic mode and manual mode the programmed values for Z1 and Z2 are checked to prevent collision between the Z1- and Z2-axis.

Figure 4.4.b

For calculation of the Z-axis positions, the following operator parameters are relevant:
- Product length. This is a product parameter.
- Z-distance. This parameter can be found in the program constants menu and defines the distance of the end of the sheet to the middle of he Z-finger.
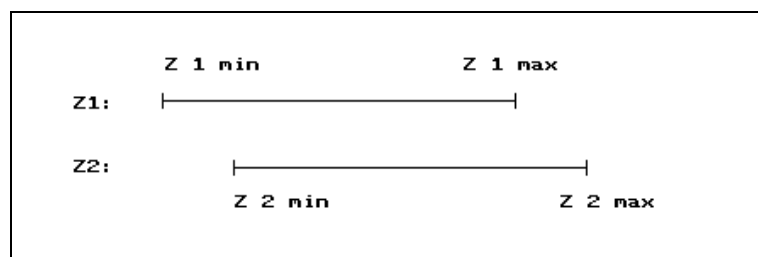- Z-position. This is a punch parameter to program an offset for the punch position, related to the middle of the machine. As such, this parameter can be positive or negative.

Default the Z1- and Z2-axis values are computed positioning the middle of the sheet in the middle of the machine. The next fomulas are used:
- Z1 = 0,5 (Z2max - Z1min) + Z1min - 0,5L + Z-distance + Z-position
- Z2 = 0,5 (Z2max - Z1min) + Z1min + 0,5L - Z-distance + Z-position

When you want to use another machine position then you can program the Z1-axis value. The corresponding Z2-axis value will be computed when you place the cursor at the Z2-axis parameter in the data preparation or data editing menu. In this case the following formula is used:
- Z2 = Z1 + L - 2x Z-distance

Example
The following parameters have been programmed.
- Z1min = 0
- Z1max = 3000
- Z2min = 200
- Z2max = 3200

- Z-distance = 10 mm
- Product length = 1000 mm

In figure 4.4.c you find the computed values for the default situation and the situation with a programmed Z1-position.
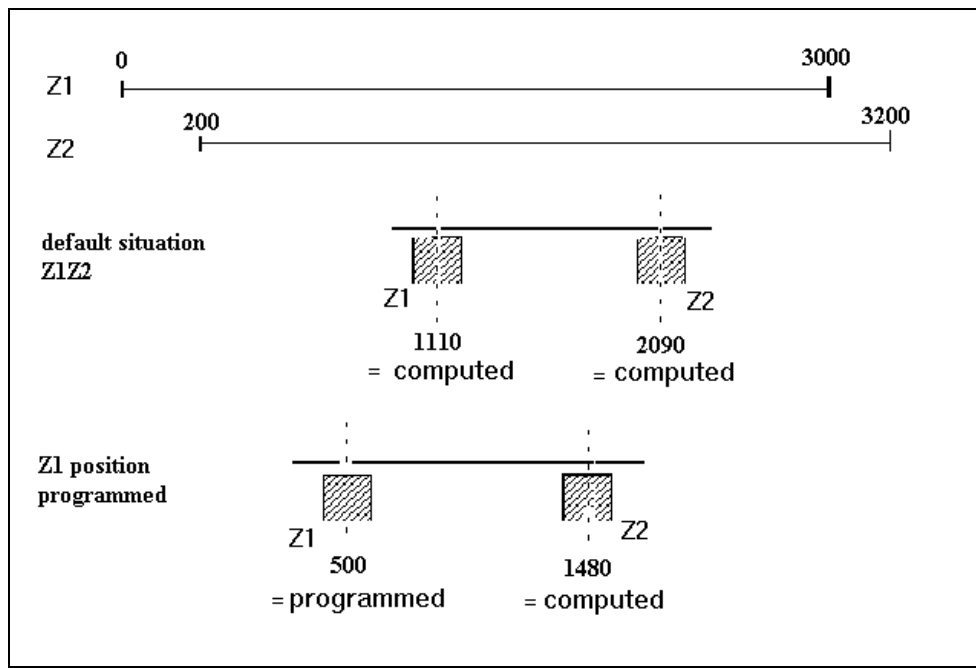

Figure 4.4.c

When the Z1 and Z2 axes have to move in the same direction, a collision could occur when the speed of both axes is not adjusted exactly the same. Delaying the start of the movement of one of the axes will prevent this. Which one of the axes is delayed depends on the direction of the movement. The delay time is 500ms.

Zm: a third Z-axis

For long, narrow sheets it can be useful to have a 3rd Z-axis (Zm) to support the sheet in the middle. By adding Zm to the configuration, the sheet will be perpendicular to the press beam when the operator pushes the sheet against the back gauge (see figure).
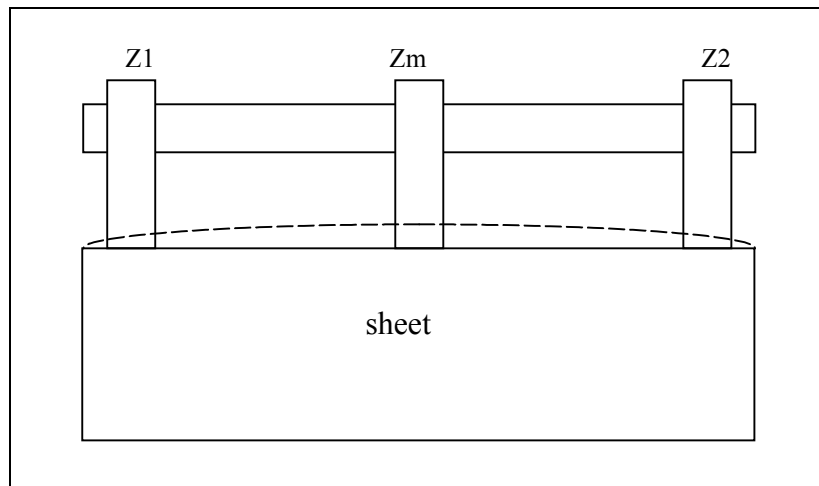
Figure 4.4.d

The position of Zm is automatically calculated to be in the middle between Z1 and Z2. The minimum distance between the axes is guarded and the post processing also includes Zm. For the moment Zm is not supported in 3D graphical mode.

4.5 A second X-axis

A second X-axis is called an X2-axis. When you have enabled an X2-axis then the programmed value of the X-axis (or X1-axis, this is programmable with machine parameter X/X1 select) is automatically copied to the X2-axis. In data editing the X-axis value is prompted when you are with the cursor on the X2-axis.

Also the programmed values for X-opening (retraction) and X-code will also be active for the X2-axis. In automatic mode and Step-by-step mode you can program corrections for the X-axis as well as for the X2-axis.

When a second X-axis is implemented, several X2-specific parameters should be programmed. These parameters are used to describe the backgauge construction that is installed and will be described in this section.

Parameter: XX
X2 relative to X (1=on, 0=off)

Range : 0-1
Default : 0
Units : -

Function
To indicate whether or not a special X2-axis is installed, which movement is relative to the movement of the X-axis. Press the key ⬜ to select the required setting.

Description
This parameter must be set to '1' if a special backgauge is installed. With this system, the backgauge finger for the X-axis is fixed on a beam and the X2-construction is mounted on the same beam.
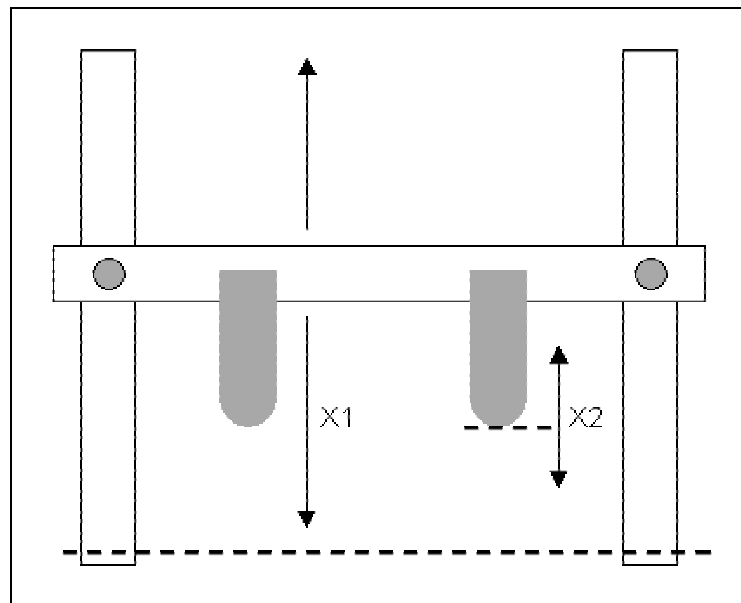
Figure 4.5.a

Such an axis should be configured as follows:
• the parameter 'X2 relative to X' should be programmed to 1
• the parameter 'backgauge type' should be programmed to 0(=console)
• the parameter 'decimal point position' should be the same as for the X-axis
• the minimum and maximum values should be according to the mechanical range of the X2-gauge
• the reference position should be adjusted such, that its zero position equals the position of the X1-axis.
In user mode the X2 value is converted for the user. If X1 and X2 are programmed equal then the two fingers will have the same backgauge position.

Parameter: 7
Max X1X2 difference

Range   : 0 - 9999
Default   : 0
Units   : mm

Function
To program the maximum allowed difference between the two X-axes.

Description
With this parameter a maximum allowed difference in values between the X1- and X2-axis can be programmed.

Parameter: 8
Backgauge type

Range   : 0-1
Default   : 0
Units   : -

Function
To program the type of backgauge construction that is used.

Description
With this parameter the type of backgauge instruction on the machine is indicated. The control makes a distinction between two types of backgauges, console type or crossbeam type.
0 = console type (default)
1 = crossbeam
Press the key ⬠ to select the required setting.
The different backgauge types are described at the beginning of this section. For a system with a relative X2 axis as described with parameter XX, this parameter should also be set to 0.

Console type
This is a backgauge construction with independent gauges, each backgauge is driven by its own gauge construction. The positions of X1 and X2 can be programmed directly. The parameter 'backgauge type' should be programmed to 0.
In user mode, the gauge positions and axis values are identical.
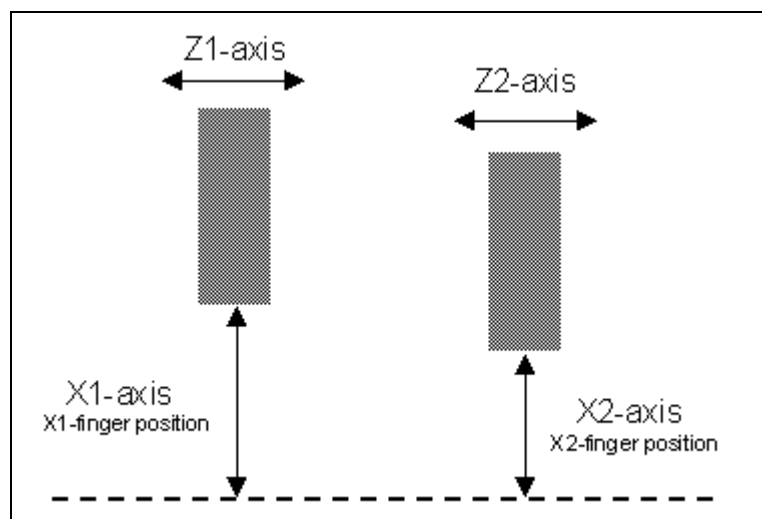
Figure 4.5.b

Crossbeam

With this construction both gauges are mounted on one beam. Different positions for X1 and X2 are achieved by turning the beam. The parameter 'backgauge type' should be programmed to 1. In case of a crossbeam construction, the four distances A, B, C and D should be programmed to describe the dimensions of the gauge construction. These dimensions will be used in the calculation of gauge positions.
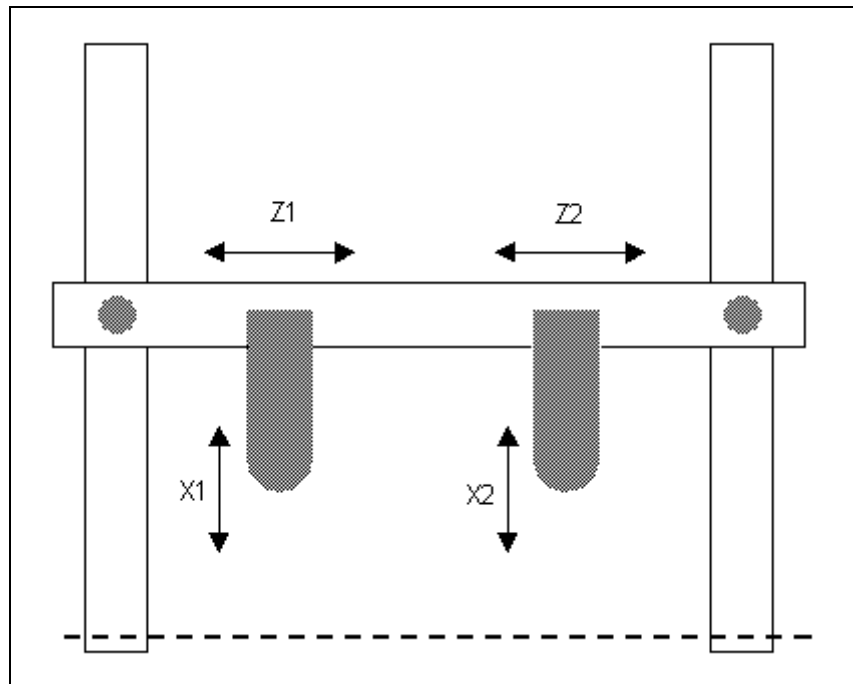
Figure 4.5.c

Parameter: 9 - 12
Distance A-D

Range : 0 - 9999
Default : 0
Units   : mm

Function
Dimensions of a crossbeam backgauge system.

Description
These four distances are used to describe the geometry of the machine in case a crossbeam is used.
The meaning of these dimensions is:
A: Length of fingers measured perpendicular from the turning point of the Z-axes to the end of the fingers.
B: Distance between the turning points of the crossbeam.
C: Z1-axis position of the left turning point of the crossbeam.
D: Radius of the end of the finger (0=no radius).
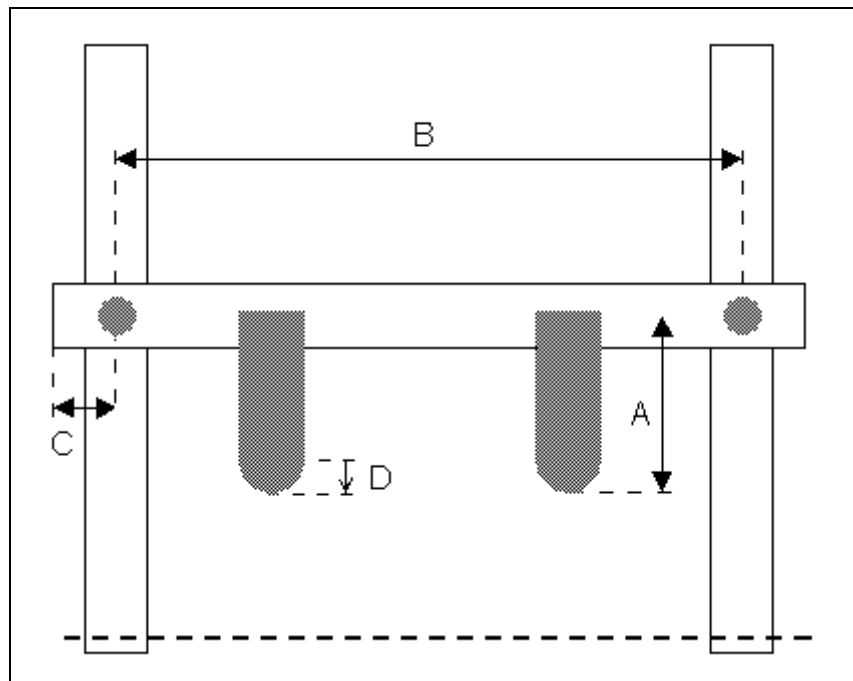
Figure 4.5.d

4.6 X1X2 difference programming (option)

This option serves to determine the X1 and X2 axes positions from the required backgauge positions. It means that the user can program the required backgauge positions in the data edit mode and the control will automatically calculate the necessary axis values. This feature can be used with a crossbeam system or a console system. For this matter, a system with a relative X2-axis may also be considered as a console system. There should also be a Z1- and Z2-axis installed.

There are two ways to program X1X2 difference:
- angular method
- projection method

These methods can be chosen in menu 11 with the program constant 'X1X2 difference programming'.

Angular method

With the angular method, the finger positions can be programmed with an angle value and the distance between the two fingers. The angle is defined as the angle between the bend line and the fingers of the crossbeam.

These values can be programmed in data edit mode in a special pop-up window. This pop-up window can be activated through a softkey 'gauge func' that is only available when the cursor is placed on X or X2. Values of either X1 or X2 can be adjusted according to this cursor position.

```
DATA EDITING              bending no: 1    prod.no:      1003
                                           draw.no:


              punch............UP=        2
              die..............UN=        2
              bend method.......BM=       0


              ANGLE...............α =         -7.13
              LENGTH..............ΔZ=       383
              Gauge pos...........GP=         0
              R-finger position.....R =       0
  X1-finger position....X1=      98.4   X2-finger position....X2=      50.9
  Z1-finger position....Z1=     1666    Z2-finger position....Z2=     2049


              delay time........TX=        0    sec

              R-axis...........R =         0    mm
              Z1-axis..........Z1=      1666    mm


 α =   -7.13  °                                                  4.2

                                                       cancel
```

Figure 4.6.a

If the cursor is on X and the pop-up window is activated, the values for the angle, the distance and the position of the X1-finger can be programmed through X1 and Z1. The values of X2 and Z2 will be adjusted according to the values of distance and angle, they cannot be altered directly. If the cursor is on X2 and the function is activated, angle, distance and the position of the X2-finger can be altered and X1 and Z1 will then be calculated.
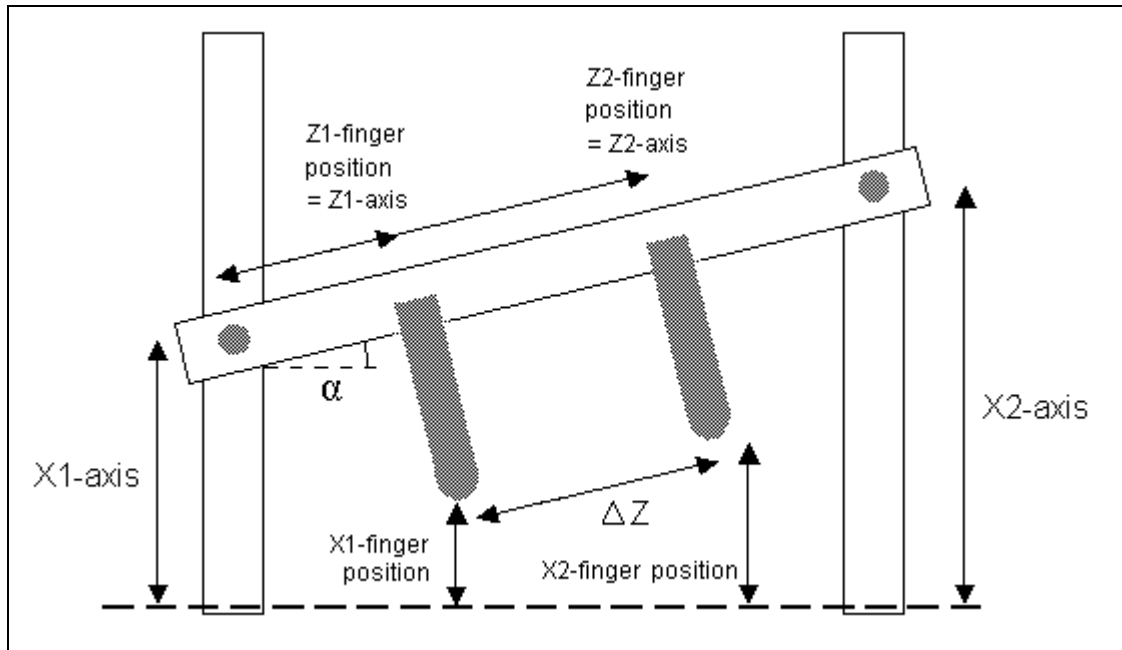
Figure 4.6.b

In case of a crossbeam system, X1/X2 must be programmed as the distance from the bend line to the gauge point, Z1/Z2 is simply the value of the Z-axis on the crossbeam.
In the case of a console system, the programmed gauge position co-ordinates and the calculated axis values are similar.

Projection method

With the projection method, the exact gauge positions of the two fingers must be entered in a similar pop-up screen in user mode. Both X- and Z- values refer to the finger positions. The resulting axes values will be calculated from these finger positions.

In the case of a crossbeam system, axis values will be calculated from the position co-ordinates. In the case of a console system, the gauges co-ordinates and the axis values are identical. Hence there is not much sense in using the projection method with a console type system: axis values can be programmed directly in data edit mode anyway.
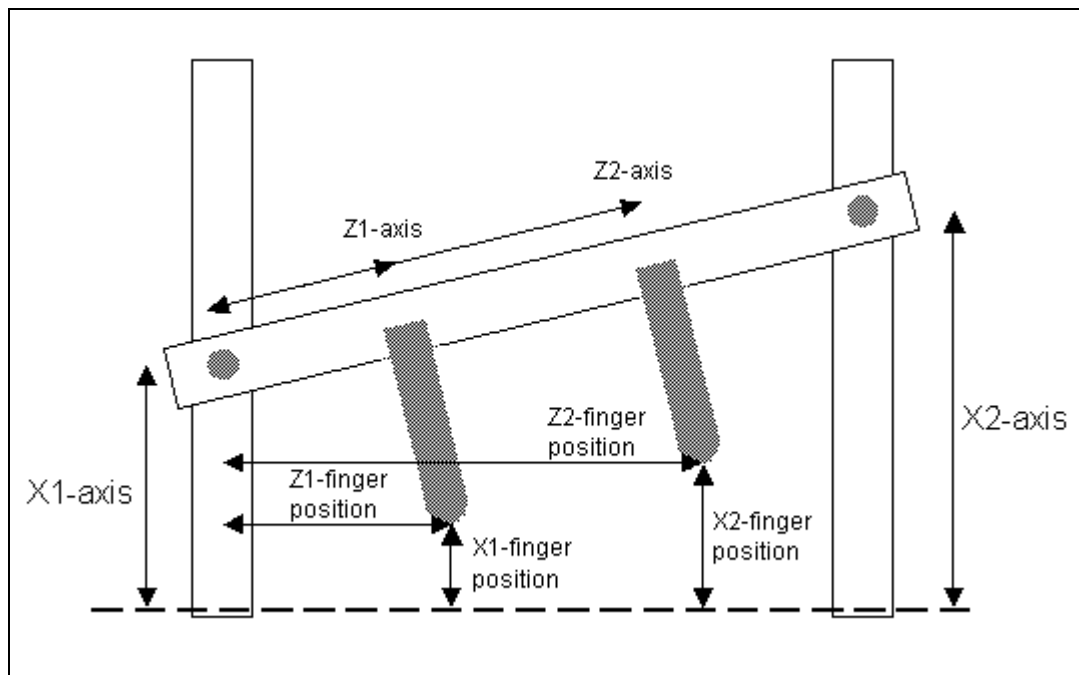
Figure 4.6.c

4.7   The spindle correction table

With this feature an axis position can be corrected for deviations in the spindle. The spindle deviations can be programmed in a table. The correction at every other position of the spindle is computed by means of linear interpolation.

A method to determine the contents of this table can be the following:
- First adjust the reference position of the axis.
- Program a value for the axis position in Manual mode and press start. Measure the actual backgauge position.
- Repeat this procedure several times.
- Compute the deviation of each measured point according to the following definition:
  Δ(Delta) = measured value - programmed value

Note
The number of points which must be measured depends on the specification of the spindle.

- Now make a graph of these results.
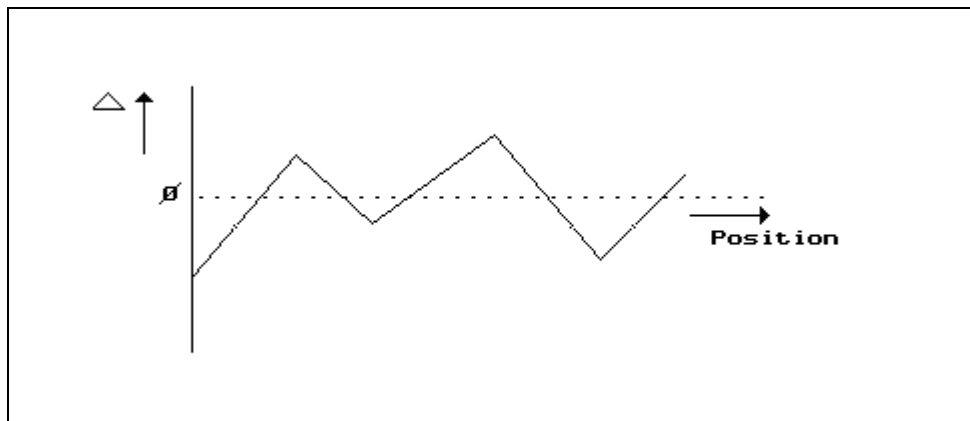
Figure 4.7.a

Select up to the maximal number of points from this graph which will give the best approximation of the original curve. These points must be programmed in the table.

The resolution of the axis values in the correction table is 1mm. The resolution of the deviation (delta) is 10 times the axis resolution. E.g. axis resolution is 0.1 mm, then the resolution of the deviation is 0.01mm. The points must be programmed in an increasing order of the axis positions. The length of the intervals between the points may vary. An entry with the axis position not programmed (____) or programmed with a lower value as its predecessor will be considered as the end of the table.

To build a spindle correction table, a plain ASCII text file must be created with table values as follows:

```
;VERSION: Example-X
;CONFIG: X: C
X10 C0.5
X500 C1.0
X1000 C2.6
```

In this example, three setpoints are defined for the X-axis. The 'VERSION' statement on the first line can be used to define a name or version for the table, but this is not compulsory.
The 'CONFIG' statement must be used to define the format of table entries. On the lines that follow, the actual table entries are written.

A spindle correction table can be loaded from floppy. To be able to recognise a table for a certain axis, each table has a unique filename, 'spcorXX.tab'. In this name, 'XX' must be replaced by the index number of the required axis.
The following axis numbers can be used in filenames for tables:

00	X-axis
01	R-axis
02	R1-axis
03	R2-axis
06	Z-axis
09	Z1-axis
10	Z2-axis
13	I-axis
15	X2-axis
17	general purpose, X3-axis
18	general purpose, X4-axis
19	general purpose, X1-axis
20	general purpose, X2-axis
21	Part support
40	R3-axis
41	R4-axis

A table can be loaded in the parameter menu of the appropriate axis. In this menu the softkey 'load cor. table' is available. When pressed, the control will search for a valid file in the floppy drive. If loading was succesfull, the string 'SpCor.:' will appear in the top row followed by the name or version of the table, if present in the textfile. If loading was not succesfull, the message 'File does not exist' is displayed.
A loaded correction table can also be erased with the softkey 'delete cor. table'. This softkey appears automatically after a table has been loaded.

The contents of the spindle correction tables can be edited on the DA control. When a spindle correction table is installed for a servo axis the following soft key will appear in the auxiliary axis screen:

S6: edit table

If S6 is selected, a submenu is opened. The actual contents of the table are shown on the screen. Two columns are shown with the following tags:

X = axis position
C= correction value

The tags shown on the screen should correspond with the tags as specified in the table file.

With the softkeys the following functions are available:

S3	modify entry	the contents of the line, which is selected with the cursor, can be modified
S4	new entry	enter a new line in the table
S5	delete entry	the line, which is selected with the cursor, can be deleted
S6	save table	the file, as shown on the screen, is saved to the internal memory

5 Auxiliary axes parameters

5.1 Introduction

In this chapter the machine parameters for several axis types are explained.
Paragraph 5.2 shows standard parameters for axes.
Paragraph 5.3 shows parameters for Servo axes.
Paragraph 5.4 shows all parameters for axes with AC drives.

Parameters for special axes are explained in chapters 6 through 9.

5.2 Standard axis parameters

On the following pages the standard axis parameters are explained.

These standard parameters will occur on almost all axes, regardless of Servo control or AC control.

Parameter 7: **Min. value**

Range : -999999.00 - +999999.00
Default : -9999.00
Units : mm

Remark : In case of an R-axis (R, R1 and R2) see also section 4.3.

Function
Minimal auxiliary axis value in display units. When the axis is moved manually the position is also limited at this value.

Parameter 8: **Max. value**

Range   : -999999.00 - +999999.00
Default : 9999.00
Units   : mm

Remark   : In case of a R-axis (R, R1 and R2) see also section 4.4.

Function
Maximal auxiliary axis value. When the axis is moved manually the position is also limited at this value.

Parameter 12: **In position tolerance**

Range : 1.0 - 999.0
Default : 1.0
Units : mm

Function
Zone in which the in-position output is active.

Description
Each axis has an in-position output. The parameter 'In position tolerance' defines the zone in which this output is active. The output is active when:

Programmed value - actual value < +/- In position tolerance
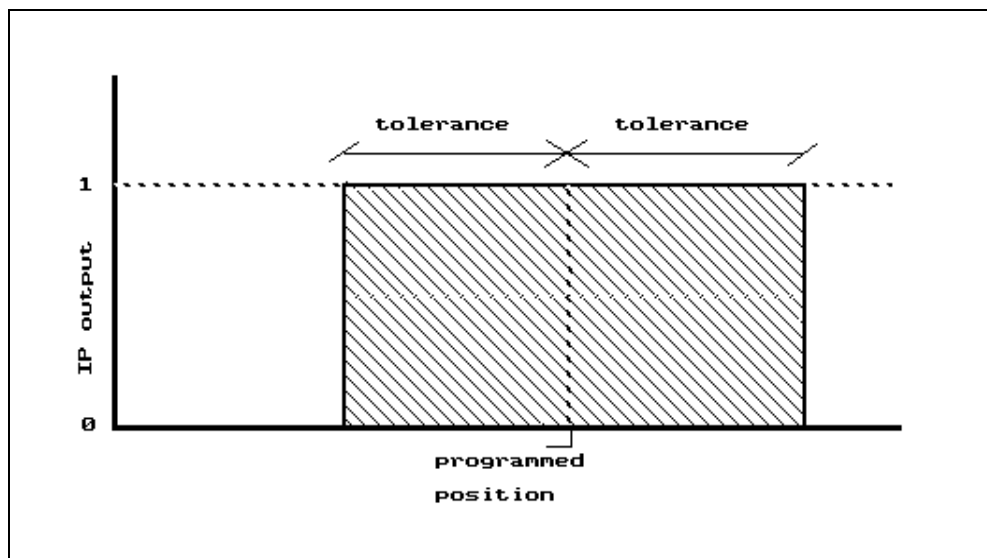
Figure 5.2.a

Parameter 28: **Position measurement system**

Range : 0 - 1
Default : 0
Units : -

Function
To select the position measurement system of the axis.

Description
You can select for each axis two types of position measurement systems.
0 = encoder
1 = potentiometer
Press the key ⬚ to select the required setting.

Encoder position measurement
The value of this parameter has also consequences for the use of other parameters.
When you have the encoder position measurement, then you can program the following parameters:

  Pre scaling.................................... 9
 Reference position........................ 5
 Ref. search direction..................... 6
 RSD switch mounted.................... 17
 Reference search speed................. 21

Potentiometer position measurement
When you have the potentiometer position measurement you have instead of parameters 9, 5, 6, 17 and 21 the following parameters to program:
 AD-min.. 29
 AD-max....................................... 30

Parameter SL: **Number of slaves**

Range   : 0 - 4
Default   : 0
Units   : -
Remark   : Not for X- and X2-axis

Function
To program the number of slave axes.

Description
It is possible to have four axis in slave function of the master axis. This means that up to five R-axes can be driven to the same value as programmed for one single R-axis in the control. Each slave axis is independently controlled by a DM module.

You only have to program the master axis position and the slaves axes will follow. The slave axes positions will not appear in the user interface. When you have defined the number of slaves, the softkey 'show slaves' appears. With this softkey you get access to the slave axes parameters. The following parameters are required for each slave axis:
• Reference position;
• encoder count direction.

All other machine parameter settings are automatically used/copied from the master axis.

Note
The control also has the possibility to program the slave axes positions individually. In this case the parameter Individual pos. programmable should be 1. In Data preparation, Data editing and Manual mode the softkey 'show slaves' will appear to program the slave positions.

Parameter 9: **Pre scaling**

Range   : 0.000 - 9999.999
Default   : 1.000
Units   : counts/mm
Remark   : Only in combination with the **encoder position measurement system**.

Function
To set the scaling for correct encoder counting. Number of count pulses (of the encoder) per mm.

Description
This parameter defines the relation between the count pulses and the values programmed and displayed on the control.

Example
Axis with spindle with pitch of = 5.0 mm and 50 encoder pulses per rotation. This means 50 pulses/5.0 mm displacement.

50 pulses/5.0 mm = 10 pulse/mm

The encoder pulses should be multiplied by 4 because, all four states of one period are counted by the control.

Pre scaling = 10 * 4 = 40

Parameter 5: **Reference position**

Range : -9999.99 - +9999.99
Default : 0.00
Units : mm
Remark : Only in combination with the **encoder position measurement system**.

Function
Auxiliary axis reference position.

Description
This is the position of the reference encoder on an auxiliary servo axis.

In the manual mode of the control you can display the actual position of an auxiliary axis with the softkey 'manual positioning'. If the auxiliary axis has not passed its reference yet the position is displayed as follows: -.-.

The auxiliary axis will start its reference search cycle after it receives its first position from the control.

The reference search cycle is as follows:
1   Push the start button of the control.
2   The axis moves to one side until an end of travel (EOT)-switch is reached.
     The direction in which the axis starts moving depends on the parameter 'reference search direction'. Reference pulses during this movement are ignored.
3   After 200 milliseconds the axis moves in the opposite direction until the reference is passed.
4   Axis moves to the programmed position.

Parameter 6: **Reference search direction**

Range : 0 - 1
Default : 0
Units : -
Remark : Only in combination with the encoder position measurement system.

Function
Axis reference search direction.

Description
When the start button on the control is pressed the first time after power on, all the axes start their reference search cycle. This also includes auxiliary servo axes.

This parameter defines the direction in which the servo axis starts moving to search for the reference:
0 = search in counting down direction
1 = search in counting up direction
Press the key ⌂ to select the required setting.

The complete reference search cycle is described at parameter 17, 'RSD switch mounted'.

Parameter 17: **RSD switch mounted**

Range : 0 - 1
Default : 1
Units : -
Remark : Only in combination with the encoder position measurement system.

Function
RSD-switch mounted and used for reference search yes (1) or no (0).

Description
Two systems for reference search are implemented:
1. without reference search direction switch (program 0)
2. with a reference search direction switch (program 1)

Press the key ⌂ to select the required setting.

System 1
The standard reference search system. For this system the motor drive must be equipped with a direction sensitive enable/disable input.

System 2
The motordrive does not need any direction sensitive enable/disable input for reference search. Also you are free where you place the reference search direction switch (RSD). It may be the same switch; EOT-switch.
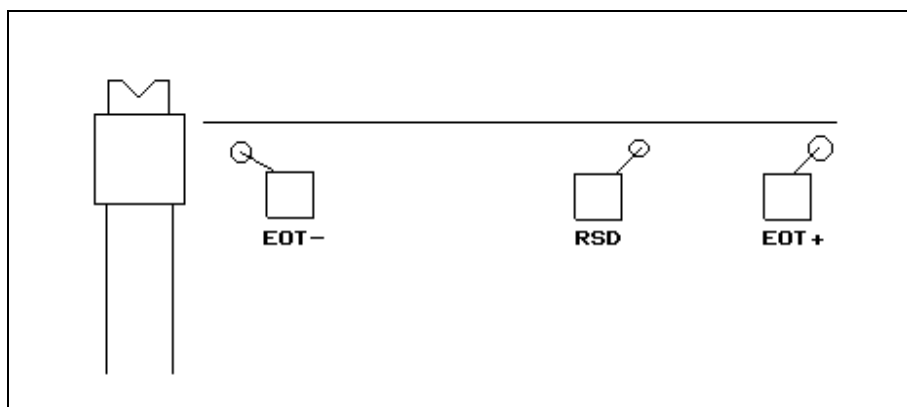
Figure 5.2.a

The advantage of the reference search cycle with system 2 is that in case the RSD switch is mounted in the middle of the X-axes stroke, the control senses the status of this switch. In case the X-axis is between the die and RSD switch a normal reference search cycle is initiated. In case the X-axis is between the RSD and EOT+ switch the status of the RSD switch indicates that reference search can start in the direction of the RSD switch (forward). Overall you will have shorter reference search cycle time. Another advantage is the fact that it is not needed to mount the limit switches for ref.-search.

Note 1
Reference switch activated means RSD input on axis connector is low. Reference switch not activated means input is high (+24V).

Note 2
To be sure that the Ref.-switch (RSD) is mounted, the control will only move the backgauge over the following distance for taking reference. This in case the RSD-switch input is active (low) at the start of the reference search cycle.
A)   Ref. search direction backwards: 1.5 x (max. position - ref. position)
B)   Ref. search direction forwards: 1.5 x (ref. position - min. position)

Reference search sequence in combination with R- and Z-axes
When the start button is pressed the first time after power on all axis will search reference first. During reference search the following cycle will be respected:
1. The X- and X2-axis move to the reference search direction switch (RSD). When RSD is activated the X- and X2 is stopped.
2. Start Z- and R-axes reference search cycle.
3. In case of Z1 Z2 they will stop at their reference position.
4. When the R-axes have found their reference they will move directly to their programmed positions.
5. When the Z-axes are at their reference position and the R-axes are at their programmed position the X-axis will start to move and take their reference. At the same time all other axes, except the R-axes, will start to move.

RSD
Active?   Yes

No

Move to the selected
reference   search
direction

Move to the selected
reference   search
direction

EOT switch activated:
motordrive   stops
movement

RSD switch activated:
stop movement   by the
control

No more movement
detected by the
control

The control enables
reference   input

Moves in opposite
direction

Move in opposite
direction until
reference   found

RSD switch
disactivated:
enable reference   input

after ref. found the
control disables ref.
input, move to prog.
pos.

Ref. found: the
control disables ref.
input, move to prog.
pos.

Figure 5.2.b

Parameter 21: **Reference search speed**

Range   : 1-100
Default : 50
Units   : %
Remark : Only in combination with the **encoder position measurement system**.

Function
Setting of the axis speed during reference search.

Description
The search speed for the reference marker can be adjusted by programming a percentage of the max. output voltage (10V).

Parameter 29: **AD-min**

Range   : 0 - 1024 (10 bits)
Default   : 0
Units   : AD-points
Remark   : Only in combination with the **potentiometer position measurement** system.

Function
Value in AD (analog-digital)-points corresponding to the minimal axis position.

Description
As there is in this case no encoder and therefore no reference pulse to determine the position of the axis you have to measure the position. If the control knows which voltage corresponds to the minimal and the maximal position, then each position in between can be determined.

The value of the analog input of the module varies between 0 V and 10 V. The accuracy of the analog inputs is 10 bits, meaning that you can divide the 10 V into 1024 steps or AD-points. So 1 V corresponds with 102.4 AD-points.
Move the axis to the minimal mechanical position (this corresponds with the programmed Min. Value), measure the voltage between the analog input and the 0V and calculate the corresponding AD-points. This value should be entered.

Parameter 30: **AD-max**

Range   : 0 - 1024 (10 bits)
Default   : 0
Units   : AD-points
Remark   : Only in combination with the **potentiometer position measurement** system.

Function
Max value in AD-points of axis position.

Description
see description AD-min.

Parameter 24: **Encoder count dir (0/1)**

Range : 0 - 1
Default : 0
Units : -
Remark : Only in combination with the **encoder position measurement system**.

Function

To change the counting direction of the axis encoder pulses.

Description

The position counting of the axis can be changed with this parameter. Press the key ⌂ to select the required setting.

Parameter 14: **Default value**

Range : -9999.99 - +9999.99
Default : 0.00
Units : mm

Function
Auxiliary axis default (position) value.

Description
This value is displayed on the control as initial value for the axis position when making a new program in Data Preparation. This value is also displayed in the Manual mode after the control is initialized.

Parameter 76: **Spindle allowance**

Range   : 0-1
Default   : 1
Units   : -

Function
One or two side positioning selection:

0= one side positioning
1= two side positioning
Press the key ⌂ to select the required setting.

Description
The one or two side positioning can be selected to overcome mechanical tolerances with two side positioning. In case of one side positioning the positioning direction is from a larger to a smaller position.

Parameter 84: **Overrun**

Range   : 0 - 9999
Default   : 50
Units   : count pulses of encoder

Function
Overrun distance in case of one-side positioning.

Description
The overrun value is always in the upcounting direction and is only valid with one-side positioning.

Parameter 85: **Overrun wait time**

Range   : 0 - 999
Default   : 500
Units   : 5 ms

Function
Wait time at the overrun position (see parameter 84) before the axis starts positioning in the opposite direction.

Description
This parameter can be used to program a delay before the motor is controlled in the opposite direction.

Parameter 15: **Decimal point pos.**

Range   : 0 - 3
Default   : 0
Units   : -

Function
Decimal point position of auxiliary axis value.

Description
This parameter defines the resolution (digits after the decimal point) in which the auxiliary axis values are programmed and displayed on the control.
0 = no resolution, value in mm
1 = 0.1 mm units
2 = 0.01 mm units
3 = 0.001 mm units

Press the key ⌂ to select the required setting.

Parameter 27: **Correction (X)**

Range   : -9.999 - +9.999
Default : 0.000
Units   : mm / 100mm
Remark   : In case of R-, R1-, R2-axes.

Function
To compensate for mechanical deviations during X-axis movements.

Description
When the X-axis moves to another position it is possible that the R (R1,R2)-axis position changes. You can use this parameter to program a position correction.
See figure 4.2j how to program the parameter. Notice the sign of the parameter value!

Correction (x) = measured value - programmed value

Example
    = 80mm - 82mm = -2 mm/ 50mm
    = -4 mm / 100 mm
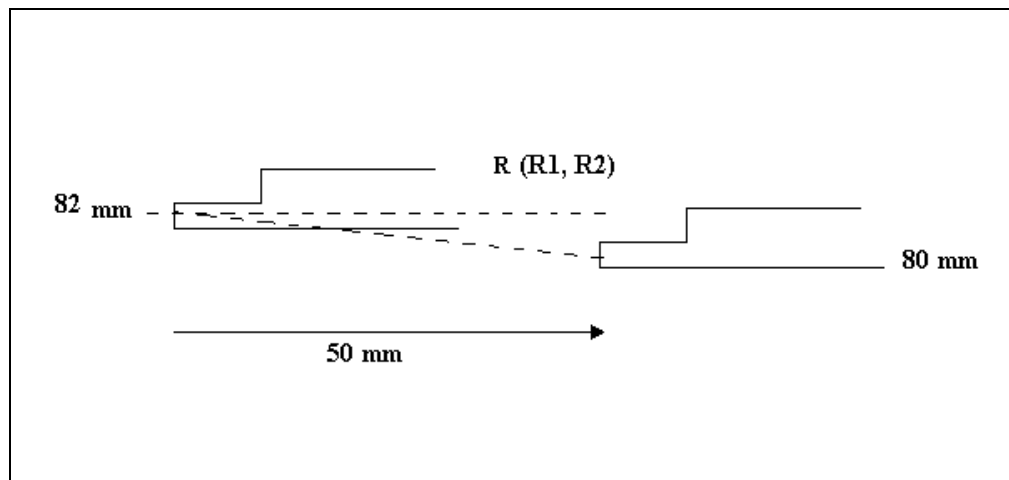
Figure 5.2.c

Parameter 27: **Correction (X)**

Range : -9.999 - +9.999
Default : 0.000
Units : mm / 100mm
Remark : In case of a Z1- and Z2-axis, only in combination with a X1-axis and a X2-axis.

Function
To compensate for mechanical deviations during X-axis movements.

Description
When the X-axis moves to another position it is possible that the Z1Z2-axis position changes. You can use this parameter to program a position correction.
See figure 4.2k how to program the parameter. Notice the sign of the parameter value!

Correction (X) = measured value - programmed value

Example
= 135 mm - 140 mm = 5   mm / 50 mm
= 10 mm / 100 mm
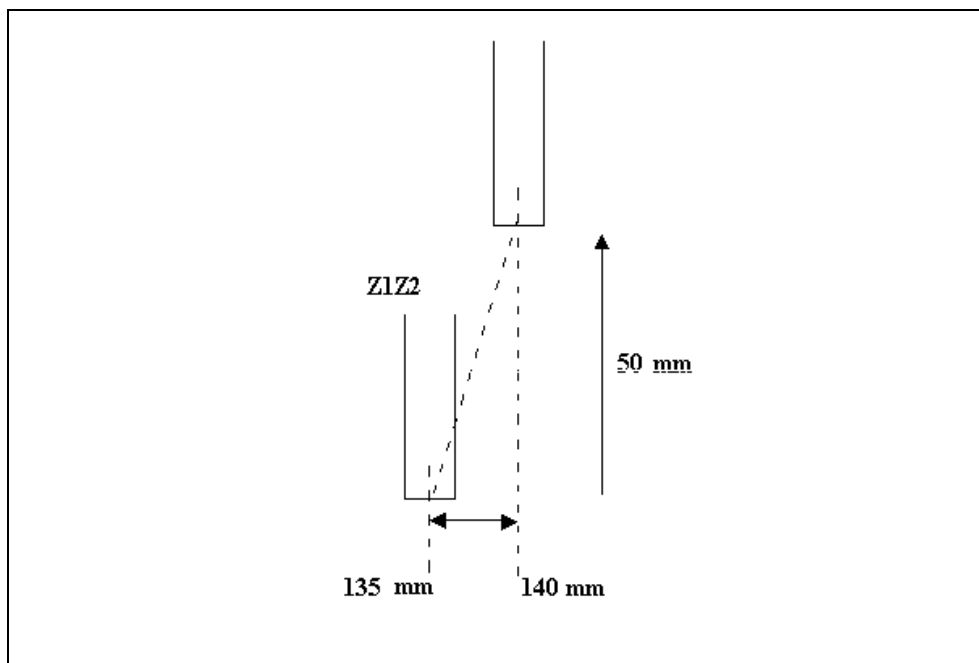
Figure 5.2.d

Parameter 25: **Correction (Z)**

Range　　: -9.999 - +9.999
Default　　: 0.000
Units　　: mm / 100mm
Remark　　: In case of a X1-axis and a X2-axis

Function
To compensate for mechanical deviations during Z1Z2-axis movements.

Description
When the Z1Z2-axis moves to another position it is possible that the X1- and X2-axis position changes. You can use this parameter to program a position correction.
See figure 4.2l how to program the parameter. Notice the sign of the parameter value!

Correction (Z) = measured value - programmed value

Example
　　　= 53 mm - 50 mm = 3 mm / 25 mm
　　　= 12 mm / 100 mm
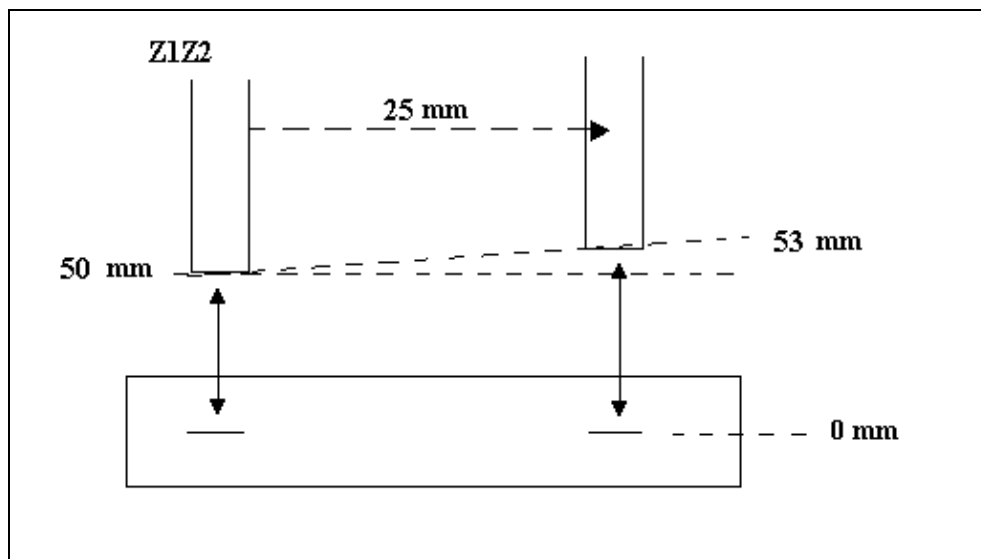
Figure 5.2.e

Parameter 25: **Correction (Z)**

Range   : -9.999 - +9.999
Default   : 0.000
Units   : mm / 100mm
Remark : In case of R1-axis, R2-axis

Function
To compensate for mechanical deviations during Z1Z2-axis movements.

Description
When the Z1Z2-axis moves to another position it is possible that the R1(R2)-axis position changes. You can use this parameter to program a position correction.
See figure 4.2m how to program the parameter. Notice the sign of the parameter value!

Correction (Z) = measured value - programmed value

Example
      = 80 mm - 81 mm = -1mm / 25 mm
      = -4 mm / 100 mm
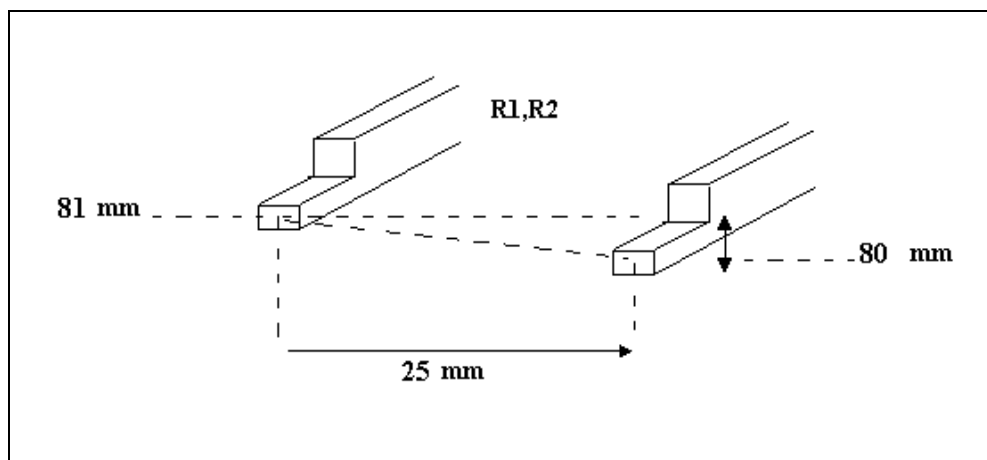
Figure 5.2.f

Parameter 26: **Correction (R)**

Range : -9.999 - +9.999
Default : 0.000
Units : mm / 100mm
Remark : In case of X2-axis

Function
To compensate for mechanical deviations during R-axis movements.

Description
When the R-axis moves to another position it is possible that the X2-axis position changes. You can use this parameter to program a position correction.
See figure 4.2n how to program the parameter. Notice the sign of the parameter value!

Correction (R) = measured value - programmed value

Example
= 100.8 mm - 100 mm = 0.8 mm / 20 mm
= 4 mm / 100 mm

Figure 5.2.g

Range   : -9.999 - +9.999
Default   : 0.000
Units   : mm / 100mm
Remark   : In case of Z1-axis, Z2-axis

Function
To compensate for mechanical deviations during R-axis movements.

Description
When the R-axis moves to another position it is possible that the Z1 (Z2)-axis position changes.
You can use this parameter to program a position correction.
See figure 4.2o how to program the parameter. Notice the sign of the parameter value!

Correction (R) = measured value - programmed value

Example
= 105 mm - 103 mm = 2   mm / 50 mm
= 4 mm / 100 mm
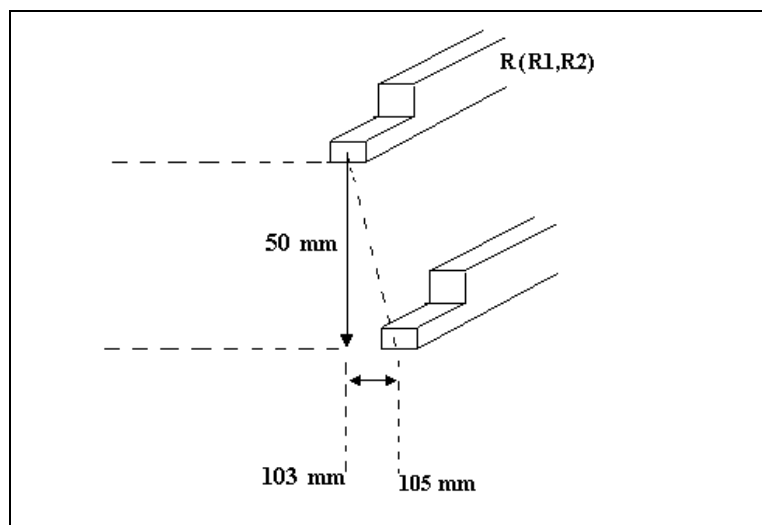
Fig. 5.2.h

Parameter 122: **Axis retract programmable**

Range : 0 - 1
Default : 0
Units : -

Function
To enable or disable a retract for the selected axis.

Description
A retract can be programmed for each axis by the operator for each step in a bending program. A softkey is then made available to the operator, in which the retract distance for a particular step can be programmed.

To enable this possibility, this parameter should be set to '1'. Press the key to select the required setting.

Parameter 130: **Safety distance**

Range : 0.00 - 999999.00
Default : 50
Units : mm

Remark: only for X/X1 axis, not for X2 axis

Function
To program a safety zone for the backgauge, where the backgauge will move with low speed.

Description
Sometimes it is required that the backgauge moves with low speed when it is within a small distance from the die. This depends on local regulations. With this parameter, a safety distance is programmed. When the backgauge moves within this distance from the die, the backgauge will move with a low speed. This safety distance is related to the limit of the safety zone of the die (it is not an X-position!).
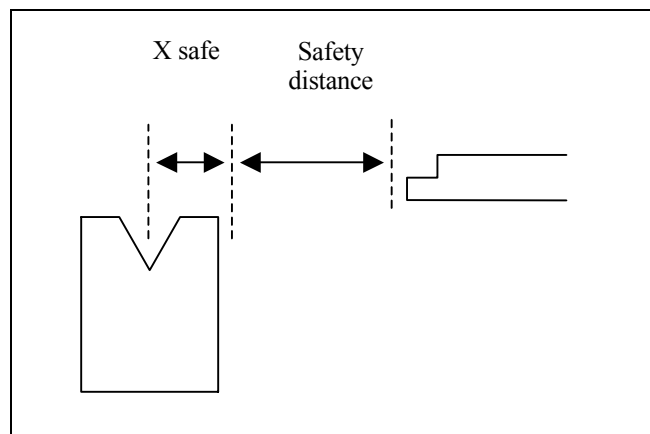
The maximum allowed speed within this area can be programmed at parameter 131, Safety speed.
For an X2 axis this parameter is not available: the safety distance programmed at the X/X1 axis is also valid for the X2 axis.

Range   : 0 - 100
Default   : 1
Units   : %

Function
To program a low, safe speed for the backgauge when it is within a programmed distance from the die.

Description
Low speed setting for the backgauge, valid when it is within the safety distance from the die. See parameter 130, Safety distance, for more information. This speed is programmed in a percentage of the maximum speed.

5.3   Parameters for Servo axes

On the following pages the servo axis parameters are explained. These parameters will occur at all servo axes, unless otherwise indicated.
The first few parameters are specific servo gain parameters to optimise servo axis positioning.

The following servo parameters are valid:
2   Gain
3   Switch
4   Ramp

Inside the switch zone the Gain is active and outside the switch zone the Ramp is active. See the Axis parameters 'Gain', 'Switch' and 'Ramp'.
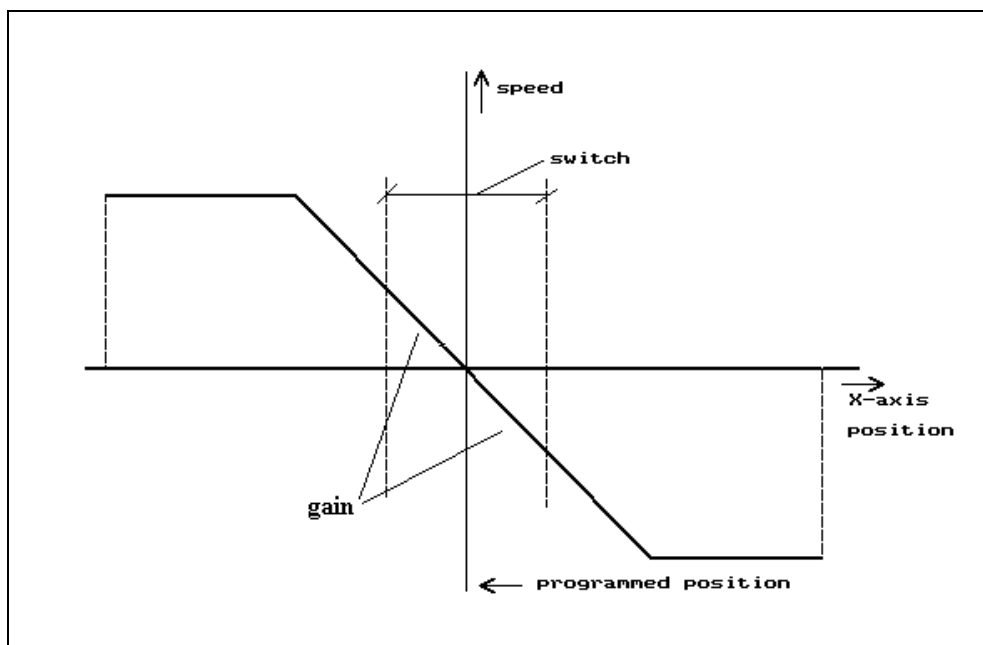
Fig. 5.3.a

These parameters must be programmed as follows:
- Increase gain until servo motor starts to oscillate.
- Decrease the value until the oscillation disappears and program this value for the gain.

Parameter 2: **Gain**

Range : 1.0 - 15.0
Default : 9.0
Units : -

Function
Position gain factor.

Description
For an accurate servo axis positioning three parameters are used: 'Ramp', Switch and 'Gain'.
- When the actual position is near the programmed position the factor 'Gain' is used. The gain factor is valid within the programmed 'switch' zone.

Range : 1 - 100
Default : 3
Units : mm

Function
Axis switching point from 'ramp' area to 'gain' area.

Description
For an accurate servo axis positioning three parameters are used: 'Ramp', 'Switch' and 'Gain'. When (actual position - programmed position) > Switch, the braking factor 'Ramp' is used, otherwise 'Gain' is used.

Parameter 4: **Ramp**

Range : 0.0 - 1000.0
Default : 5.0
Units : -

Function
Servo axis braking factor.

Description
Servo axis braking factor in case (actual position - programmed position) > switch.
See also Auxiliary axis parameters 'Gain' and 'Switch'.
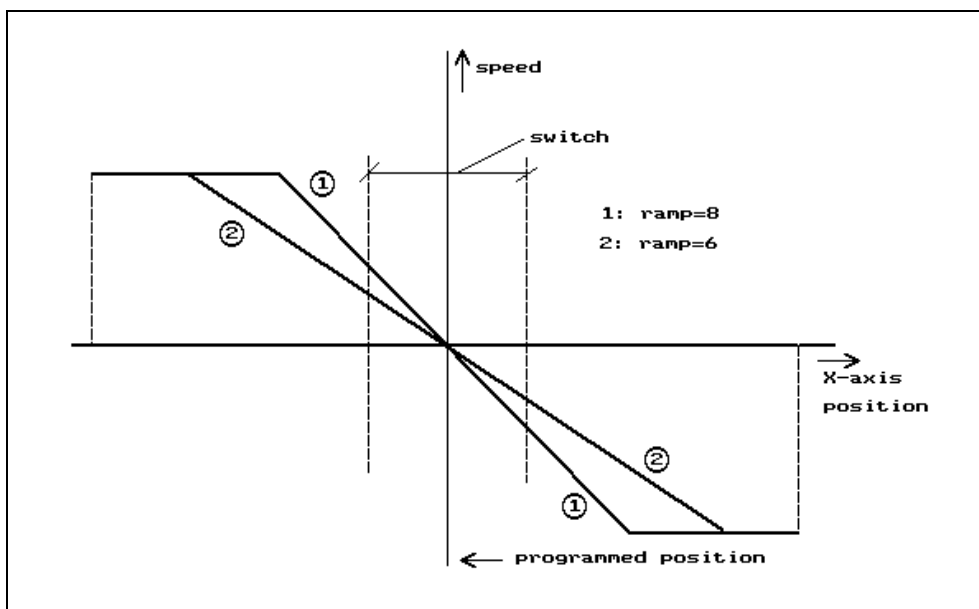
Figure 5.3.c

Parameter 11: **Manual speed high**

Range : 1.00 - 100.00
Default : 10.00
Units : %

Function
Axis manual movement high speed limit.

Description
In manual mode and the automatic mode you can select 'manual position'. The axis can now be moved with the handwheel on the front panel. The movement is depending on the speed with which you turn the handwheel.
This parameter value is the highest possible axis speed for manual movement. You program this parameter as a percentage of the speed output (+/- 10V).

Parameter 13: **Acceleration ramp**

Range : 5 - 1275
Default : 160
Units : ms

Function
Acceleration ramp for the connected axis.

Description
This parameter defines the time needed to reach the full speed output. An acceleration ramp means that when the axis starts moving to a new position the speed signal increases with a certain ramp until the maximum needed speed has been reached.
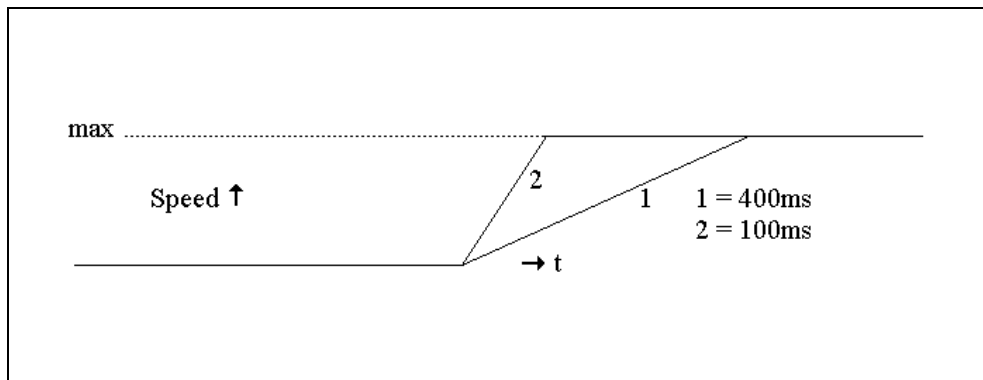
Figure 5.3.e

Parameter 34: **Axis speed programmable**

Range : 0-1
Default : 0
Units : -

Function
To enable axis speed programming in user mode.

Description
This parameter defines whether or not the speed of the selected axis can be programmed in user mode. Press the key ⌂ to select the required setting.
If enabled, then in programming mode and manual mode the operator can program the axis speed in a percentage of the maximum speed.

```
                                        prod.no:     9001
                          bending no: 1  draw.no:


              punch...........UP=      1
              die.............UN=      1
              bend  Axes speeds
                    X-AXIS....X =      0      %
              lengt X2-axis...X2=      0      %  mm
                    R1-axis...R1=      0      %
        ANGLE.....                              °
              opening.........DY=      10.0    mm

        BACKGAUGE POSITION......X1=     49      mm
              retract.........DX=      0       mm
              code............CX=      2
              delay time......TX=      0       sec


              X2-axis.........X2=      49      mm

 X =  1 %                                      4.2
```
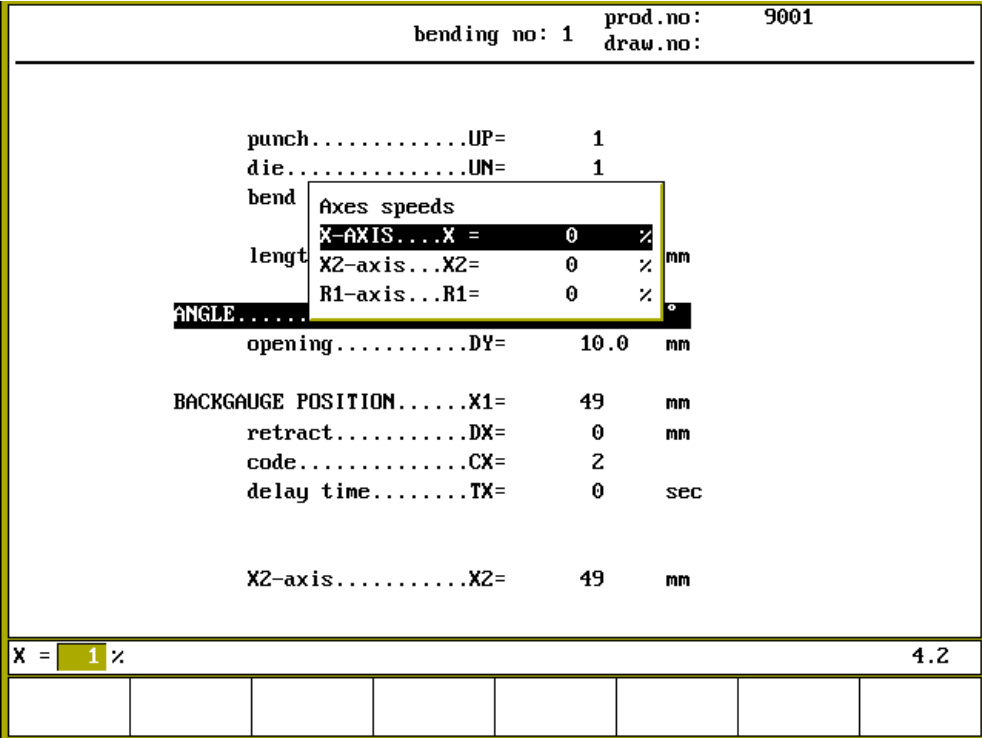
Figure 34.a

5.4   Parameters AC axes

In this paragraph, the parameters for axes with AC drives are discussed.

When using AC drives, it is possible to program 1-side positioning or 2-side positioning. Beside this, it must be indicated whether a one-speed or 2-speed motor drive is used.

With these parameters you can optimize the positioning accuracy of the AC-axis:

- Breakpoint high speed (Bfs)
- Breakpoint low speed (Bss)
- Overrun (OR)
- Overrun wait time
- Stop time (T)

Two side positioning:
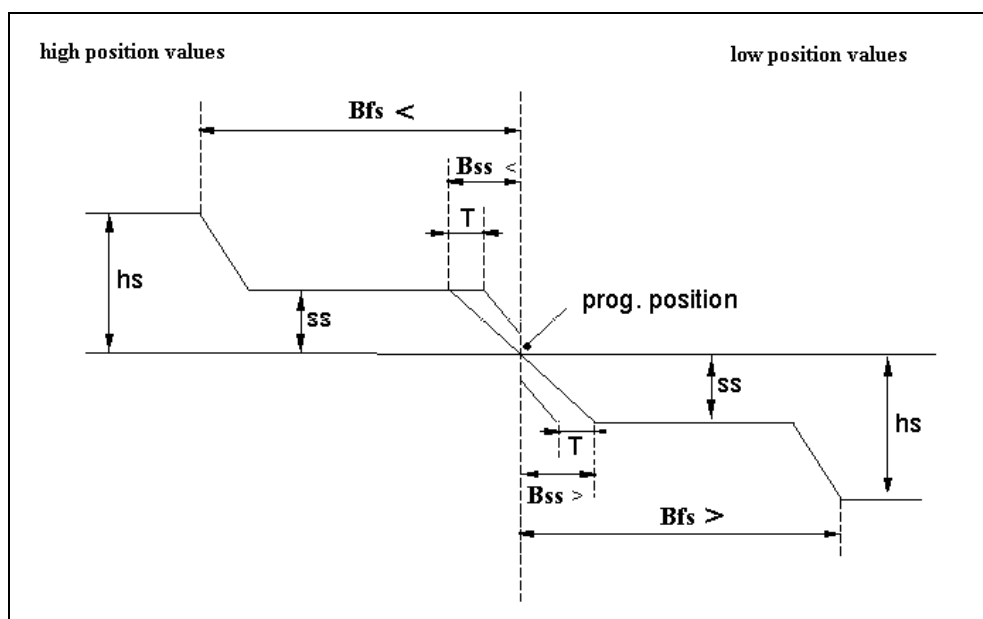
Figure 5.4.a

When the axis approaches the programmed position the motor output is switched off when the actual position is within Bss and the stop time T has elapsed.

The stoptime should be less then the time between two successive encoder pulses.

One side positioning:
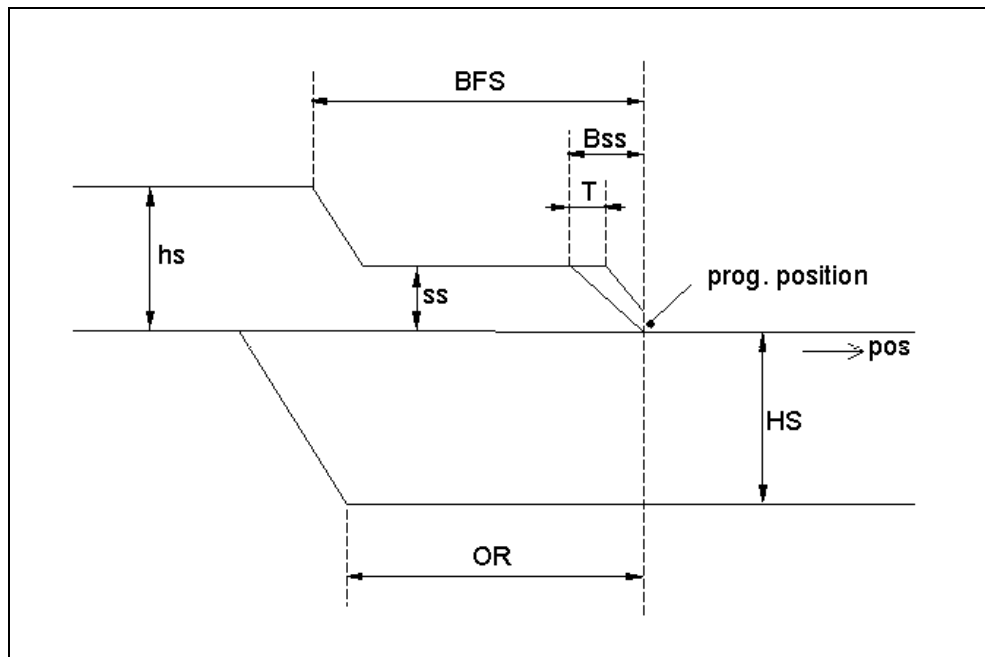
Figure 5.4.b

One side positioning is useful to overcome mechanical inaccuracies in the spindle. Final positioning of the axis is always done from a higher to a lower position. So when the axis moves from a high to a low position, positioning is done immediatly. When the axis moves from a low to a high position, the axis will move to the overrun position (= programmed position +OR). After that, the axis starts moving in the opposite direction and positioning takes place.

When the difference between the new programmed position and the actual position is smaller then BSS the axis is always moved to the overrun position first, also in case of two side positioning.

Delem

Range   : 1 - 2
Default : 1
Units   : -

Function
Selection of type of drive.

Description
1= one-speed AC- or DC-drive   (digital outputs)
2= two-speed AC-or DC-drive   (digital outputs)
Press the key to select the required setting.

Parameter FG: **Break point high speed (Bfs)>**

Range   : 0 - 9999
Default   : 100
Units   : count pulses of encoder
Remark   : Only in case of two side positioning

Function
Switch point from high speed to low speed.

Description
This is the breakpoint for one-and two-speed drives.

Parameter SG: **Break point low speed (Bss)>**

Range   : 0 - 9999
Default   : 10
Units   : count pulses of encoder
Remark   : Only in case of two side postioning

Function
Switch point from slow speed to off.

Description
This is the point to switch off the low speed.

Parameter FS: **Break point high speed (Bfs)<**

Range   : 0 - 9999
Default   : 100
Units   : count pulses of encoder
Remark   : Only in case of one side positioning

Function
Switch point from high speed to low speed.

Description
This is the breakpoint for one-and two-speed drives.

Parameter SS: **Break point low speed (Bss)<**

Range : 0 - 9999
Default : 10
Units : count pulses of encoder
Remark : Only in case of one side postioning

Function
Switch point from slow speed to off.

Description
This is the point to switch off the low speed.

Parameter 83: **Stop time**

Range   : 0 - 99
Default   : 0
Units   : 5 ms

Function
Stop time for correct positioning.

Description
This is the delay time before switching off the low speed after the 'Breakpoint slow speed' (BSS) has been reached. See also figure 5.3.a and 5.3.b.

Parameter 86: **Dc low speed**

Range   : 1 - 100
Default: : 4
Units: : %

Function
To program the low speed when a 2-speed DC-motor has been applied.

Description
It is possible to control a 2-speed motor drive through the analog output of the DM module. In that case, high and low speed are recognised by two voltage levels which must be programmed in the machine parameters. You have to program a percentage of the maximum output control voltage which is +/- 10V.
This parameter refers to low speed of the negative direction movement.

Parameter 87: **Dc high speed**

Range   : 1 - 100
Default: : 4
Units: : %

Function
To program the high speed when a 2-speed DC-motor has been applied.

Description
You have to program a percentage of the maximum output control voltage which is +/- 10V.
This parameter refers to high speed of the negative direction movement. See also parameter 86 for more information.

Parameter 88: **Dc low speed >**

Range   : 1 - 100
Default: : 4
Units: : %

Function
To program the low speed when a 2-speed DC-motor has been applied.

Description
You have to program a percentage of the maximum output control voltage which is +/- 10V.
This parameter refers to low speed of the positive direction movement. See also parameter 86 for more information.

Parameter 89: **Dc high speed >**

Range   : 1 - 100
Default: : 4
Units: : %

Function
To program the high speed when a 2-speed DC-motor has been applied.

Description
You have to program a percentage of the maximum output control voltage which is +/- 10V.
This parameter refers to high speed of the positive direction movement. See also parameter 86
for more information.

6 Crowning

6.1 Introduction

In the auxiliary axes menu you can program the required axes. The number of axes you can program depends on the type of control.

The following axes combinations can be programmed:
- Calculated crowning value: choose axis type 'CROWNa'
- Non calculated crowning value: choose axis type 'CROWN'.

Both axis types can be used for AC crowning and hydraulic crowning. In section 6.3 the parameters are discussed in order of appearance. The connection and adjustment of an AC crowning device is different from the connection of an hydraulic crowning device. Another difference is the fact that AC crowning has a position feedback and hydraulic crowning not.

If you have programmed the required 'axis type' you can program the corresponding parameters after pressing the softkey 'change parameters'.

6.2 Installation of the crowning device

There are two types of crowning devices:
- AC crowning;
- Hydraulic crowning.

Installation of an AC crowning device
An AC crowning device has normally a potentiometer feedback for the actual value. The position of the deflection device is controlled by a (one speed) AC motor. To control this motor the Y-axis module has two outputs: "A>" and "A<". These outputs correspond with the outputs 12 and 13 of the DM02 in the standard connection diagram.
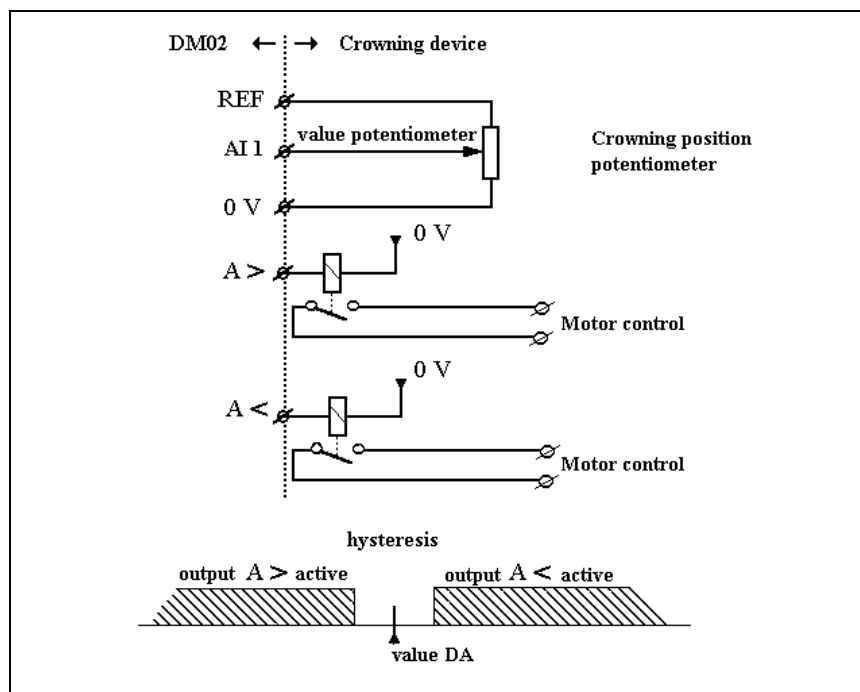
Figure 6.2.a

Installation of an hydraulic crowning device
In case of hydraulic crowning you should connect the crowning axis according to the standard connection diagram as indicated by DF-out.
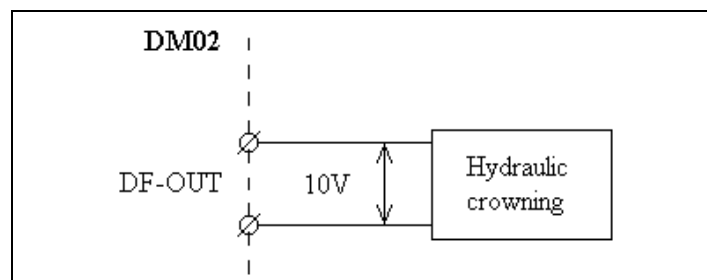
Figure 6.2.b

6.3 Crowning device programming and adjusting

The crowning device position and the crowning device adjustment are necessary to work properly with the crowning device.

Crowning device position and adjustment for calculated purposes
When you use the calculated crowning device then the required crowning is based on the programmed values of three machine parameters. The following machine parameters must therefore be programmed (See also Y-axis and general parameters of chapter 3):
- inertia upper beam;
- inertia under beam;
- machine length.

The required crowning value is calculated (computed value in data preparation and data editing). To be sure that the crowning device reaches the computed position, the crowning device should be adjusted as follows:
- Go to to the auxiliary menu and program axis 'CROWNa'.
- Press 'change parameters'.
- Program for Min. value and DA-min 0.
- Program for Max. value and DA-max 255 (standard resolution) or 1023 (high resolution).
- Move the crowning device to its mechanical minimal position by means of the handwheel.
- Measure the deflection in hundreds of mm. Remember this value and program it at the end of the adjustment procedure for the parameter Min. value. The programmed Min. value is the measured value times hundred. Measured value 1.05, programmed value 105 (In most cases this value will be near to zero).
- Read out the deflection value on the screen (Manual mode, manual positioning). This value corresponds with the number of DA-points. Remember that value and program it at the end of the adjustment procedure at the parameter DA-min.
- Now move the crowning device to its mechanical maximal position.
- Measure the deflection in hundreds of mm. Remember this value and program it at the end of the adjustment procedure for the parameter Max. value. The programmed Max. value is the measured value times hundred.
- Read out the deflection value on the screen (Manual mode, manual positioning). This value corresponds with the number of DA-points. Remember the value and program it at the end of the adjustment procedure at the parameter DA-max.
- Program now the found values to the corresponding machine parameters.

Example
The crowning device position must always be programmed in 0.01 mm units and the initial value and the decimal point position must be 0.
- The minimal deflection = 0 mm at 25 DA-points.
- The maximal deflection = 1.20 mm at 185 DA-points.

For this example the crowning device parameters must be programmed as follows:

DA-min.   = 25
Min. value = 0
Max. value = 120

DA-max.   = 185

Note: The unit indication "mm" will not be displayed on the screen (data preparation and data editing) of the control.

Crowning device position and adjustment for non calculated purposes

When you use the non calculated crowning device the required crowning is not based on the three machine parameters, as described before. You have to program the required value.

To be sure that the crowning device is adjusted to the programmed position. The crowning device should be adjusted as follows:

- Go to to the auxiliary menu and program axis 'CROWN'.
- Press 'change parameters'.
- Program for Min. value and DA-min 0.
- Program for Max. value and DA-max 255 (standard resolution) and 1023 (high resolution).
- Move the crowning device to the mechanical minimal position by means of the handwheel or to the position that corresponds with 0 % crowning.
- Read out the deflection value on the screen (Manual mode, manual positioning). This value corresponds with the number of DA-points. Remember that value and program it at the end of the adjustment procedure at the parameter DA-min.
- Now move the crowning device to the mechanical maximal position or to the position that corresponds with 100% crowning.
- Read out the deflection value on the screen (Manual mode, manual positioning). This value corresponds with the number of DA-points. Remember the value and program it at the end of the adjustment procedure at the parameter DA-max.
- Program now the found DA-values to the corresponding machine parameters and program Min. Value at 0 (read 0 %) and Max. Value at 100 (read 100 %).

6.4 Crowning parameters

```
AUXILIARY AXIS 5                    text:      deflect
                                    axis type: An. out


         Min. value.......................... 7=      0.00  %      (2)
         Max. value.......................... 8=    100.00  %      (2)
         Standard/high resolution (0/1)......31=       0    Standard  (2)
         DA-min..............................18=      0.00  %      (2)
         DA-max..............................19=    100.00  %      (2)
         DA-out linear/table (0/1)...........22=       0    Linear
         Hysteresis..........................23=      0.00
         Default value.......................14=      0.00  %
         Decimal point pos...................15=       0    1      (2)
         Max computed value..................31=       0    kN
         Automatic R-axis correction (0/1).....AR=     1    ON



   7=         0.00                                            19.51

            │      │      │      │ reset to │      │      │
            │      │      │      │ default  │      │      │
```

Figure 6.4.a

Range   : -999999.00 - +999999.00
default   : -9999.00
Units   : display units

Function
Minimal value of auxiliary axis in defined display units. When the axis is moved manually the position is also limited at this value.

Description
The value of this parameter depends on the accuracy you want to have for your axis. For calculated crowning the resolution must always be in hundreds (0.01).
The parameter 'decimal point position' should stay 0 (default value) in this case. See parameter 15.

Example
The axis must be programmed with a resolution of 0.01 mm. When the minimal value of the axis is 10.00, you should program 1000.

In case of non calculated crowning the Min. Value is normally 0 (0%). Depending on the parameter 'Decimal point position' this value can also be 0.0 or 0.00 or 0.000.

Parameter 8: **Max. value**

Range   : -999999.00 - +999999.00
Default : 9999.00
Units   : display units

Function
Maximal value of auxiliary axis in defined display units. When the axis is moved manually the position is also limited at this value.

Description
See description Min. Value.

Parameter 15: **Decimal point pos.**

Range : 0 - 3
Default : 0
Units : -

Function
Decimal point position of auxiliary axis value.

Description
This parameter should always have the value 0 in case of the calculated crowning axis function.

In the non calculated crowning selection it is possible to set the decimal point position as required.
0 = no resolution
1 = 0.1 resolution
2 = 0.01 resolution
3 = 0.001 resolution
Press the key to select the required setting.

Parameter 18: **DA-min**

Range   : 0.00 - 100.00
Default   : 0.00
Units   : %

Function
Minimal value in percentage.

Description
With this parameter the minimum voltage value of the crowning unit is programmed in a percentage of the maximum voltage.

Parameter 19: **DA-max**

Range   : 0.00 - 100.00
Default : 1.00
Units   : %

Function
Maximal value in percentage.

Description
With this parameter the maximum voltage value of the crowning unit is programmed in a percentage of the maximum voltage.

Parameter 22: **DA-out linear/table (0/1)**

Range   : 0 - 1
Default   : 0
Units   : -

Function
Linear or non-linear output scaling of the crowning device.

Description
The output scaling of the crowning device can be based on a linear relation between the output signal and the position of the crowning device (minimum + maximum position).
It is also possible to drive a non-linear crowning device.
0 = linear
1 = table (non- linear)
Press the key ⌷ to select the required setting.

When you have selected the non-linear crowning device you can program the output scaling via a table. The values of DA-min and DA-max are ignored in this case. Go to the table with the 'next page' softkey.
The table has 10 entries. For each position the output value (in DA-points) can be programmed. At least 2 entries should be programmed. The actual output value will be computed by means of linear interpolation. In case of two entries you should program the first and second entry.

```
AUXILIARY AXIS 5                        text:       deflect
                                        axis type:    5


     PROGRAMMED AXIS POSITION               DA OUTPUT VALUE

   position.....P 1=    _____       da-output....DA 1=      0
   position.....P 2=    _____       da-output....DA 2=      0
   position.....P 3=    _____       da-output....DA 3=      0
   position.....P 4=    _____       da-output....DA 4=      0
   position.....P 5=    _____       da-output....DA 5=      0
   position.....P 6=    _____       da-output....DA 6=      0
   position.....P 7=    _____       da-output....DA 7=      0
   position.....P 8=    _____       da-output....DA 8=      0
   position.....P 9=    _____       da-output....DA 9=      0
   position.....P10=    _____       da-output....DA10=      0




 P 1=     0                                              19.32
  previous        erase             reset to
   page           point             default
```

Figure 6.4.b

Parameter 23: **Hysteresis**

Range   : 0.00 - 100
Default   : 1
Units   : DA-points

Function
To determine the switch-off point (switch-off zone) for the programmed DA-value. See also figure 6.1a.

Description
The hysteresis value determines the switch-off zone around the DA-value in the feedback application. The value of the hysteresis depends on your crowning device. A hysteresis might be necessary to stop the crowning device at the correct position, because of the inertia of the crowning device.

Parameter 14: **Default value**

Range   : -999999.00 - +999999.00
Default   : 0.00
Units   : display units

Function
Initial axis value

Description
The default value is used as initial value for the axis in case of a new numerical program (data preparation menu).

Parameter 31: **Max. computed value**

Range : 0.00 - 9999.99
Default : 0.00
Units : mm

Function
To program the maximum value that the control will calculate when calculated crowning is used.

Description
When the crowning position is calculated for a bending step, it will never exceed this value.

Parameter 31: **Standard / high resolution (0) /1**

Range : 0 - 1
Default : 0
Units : -

Function
To determine the resolution of the potentiometer

Description
0 = standard resolution of potentiometer, 8 bits (values 0 - 255)
1 = high resolution of potentiometer, 10 bits (values 0 - 1023)
Press the key to select the required setting.

See also parameters DA-min, DA-max and hysteresis.

Parameter AR: **Automatic R-axis correction (0/1)**

Range : 0 - 1
Default : 1
Units : -

Function
This parameter serves to switch automatic correction of the R-axis position on or off.

Description
Normally the R-axis position is corrected to compensate for the crowning movement. This to avoid collision between backgauge and die.
It may not always be necessary to adjust the R-axis position to compensate for the crowning movement. In case of an hydraulic crowning, the crowning-pressure is built-up in the lower machine table only during the pressing cycle. Since the backgauge is not moving during that phase, there is no need to adjust the R-axis value. This parameter can then be used to have automatic correction or not.

Press the key to select the required setting.

7   Digital outputs

7.1   Introduction

Digital output axes are 'axes' that are driven by digital outputs. They do not require an additional DM-module. The number of axes you can program depends on the type of control.

The following Digital output axes can be programmed:
- R-digital: axis type 'RD'.
- on / off: axis type 'FD'
- second on/off: axis type 'FD2'

For each axis, choose drive type 'dig. out'.

The parameters are discussed in order of appearance. You can program the corresponding parameters after pressing the softkey 'change parameters'.
The parameters of R-digital are discussed in section 7.2 and the parameters of On/off in section 7.3.

7.2   Digital R-axis

You can use a digital R-axis in stead of a fully motor driven R-axis (servo R-axis or AC R-axis). This type of axis is driven with digital outputs. These digital outputs - F1 and F2 in the included default connection diagram - determine the possible digital R-axis situations or positions.

As there are only two digital outputs available, you can program maximal 4 different positions of the digital R-axis.
There are seven different R-axis situations. Therefore some situations must be regarded as the same axis position.

For each situation you have to program a parameter. Each parameter has three digits. The right digit is to determine if this R-axis situation is allowed. When a situation is not allowed (A = 0) then the values of F1 and F2 are ignored. The construction of your digital R-axis determines which situations should be regarded as the same position (programmed with the same F1 and F2 value).

In the data preparation menu you must enter the three digit code that corresponds with the required R-axis position. When you program a graphical product, then the positions are computed automatically during postprocessing. The lay-on backgauge functionality is not supported by the 3D bend sequence menu. In figure 7.2a you see the possible situations.
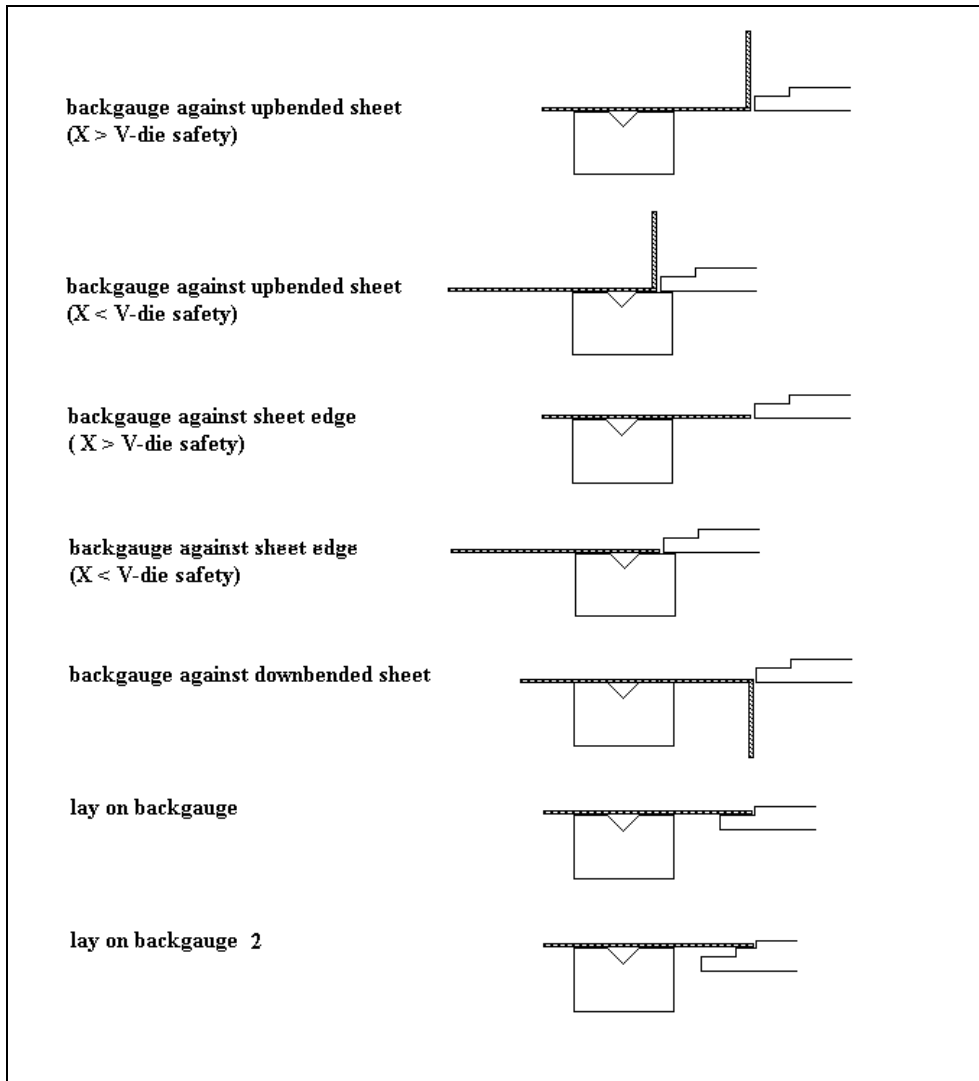
Figure 7.2.a

Example

First you decide which situations are allowed. Then you determine which of the allowed situation have the same R-axis position. Then you determine which F1-F2 code belongs to the - maximal four - situations.

A possible solution might be (see figure 7.2a):
- situation 1, 2, 3 and 4 have the same R-axis position. This is position 1 and is allowed.
- situation 5. This is position 2 and is allowed
- situation 6. This is position 3 and is allowed
- situation 7. This is position 4 and is not allowed

The parameters values are now for example:
- parameter HG (position 1)   001
- parameter HS (position 1)   001
- parameter MG (position 1)   001

- parameter MS (position 1)   001
- parameter LE (position 2)   011
- parameter OE (position 3)   101
- parameter O2 (position 4)   110

The digital outputs F1 and F2 can have the values 0 and 1. The three digit code of the parameters is entered from right to left. In figure 7.2b you see the default parameter screen.

```
AUXILIARY AXIS 6                        text:      R-digital
                                        axis type: 11

    DIGITAL R-AXIS ASSIGNMENTS


         Define for each of the following situations if it is
         allowed or not (A=1: Allowed, A=0: not Allowed).
         Also define the setting of the digital outputs
         F2 and F1 for each situation.
                                                     F 21A
                                                     -----
Backgauge against upbended sheet..(X>safety)..........HG=   000    (2)
Backgauge against upbended sheet..(X<safety)..........HS=   000    (2)
Backgauge against sheet edge..(X>safety)..............MG=   000    (2)
Backgauge against sheet edge..(X<safety)..............MS=   000    (2)
Backgauge against downbended sheet....................LE=   000    (2)
Lay on backgauge......................................OE=   000    (2)
Lay on backgauge 2....................................O2=   000    (2)
Default value.........................................14=    00    (2)



HG= 000                                                      19.31
         |         |         | reset to |         |         |
         |         |         | default  |         |         |
```

Figure 7.2.b

Parameter 14: **Default value**

Range   : 00 - 11
Default : 00
Units   : -

Function
Auxiliary axis default situation value.

Description
This value is displayed on the control as initial value when making a new program in Data Preparation. This value is also displayed in Manual mode after the control is initialized.

7.3   On/off outputs

If you require digital outputs then you can define the number. The maximum number of digital outputs you can program is 5: F5, F4, F3, F2 and F1. The outputs F1 - F4 correspond with the output pins 10 - 13 of the DM02 in the standard connection diagram. F5 is standard not mapped on an output.
However, when you already have enabled a digital R-axes you only have three digital outputs left. The R-digital always uses F1 and F2. In this case you can only use F3, F4 and F5 for additional digital outputs.

```
AUXILIARY AXIS 6                        text:      on/off
                                        axis type:  11


        Number of FD outputs.................NO=      3        (2)

        Ls FD output........................LS=       3        (2)

        Default value.......................14=      000




NO= 3                                                        19.31
                                    reset to
                                    default
```

Figure 7.3.a

There are three parameters to define the number of digital outputs, the least significant digital output and the default value of the selected digital outputs in the user screens.

There is a possibility to program a second set of digital function outputs. To activate these outputs, choose axis type 'FD2' in the auxiliary axis menu. This will enable a second set of digital outputs to a maximum of 5. This second set can be programmed in the same way as the first set.
These 5 output signals are not mapped on module outputs. To utilise these outputs, the Delem sequencer on the control will have to be modified.

Parameter NO: **Number of FD outputs**

Range   : 1 - 5
Default : 5
Units   : -

Function
The number of digital outputs you want to use. The number you can use is always related to the use of a digital R-axis. The digital outputs you want to use, are always in succession.

Parameter LS: **Ls FD output**

Range : 1 - 5
Default : 3
Units : -

Function
To define the least significant digital output. The default value is F3, because in case of a digital R-axis F2 and F1 are already used. The digital output numbering is from right to left, from least significant to most significant.

Parameter 14: **Default value**

Range : 00000 - 11111
Default : 00000
Units : -

Function

The default value of the digital outputs - programmed in this menu - in the user screens. If the Number of FD outputs is 3, then the range of the default value becomes automatically 000 - 111. So, the number of digits refers to the number of digital output programmed.

Examples digital outputs

In **situation 1** there is no digital R-axis and the on-off parameters should be programmed as:
- the number of digital outputs: 2
- the least significant output: 2
- default value: 00 (this can be programmed to 01, 10 or 11)

In **situation 2** there is no digital R-axis and the on-off parameters should be programmed as:
- the number of digital outputs: 2
- the least significant output: 4
- default value: 00 (this can be programmed to 01, 10 or 11)

In **situation 3** there are two solutions:
3a: there is no digital R-axis and the on-off parameters should be programmed as:
- the number of digital outputs: 4
- the least significant output: 1
- default value: 0000 (this can be programmed from 0000 to 1111)
3b: there is a digital R-axis and the on-off parameters should be programmed as:
- the number of digital outputs: 2
- the least significant output: 3
- default value: 00 (this can be programmed to 01, 10 or 11)

Situation 4 is not allowed, because the digital outputs are not in succession.

In **situation 5** the only solution is that there is a digital R-axis and:
- the number of digital outputs: 1
- the least significant output: 4
- default value: 0 (or 1)

8 I-axes

8.1 Introduction

In the auxiliary axes menu you can program the required axes. There are three different types of I-axes controlling the die movement. The number of axes you can program depends on the type of control.

The following types of I-axes can be programmed:
- Servo I-axis
- AC I-axis
- I-axis with 1-speed AC-motor with potentiometer feedback
- Digital I-axis

The parameters are discussed in order of appearance.
- The servo I-axis and AC I-axis contain the same parameters as discussed in chapter 5.
- The I-axis with 1 speed AC-motor is discussed in section 8.2. This type of axis can be compared with the crowning axes of chapter 6.
- The digital I-axis is discussed in section 8.3.

If you have programmed the required 'axis type' you can program the corresponding parameters after pressing the softkey 'change parameters'.

8.2 I-axis with 1 speed AC motor with potentiometer feedback

Parameter programming and adjustment procedure for this axis is similar to the crowning device, as described in chapter 6.

```
AUXILIARY AXIS 6                          text:       I-axis
                                          axis type:   5


          Min. value........................ 7=   -9999.00        (2)
          Max. value........................ 8=    9999.00        (2)
          Standard/high resolution (0/1).......31=        0       (2)
          DA-min..............................18=     0.00 %      (2)
          DA-max..............................19=   100.00 %      (2)
          DA-out linear/table (0/1)...........22=        0
          Hysteresis..........................23=     0.00
          Default value.......................14=     0.00
          Decimal point pos...................15=        0        (2)
          Max computed value..................31=     0.00


  7=    -9999.00                                              19.31
                              reset to
                              default
```

Figure 8.2.a

8.3 Digital I-axis parameters

```
AUXILIARY AXIS 6                          text:       I-axis
                                          axis type:  11


            Nbr positions........................NR=      2        (2)
            Ls FD output.........................LS=      1        (2)
            Positioning time.....................PT=      0.1      (2)
            Position 1...........................P1=     00        (2)
            Position 2...........................P2=     01        (2)
            Position 3...........................P3=     10        (2)
            Position 4...........................P4=     11        (2)




 NR= 2                                                         19.31
 ┌──────┬──────┬──────┬──────┬─────────┬──────┬──────┬──────┐
 │      │      │      │      │reset to │      │      │      │
 │      │      │      │      │default  │      │      │      │
 └──────┴──────┴──────┴──────┴─────────┴──────┴──────┴──────┘
```

Figure 8.3.a

Parameter Nr: **Nbr positions**

Range   : 2 - 4
Default   : 2
Units   : -

Function
to determine the number of positions of the I-axis.

Parameter LS: **Ls FD output**

Range : 1 - 5
Default : 3
Units : -

Function
To determine the least significant digital function output. There are five digital function outputs. F1 and F2 are used by the digital R-axis, if available. Therefore the default value is 3 (=F3). Depending on the Number of positions of the digital I-axis you require one or two digital outputs.
In case you require two digital outputs these digital outputs have to be in succession. In this case the value of the least significant FD output can never be 5.

Parameter PT: **Positioning time**

Range   : 0.0 - 99.0
Default   : 0.0
Units   : s

Function
to determine the time the X-axis has to wait before it can go to its new position. In the intermediate time the I-axis moves to its new position.

Parameter P1..P4: **Position 1...4**

Range   : 00 - 11 (binary values)
Default   : 00
Units   : -

Function
to define the binary value of the digital output of the several possible positions of the die.

Description
The I-axis (die shifting) moves from position to position as defined by the values of the digital outputs. When you have enabled a digital I-axis then you also have to program the correct I-axis position in the menu of the dies in the programming mode. In figure 8.3b you see the die parameter screen with I-axis enabled.

Figure 8.3.b

Notice that you program the positions of the I-axis in such a way that the moving direction of the I-axis is the same as the backgauge. This is to prevent collision between the die and the backgauge finger. This means moving backward when moving to a higher position, moving forward when moving to a lower position. So:

- the I-axis moves forward when the die has to go to a lower position (for example from position 3 to position 2)
- the I-axis moves backward when the die has to go to a higher position (from position 1 to position 2)

For each I-axis position you should program a separate die that corresponds with that situation in the bending point.
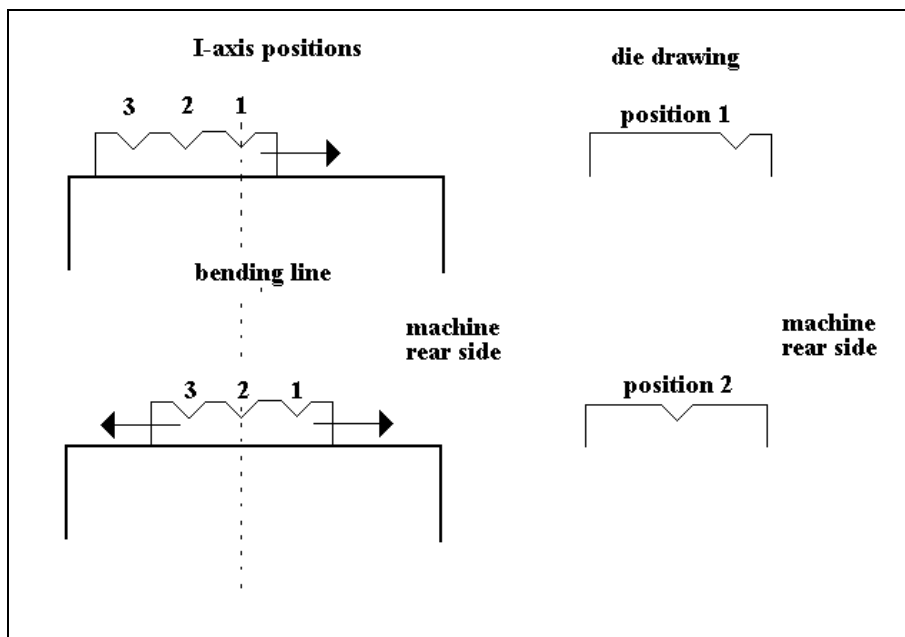
Figure 8.3.c

9 Part support

9.1 Introduction

The part support system
The system has been designed to control the angle at which the sheet must be supported by the part support arm. Figure 9.1 shows how the angle is defined: when the sheet has been clamped by the punch, at the clamping point, the angle of the part support arm is zero. When the sheet is moved upwards as result of a bending action, a positive angle is obtained.
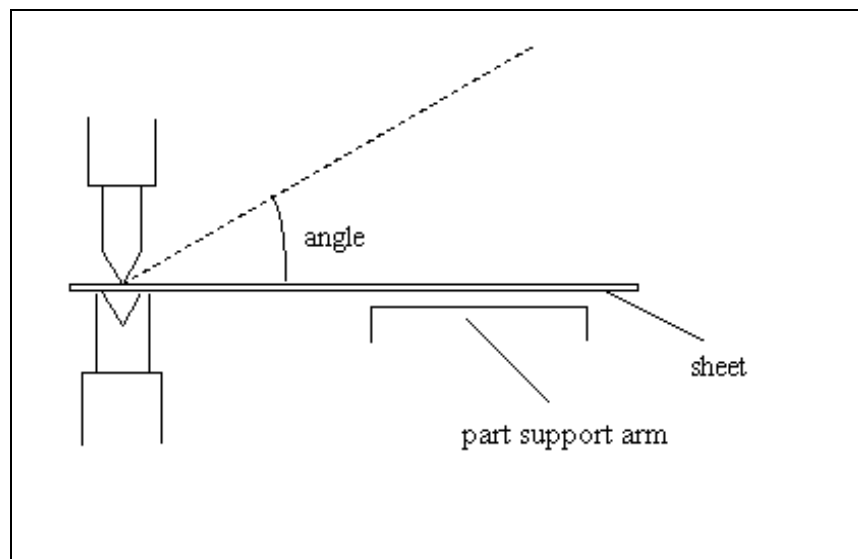
Figure 9.1.a

In the auxiliary axes menu you can program the required axes. The part support option can be programmed by selecting axis 'PS'.
There are two axis types that can be selected:
- 'Dig. part support' to select the digital part support.
- 'Servo' to select a classic part support control system with the DBT-01 control card.

Press the softkey 'change parameters' to program the parameters of the selected axis.
The digital part support control is integrated in a standard DM01 module, no additional hardware is necessary. The digital part support is described in section 9.2.
If a part support unit is installed which can be moved along the machine, additional axes can be progammed to control the part support movement. See section 9.3.
For a part support control system with the DBT-01 control card we refer to section 9.4.

Delem

9.2   Digital part support

9.2.1   Installation

Install the following equipment for the part support function:

- DM01 module
- drive system (motor drive and motor or a hydraulic system)
- the part support arm
- a potentiometer for a position feedback signal.
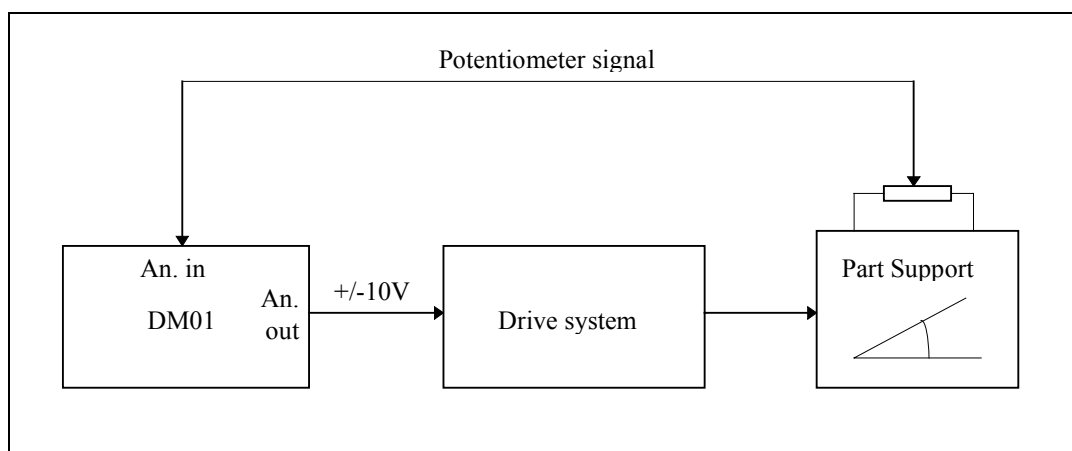
Figure 9.2.a

See drawing number 9024-112 for proper connection of a DM01 module.

In the following table, the definitions for control signal and part support movement are explained.

Control signal DM01	voltage potentiometer	movement part support
> 0	bigger	up
0	equal	none
< 0	smaller	down

In order to achieve acceptable results with a part support system, the system should meet several requirements.

Like every Delem module, the DM01 module for the part support has several LED's on the front which indicate the status of the module.

When used for a part support, the LED's 1 and 2 have the following meaning:
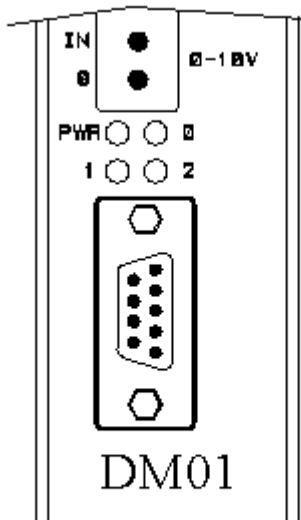
	Diag 1	Diag 2
Part support disabled	OFF	OFF
Part support enabled	ON	OFF
Part support angle larger than minimum angle.	OFF	ON

9.2.2 Parameters digital part support

```
AUXILIARY AXIS 4                      text:        Part support
                                      axis type:    6
_____

            Sheet follow function (on=1/off=0)....127=      0




            Number of slaves.....................SL=       0
            Default value........................14=    0001

            X-movement...........................124=    X_GP1
            R-movement...........................125=    R_GP1
            Z-movement...........................126=    Z_GP1


  127= 0                                                      19.41
 _____
  |       |       |       |       | reset to |       |       |      |
  |       |       |       |       | default  |       |       |      |
```

Figure 9.2.b

Sheet follow function on/off

This parameter serves to switch the 'sheet follow function' on or off. Press the key ⬒ to select the required setting.

When switched on, the part support is controlled to guide the metal sheet during bending. In this situation all positioning parameters must be programmed correctly to ensure good positioning behaviour of the part support.

When switched off, the part support arm is not controlled during bending. In this situation no positioning parameters are to be programmed, only the additional parameters for positioning of the part support unit. This allows you to program and control a supporting unit that is not made to follow sheet movement during bending, but can be used to place a sheet in front of the machine.

See section 9.3 for more information about the additional axes.

On the following pages the part support parameters are explained.

```
AUXILIARY AXIS 4                          text:      Part support
                                          axis type:    6
──────────────────────────────────────────────────────────────────

        Sheet follow function (on=1/off=0)....127=      1

        Min. Angle........................... 7=       0      °       (2)
        Max. Angle........................... 8=       0      °       (2)
        Min. AD-value........................18=       0
        Max. AD-value........................19=       0
        Delay before retour factor...........RF=      1.0
        Safety stop angle....................SA=      0.0     °
        Max. Angle speed.....................MS=       0      °/sec

        Number of slaves.....................SL=       0
        Default value........................14=      0001

        X-movement..........................124=    X_GP1
        R-movement..........................125=    R_GP1
        Z-movement..........................126=    Z_GP1


127= 1                                                            19.41
┌───────┬───────┬───────┬───────┬───────┬───────┬───────┬───────┐
│       │ next  │       │       │reset to│      │       │       │
│       │ page  │       │       │default │      │       │       │
└───────┴───────┴───────┴───────┴───────┴───────┴───────┴───────┘
```

Figure 9.2.c

```
AUXILIARY AXIS 4                          text:      Part support
                                          axis type:    6
──────────────────────────────────────────────────────────────────

     Mean angle speed:   low..............ML=      0      °/sec
                         high.............MH=      0      °/sec

     Proportional gain: min...............PN=      0
                        max...............PX=      0

     Feedforward gain:  min...............FN=      0
                        max...............FX=      0

     Differential gain: min...............DN=      0
                        max...............DX=      0

     Retour movement gain.................RG=      1

     Adjustment mode......................AM=      0

     In position tolerance................12=      0      °


ML=   0                                                           19.42
┌───────┬───────┬───────┬───────┬───────┬───────┬───────┬───────┐
│previous│      │       │       │reset to│      │       │       │
│ page  │       │       │       │default │      │       │       │
└───────┴───────┴───────┴───────┴───────┴───────┴───────┴───────┘
```

Figure 9.2.d

Parameter 7: **Min. Angle**

Range   : 0.0 - 90.0
Unit   : degrees (°)
Default : 0.0

Function
The minimum angle at which the support arm may be positioned. This is a software limit.

Parameter 8: **Max. Angle**

Range   : 0.0 - 90.0
Unit   : degrees (°)
Default : 0.0

Function
The maximum angle at which the support arm may be positioned. This is a software limit.

Parameter 18: **Min. AD-value**

Range : 0 - 1023
Unit   : -
Default : 0

Function
Minimum value of AD-converted potentiometer voltage. This value represents the minimum angle at which the part support arm may be positioned.

Parameter 19: **Max. AD-value**

Range : 0 - 1023
Unit   : -
Default : 1023

Function
Maximum value of AD-converted potentiometer voltage. This value represents the maximum angle at which the part support arm may be positioned.

Parameter RF: **Delay before retour factor**

Range : 0.0 - 9.9
Units : -
Default : 1.0

Function
Multiply factor, used to program the time the part support arm must stay on the final position.
The parameter 'Delay Before Opening' is multiplied by 'Delay Before Retour Factor' to program how long the part support arm must stay. If 'Delay Before Retour Factor' is set to 1.0, pressbeam and part support arm will move back simultaneously.

Parameter SL: **Nbr. of slaves**

Range : 0 - 4
Units : -
Default : 0

Function
The number of part support units that is installed. 5 units at most can be controlled.

Parameter 14: **Default value**

Range : 0000 - 1111 (binary values)
Unit : -
Default : 0000

Function
Toggle on/off function for each part support unit. A "1" means it is switched ON, "0" means it is switched OFF. For instance, 1000 means that one part support axis is enabled, on the first position.

Parameter SA: **Safety stop angle**

Range : 0.0 - 90.0
Unit : degrees (°)
Default : 0.0

Function
Angle at which the part support arm is stopped in the retour movement. The part support arm can be moved back to its minimum position by setting flag 8128 in the Delem Sequencer. See the manual "Delem Sequencer Programming Language" for information about programming the Sequencer.
If no sequencer is used, leave this parameter at 0.0.

Range : 0 - 255
Unit   : degrees per second (°/s).
Default : 10

Function
The maximum angle speed at which the support arm can move.

As shown in figure 9.2.a, the control gains can vary according to a linear function of the mean part support angle speed.
The setpoints with minimum and maximum values of gain and speed can be adjusted in the following machine parameters. The min. gain and max. gain should be set as high as possible, but without causing oscillation of the part support arm as it moves.
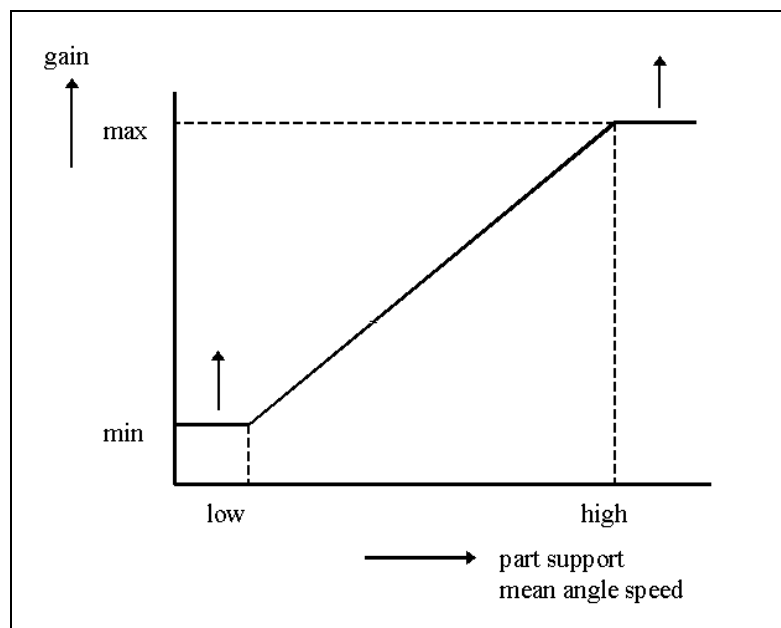
Figure 9.2.e

Parameter ML: **Mean angle speed low**

Range : 0.0 - 999.9
Unit : degrees per second (°/s)
Default : 1.0

Function
lowest value of angle speed, belonging to the first setpoint in the speed/gain function.

Parameter MH: **Mean angle speed high**

Range : 0.0 - 999.9
Unit : degrees per second (°/s)
Default : 1.0

Function
Highest value of angle speed, belonging to second setpoint in speed/gain function.

Parameter PN: **Proportional gain min**

Range : 0 - 9999
Unit : -
Default : 0

Function

Gain of the reference input signal. This value is for the first setpoint of the speed/gain function.

Parameter PX: **Proportional gain max**

Range : 0 - 9999
Unit : -
Default : 0

Function

Gain of the reference input signal. This value is for the second setpoint of the speed/gain function.

The next four parameters for minimum and maximum values of feedforward gain en differential gain are optional. They might help to reduce the maximum error of the part support, but this depends on the accuracy that is required. See sections 9.2.3 and 9.2.4 for more information about gain parameters and adjustment procedures.

Parameter FN: **Feedforward gain min**

Range : 0 - 255
Unit : -
Default : 0

Function
Optional gain of the reference input signal, to reduce the maximum error.

Parameter FX: **Feedforward gain max**

Range : 0 - 255
Unit : -
Default : 0

Function
Optional gain of the reference input signal, to reduce the maximum error.

Parameter DN: **Differential gain min**

Range : 0 - 255
Unit : -
Default : 0

Function
Optional gain of the error signal, to reduce the maximum error in the system.

Parameter DX: **Differential gain max**

Range : 0 - 255
Unit : -
Default : 0

Function
Optional gain of the error signal, to reduce the maximum error in the system.

Parameter AM: **Adjustment mode**

Range : 0 - 6
Unit : -
Default : 0

Function
When Part Support is switched on in manual mode, the user can monitor a value in the "zoomed values" menu. With this parameter, you can program which value you want to be displayed in that menu. There are seven possibilities:
0: Actual part support angle [°]. This is the standard setting;
1: Actual error [°];
2: Maximum error per bend [°];
3: Minimum error per bend [°];
4: Actual part support angle speed [°/s];
5: Maximum part support angle speed per bend [°/s];
6: Mean reference angle speed per bend [°/s];

Normally during operation this parameter is set to 0, but during adjustment the settings 1-6 are useful to monitor the behaviour of the part support.

Delem

Parameter 12: **In Position tolerance**

Range : 0.0 - 90.0
Unit : degrees (°)
Default : 2.0

Function
Error tolerance of the part support angle. When the part support angle is within this tolerance, the value after 'PS= ..' in the menu "zoomed values" in manual mode is highlighted, meaning that the part support is 'In Position'. When the error in the part support angle is bigger than this tolerance, the value in manual mode is not highlighted.

9.2.3 Adjustment procedures

There are several adjustment procedures to program the part support. The following adjustment procedures can be executed:
- determination of Max AD-value and Min. AD-value;
- determination of the maximum angle speed of the part support;
- adjustment procedure of control gains:
  - adjustment of proportional gain max;
  - adjustment of proportional gain min;
  - adjustment of feedforward gains;
  - adjustment of differential gains.

- **Initial values**

Before starting adjustment procedures, some parameters should be set to initial values:

```
Min. Angle              = ..(machine dependent)
Max. Angle              = ..(machine dependent)
Max. angle speed        = 0 °/s
Mean angle speed:   low  = 1 °/s
                    high = 1 °/s
Proportional gain:  min. = 1
                    max. = 1
Feedforward gain:   min. = 0
                    max. = 0
Differential gain:  min. = 0
                    max. = 0
Adjustment mode         = 0
In position tolerance   = .. ° (to be determined by user)
```

- **Determination of Max AD-value and Min. AD-value**

The voltage signal from the potentiometer is converted to a digital value. The parameters for AD-values serve to indicate which value represents the minimum angle and which value the maximum angle. The range for AD-points is 0 - 1023. These AD-values can be determined in the diagnostic mode. Proceed as follows:

1. Go to diagnostic program, select 'DM Module Test' and select the module for part support.
2. Move the cursor to 'Output 0'.
3. Position the part support with the handwheel at its minimum angle, read the AD-value at 'Input1'. This will be the minimum AD-value.
4. Position the part support with the handwheel at its maximum angle, read the AD-value at 'Input1'. This will be the maximum AD-value.
5. Go to the digital part support machine parameters (Axis-type 6 and Text no 21) and set the parameters 'Min. AD-value' and 'Max. AD-value' to the values found at point 3 and 4.

- **Determination of the maximum angle speed of the part support**

1. Go to the machine parameters for digital part support.
2. Select 'Adjustment mode = 5' (on the second page) to ensure that the part support maximum angle speed will be displayed in the 'Zoomed Values' menu.
3. Go to manual mode, select a die with a V-opening between 5 and 7 mm and select the maximum possible press speed for this specific machine.
4. Enter such an angle for bending, that the part support will go to 90% of its maximum angle. This bend angle can be calculated as follows:

$$\alpha_{bend}= 2 \bullet (90° - 0.9 \bullet \alpha_{max})$$

in which α_{max} is the maximum angle of the part support).

Example: If the maximum part support angle for your machine is 60°, then the angle that must be used for bending would be 72°.

5. Enable the part support by setting 'Part Support' to 1.
6. Set the part support correction 'G-corr.' to 0.0.
7. For the other values for bending, scroll through the list by pressing <enter>. Go to 'Zoomed Values' menu, perform a bend and check for the maximum angle speed (displayed at 'PS =..'), rounded at 1°/s (no decimals).
8. At the part support machine parameters, increase 'Proportional Gain Max.' by 1. Go back to Manual mode, open the 'Zoomed Values' menu, perform a bend and check for the maximum angle speed, again rounded at 1°/s.
9. Repeat the last step until the maximum angle speed does not increase anymore.
10. Note the reached value (rounded at 1), this is the maximum angle speed of the part support.
11. Go to the part support machine parameters and fill in the maximum angle speed.

- **Adjustment procedure of control gains**

For all adjustments, choose the following settings in Manual menu:
1. Select a die with V-opening between 5 and 7 mm.
2. Select such an angle, that the part support will go to 90% of its maximum angle, as already used in the previous paragraph.
3. Select a bending dwell-time ('d-time') of at least 2 seconds.

If gain values are set too high, the part support arm does not run smoothly anymore, but starts oscillating. This is not acceptable. Adjust gain values for optimal performance, without oscillating.

- **Adjustment of Proportional gain max**

To adjust 'Proportional Gain Max.' perform the following steps:

1. Go to the digital part support machine parameters.
2. Select 'Proportional Gain Max = 1'.
3. Set 'Adjustment Mode' to 6 for displaying the reference mean angle speed [°/s].

4. Go to Manual mode. Adjust the pressing speed (further on called S_{high}) to the maximum pressing speed and press 'Start'. In the menu 'Zoomed Values' the angle speed is displayed (this value is calculated after pressing Start, **so no bending cycle is necessary**). Adjust the pressing speed S_{high} to such a value, that the angle speed displayed is about 85% of the Maximum Angle Speed, as determined in paragraph 4.3. Write down the value of S_{high}. This value will also be used when adjusting the other gain values, Feedforward and Differential Gain.

5. Go to the digital part support machine parameters and set 'Adjustment Mode' to 2 for displaying the maximum error in degrees.

6. Go to manual mode, perform a bend, consider the maximum error (in degrees) displayed in 'Zoomed Values' menu, and increase 'Proportional Gain Max.' by 1 until the maximum error is as small as possible, while the movement of the part support is still acceptable.

- **Adjustment of Proportional gain min**

To adjust Proportional Gain Min, perform the following steps:
1. Go to the digital part support machine parameters and fill in at 'Mean Angle Speed high' the Maximum Angle Speed, as determined in paragraph 4.3.
2. Set 'Proportional Gain min' to 1.
3. Select 'Adjustment Mode' 2 for displaying the maximum error in degrees.
4. Go to Manual menu, select a press speed of 0.2 mm/s and perform a bend.
5. Consider the displayed maximum error, increase 'Proportional Gain min.' by 1 and perform a bend. Repeat this until the maximum error is as small as possible, while the movement of the part support is still acceptable.

Adjustment of the next two parameters, Differential gain and Feedforward gain, is optional. When adjusted properly, these parameters could help to reduce the maximum error.

- **Adjustment procedure for Feedforward gains**

The value for 'Feedforward Gain Min' should always be 0.
To adjust 'Feedforward Gain Max.' perform the following steps:
1. Go to the digital part support machine parameters and set 'Feedforward Gain Max' to 1.
2. Set 'Adjustment mode' to 2 for displaying the maximum error in degrees.
3. Go to Manual Mode and set the press speed S_{high} to the value as already determined in the section about Adjustment of Proportional Gain Max.
4. Perform a bend, consider the displayed maximum error and increase 'Feedforward Gain Max.' by 1 until the movement of the part support becomes unacceptable.

- **Adjustment procedure for Differential gains**

The value for 'Differential Gain Min.' should always be 0.
To adjust 'Differential Gain Max.' perform the following steps:

1. Go to the digital part support machine parameters and set 'Differential Gain Max.' to 10.
2. Set 'Adjustment Mode' to 2 for displaying the maximum error in degrees.
3. Go to Manual menu, select press speed S_{high} and perform a bend.

4. Consider the the maximum error, and increase 'Differential Gain Max' by 10 until the maximum error is reduced sufficiently, while the movement of the part support is still acceptable. If the maximum error does not become smaller while increasing 'Differential Gain Max.', set 'Differential Gain Max.' to zero.

When the procedure is finished, make sure to set the parameter 'Adjustment Mode' to 0. This way, the actual angle of the part support will be displayed in Manual mode.

9.2.4   Extra info and recommendations

Utilities while adjusting control gains

It is not required, but it may be useful to make use of the following utilities while performing the adjustment procedure of the control gains:

- **In Position Tolerance**

The digital part support machine parameter 'In Position Tolerance' can be used while adjusting the control gains.

When the part support angle error is smaller than the angle given by In Position Tolerance, the displayed value in Zoomed Values menu (after PS=) is highlighted.

Otherwise, the displayed value in Zoomed Values menu is not highlighted.

- **Overshoot measurement**

When choosing the control gains too high, this may result in an overshoot. This means that the part support will first go somewhat further than the final desired angle before the part support moves back to the desired angle.

The overshoot can also be measured by setting 'Adjustment Mode' to 3 in the part support machine parameters.

In the 'Zoomed Values' menu, after 'PS = ..', the amount of overshoot (in degrees) can then be read off in press status 4. In case of an overshoot this value is negative, since it is calculated as the difference between the programmed value and the actual value:

overshoot = programmed value - actual value

Select a dwell-time of at least 2 seconds, to be able to read this value.

If necessary, there are two possibilities to decrease the overshoot:

- increase the value of the Differential Gain Max. This can decrease the overshoot value, but the movement of the part support arm may become less smooth.
- decrease the value of the Proportional Gain Max. This can also decrease the overshoot value, but the accuracy of the part support movement with respect to the pressing movement will be less.

Gain parameters

The figure below illustrates the function of the gain parameters in a control technical schematic.
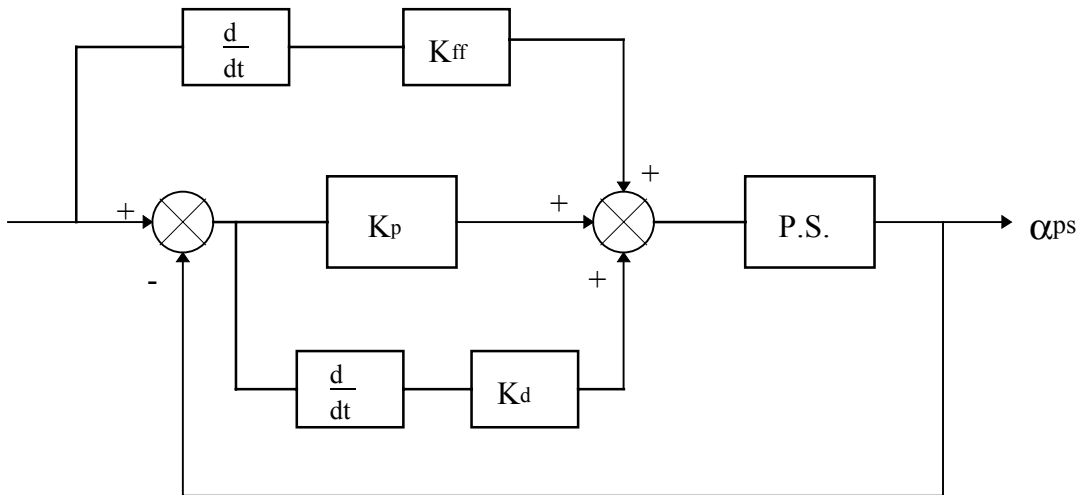
In this schematic, the following parameters are shown:

P.S. = Part Support
K_p = Proportional gain
K_d = Differential gain
K_{ff} = Feedforward gain

The parameter for proportional gain must always be adjusted, the two others are optional.

Requirements and recommendations for part support systems

The following remarks are meant to give some recommendations for building an adequate part support system.

Acceleration and deceleration of the part support system

The part support mechanism should be capable of fast movement and quick response: it should be able to move with the maximum required speed during bending but it should also be capable of changing speed quickly when a bending starts or stops.
When a large maximum part support speed is required, even so a large acceleration and deceleration of the part support is needed to limit the maximum position error and overshoot. The relation between maximum part support speed and required acceleration / deceleration is quadratic. When the maximum speed becomes twice as large, the required acceleration becomes four times as large to maintain the same maximum position error.

Hydraulic part support systems

1. Hose lines
Special care should be taken when using hose lines, because they react elastically on internal over pressures. Hose lines can have the following disadvantages:
- An increased maximum position error.
- An increased amount of overshoot.

Hose lines should not be mounted between the flow control valve and the cylinder, but for instance between the pressure control valve and the flow control valve.

2. Flow control valve
The maximum flow of the control valve should not be too large, but should be just large enough to be able to reach the desired maximum part support speed.
To limit the maximum position error of the part support, it is better to select a flow control valve which has a relatively short response time.
The flow control valve should be mounted as close as possible to the cylinder, to eliminate the effect of hydraulic lines between the flow control valve and the cylinder.

Control voltage to part support system

The control voltage to the part support system can be tested in the module test of the diagnostic program. The voltage can be varied between -255 and 255 DA-points, which resembles a range between -10V and 10V.

The part support system should respond to the control signal as follows:

- At a control signal of 0 V the part support should not move.
- At a control signal of 40 mV (1 DA point for DA60 series controls) the part support should not stand still and should reach a maximum speed of 0.5°/s. When the part support has an angle range of e.g. 60°, it should take at least 120 s to move the part support from its minimum to its maximum angle, at a control signal of 40 mV.
- At a control signal of -40 mV, the part support should not stand still and the part support should reach a maximum speed of 0.5°/s in the opposite direction. When the part support has an angle range of e.g. 60°, it should take at least 120 s to move the part support from its maximum to its minimum angle, at a control signal of -40 mV.
- The relation between input voltage of the part support and the corresponding part support speed should be linear. Non-linearity can have a bad influence on the part support movement.

Potentiometer voltage

The feedback voltage from the potentiometer should have a large range between minimum and maximum values which correspond with the minimum and maximum angle. This will benefit the behaviour of the part support control system.

The feedback voltage is converted to AD points, ranging from 0 to 1023. In formula, the potentiometer voltage has to meet the following requirement:

$$Angle\ resolution = \frac{Max.\ Angle - Min.\ Angle}{Max.\ AD\ value - Min.\ AD\ value} \leq 0.1$$

This means a difference of 1 AD point should correspond to a part support angle of maximal 0.1°.

Play and stiffness of mechanical construction

Play

The play of the potentiometer construction has to meet the following requirement:

$$Play < \frac{Angle\ resolution}{2}$$

Play can cause a worse standstill of the part support en can lead to an increment in overshoot.

Stiffness

The stiffness of the mechanical construction of the potentiometer has to be large enough to have no negative influence on the measurement of the part support angle. An insufficient stiffness can increase the maximum position error and can cause an increased overshoot.

9.3   Additional part support axes

If the part support unit on the machine is equipped with additional spindles to be able to move along the machine, then additional axes can be programmed on the control to control these spindles. Each of these axes can be selected from the parameter screen of the digital part support.
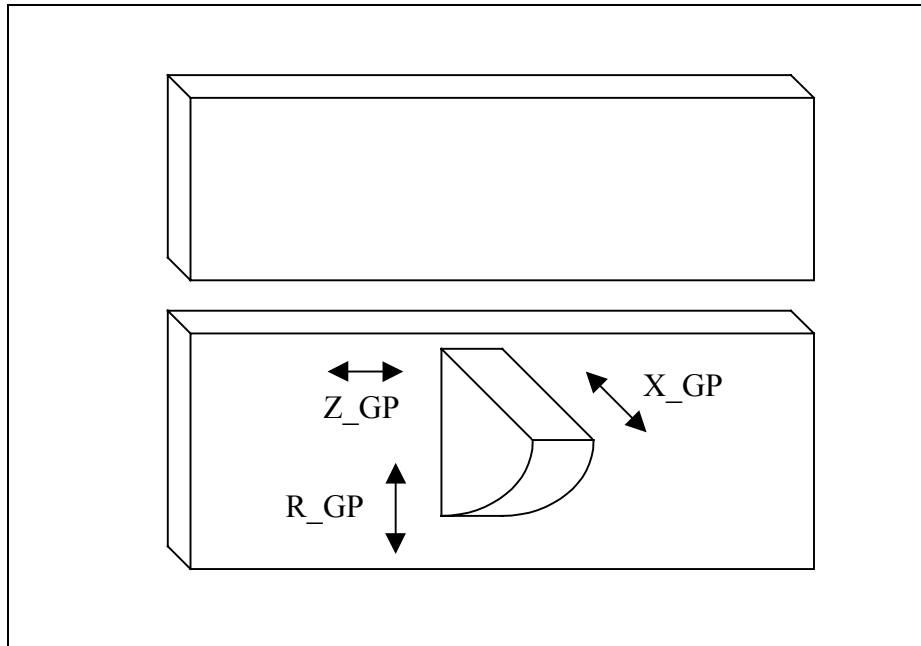
Fig. 9.3.a

It is possible to program three axes for each part support unit:
- X_GP
- R_GP
- Z_GP

Since it is possible to program four part supports on a machine, four names for each axis type are reserved: X_GP1, X_GP2, etc.
Programming any such axis for a part support involves the following:

1. in the parameter screen of the part support, select the axis name for each movement (X_GP1 for X-movement, etc.),
2. go to the auxiliary axis menu and program an auxiliary axis with the name that was chosen,
3. program the parameters for this axis,
4. make sure this axis is mapped on a module.

Step 1 is carried out by moving the cursor to the movement parameter. When the cursor is placed on one of these parameters, a pop-up window can be activated with the softkey 'select axis'.

```
AUXILIARY AXIS 9                        text:      Part support
                                        axis type:  6


           Sheet follow function (on=1/off=0)....127=      0




                                                        ┌──────────┐
                                                        │ No axis  │
           Number of slaves.....................SL=   0 │ X_GP1    │
           Default value........................14=  0001 │ X_GP2  │
                                                        │ X_GP3    │
           X-movement...........................124= No axis│ X_GP4 ↓│
           R-movement...........................125= No axis└──────────┘
           Z-movement...........................126= No axis

 124= [ -1 ]                                                    19.91
 ┌───────┬───────┬───────┬───────┬───────┬───────┬───────┬───────┐
 │ prev. │ next  │       │       │       │       │       │       │
 │ page  │ page  │       │       │       │       │       │       │
 └───────┴───────┴───────┴───────┴───────┴───────┴───────┴───────┘
```
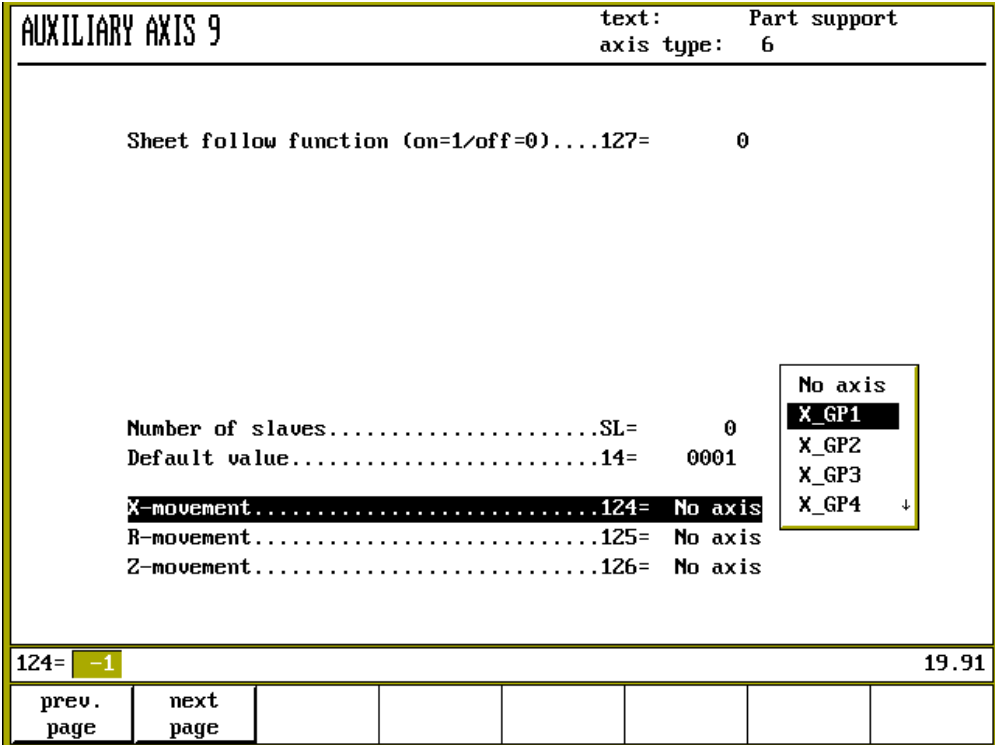
Fig. 9.3.b

Choose the required axis from the list.

For the other steps, the standard procedure for programming an axis can be followed. This procedure is described in detail in chapter 4.

9.4 Analog part support

9.4.1 Introduction

A part support system can also be driven by connecting a DBT01 card to a DM01. If that is the case, axis type 'servo' must be selected for the part support in the menu of the auxiliary axis.

In the beginning of the bend the metal plate accelerates very fast while the angle variation is not of the same speed order. High accuracy part support control requires closed loop regulated speed and angle control of one or more support arms. Therefore the DBT01 is equipped with an angle control amplifier and a speed regulator.

With the P-m potentiometer (or angle deflection potentiometer) the angle of the part support arm is measured (diagram Part support control) . The signal of this potentiometer is compared with the 0 - 10V angle output signal of the DM01 module. The difference of these signals controls the output voltage to for example an hydraulic valve amplifier (AL and AR in diagram Part support control. This diagram represents a dual part support system). Subsequently the hydraulic valve is controlled to move the part support arm. (Instead of a hydraulic valve the part support arm can also be controlled by a motor drive.)

At the same time the speed of the arm is measured (angle variation per unit of time). The output voltage variation of the controller and the speed variation signal of the angle potentiometer (P-m) are compared (speed difference). The difference of these signals is used to accelerate the speed of the control arm.

In case the acceleration required to move the arm is too high for the support arm to follow the sheet metal plate then a PWM-signal is generated at the Y-brake signal of the module to slow down the speed of the Y-axis of the press brake.

When the Y-axis moves slower then also the angle variation per unit of time will be slower.

In case of using two support arms the speed of both arms are compared and the slowest arm will regulate the speed of the Y-axis (Dual part support application).

9.4.2 Installation and adjustment of the DBT01 control card

The DBT-01 control card is used for the part support function. First the DBT01 card is installed then the part support arm should be adjusted. Both procedures are discussed.

Installation procedure
- Connect the part support control card DBT01 according to the standard connection diagram.
- Put the part support brackets in a horizontal position
- Make sure that the potentiometer - which reads the actual position of the part support - is then not more than 25 degrees turned from the zero-position. This should correspond with approximately 0,5 Volt on the runner of the potentiometer
- Adjust the following potentiometers before you start the adjustment procedure. See also diagram of DBT01 component layout:

Potentiometer nr.	Function	Start position
RP1	offset feedback	minimal = completely turned to the right
RP2	gain feedback	maximal = completely turned to the left
RP4	gain braking on Y-brake	minimal = completely turned to the left
RP5	slip factor	minimal = completely turned to the left
RP6	gain differential	minimal = completely turned to the left

- The potentiometers RP3, RP7, RP8, RP9 and RP10 are factory set to optimal values.

Adjustment procedure part support
- Go to the diagnostic mode
- Select DM01 module that controls the part support.
- Move cursor to the speed output parameter 'output0' with cursor key.
- Select 0 (= 0%).
- Start the machine and the hydraulic pump of the part support construction.
- Follow the next adjustment procedures:

** Adjustment of the feedback offset (see O1 in the blockdiagram of principle PID-controller)

- Turn RP1 until the part support is in the horizontal position.
  In case the part support can not be adjusted in an optimal way turn potentiometer RP6 a couple of turns to the right.
** Adjustment of the feedback gain (see A1 in the blockdiagram of principle PID-controller)

- Select 50% of 'output0'. This corresponds with the value 127.
- Turn potentiometer RP2 until the part support brackets are exactly halfway the maximum required angle.

** Adjustment of the differential gain (see A3 in the blockdiagram of principle PID-controller)

- Leave the diagnostic program.
- Program the part support machine parameters before continuing this procedure. See section 9.3.
- Select the manual mode.
- Program the manual mode parameters and program the pressing speed not too high, e.g. 2 mm/s.
- Make some pressing movements and turn potentiometer RP6 during the pressing phase so, that the part support is not oscillating and following the pressing movement fluently.

** Adjustment of the slipfactor (differentiating gain D in the blockdiagram of principle PID-controller)

- Make some more pressing movements and turn potentiometer RP5 until the part support is following the part bending in a optimal way and is not faster than the beam movement.

** Adjustment of the gain on deceleration of the beam (see O2 in the blockdiagram of principle PID-controller) Part support arms cannot follow the plate, e.g. Y-axis too fast.

  The beam will be decelerated by activating the Y-brake input of the module.

- Release the pressing command during the bending stroke, so that the part support is in a lifted position.

- Turn potentiometer RP4 until the Y-brake input of the module is just starting to light (activating).

- Now you can check whether the part support is also following the part while bending with higher pressing speeds. The bigger the difference between the required part support angle and the measured angle the more the Y-brake will be activated, so that the beam will be braked more frequently.

- For dual part support you must first adjust each part support separately, as they are single part supports. Then make the connections as in the connection diagram. The Y-brake will be active when one of the two support arms will have a too large error signal. Potentiometer RP4 needs only to be adjusted at the DBT01 card of which output T (See standard connection diagram) is connected to the module input Y-brake.

9.4.3   Parameters analog part support

Parameter: 7
Min. Value

Range : 0.0 - 90.0
Default : 90.0
Unit   : degrees (°)

Function
The minimum angle at which the support arm may be positioned. This is a software limit. See also adjustment procedure part support parameters.

Parameter: 8
Max. Value

Range : 0.0 - 90.0
Default : 90.0
Unit   : degrees (°)

Function
The maximum angle at which the support arm may be positioned. This is a software limit. See also adjustment procedure part support parameters.

Parameter: 18
DA-min

Range : 0 - 255
Default : 0
Unit   : -

Function
Minimum value of AD-converted potentiometer voltage. This value represents the minimum angle at which the part support arm may be positioned. See also adjustment procedure part support parameters.

Range : 0 - 255
Default : 1
Unit : -

Function
Maximum value of AD-converted potentiometer voltage. This value represents the maximum angle at which the part support arm may be positioned. See also adjustment procedure part support parameters.

Adjustment procedure part support parameters
To be sure that the part support is following the sheet metal plate fluently. The part support should be adjusted as follows:

-       Go to to the auxiliary menu and program the part support (1, 21).

-       Press 'change parameters' and program the DM-identifier and Box-number.

-       Program for Min. value and DA-min 0.

-       Program for Max. value and DA-max 255.

-       Go to the manual mode.

-       Move the part support arm to the mechanical minimal position by means of the handwheel or to the position that corresponds with 0 degrees angle.

-       Read out the value on the screen (Manual mode, manual positioning). This value corresponds with the number of DA-points. Remember that value and program it at the end of the adjustment procedure at the parameter DA-min.

-       Now move the part support to the mechanical maximal position or to the position that corresponds with 90 degrees angle.

-       Read out the value on the screen (Manual mode, manual positioning). This value corresponds with the number of DA-points. Remember the value and program it at the end of the adjustment procedure at the parameter DA-max.

-       Program now the found DA-values to the corresponding machine parameters and program Min. Value at 0 (read 0 degrees) and Max. Value at 90 (read 90 degrees).

Parameter: RF
Delay before retour factor

Range : 0.0 - 9.9
Default : 1.0
Unit   : -

Function
Multiply factor, used to program the time the part support arm must stay on the final position.
The parameter 'Delay Before Opening' (chapter 3, parameter 36) is multiplied by 'Delay Before
Retour Factor' to program how long the part support arm must stay.

If 'Delay Before Retour Factor' is set to 1.0, pressbeam and part support arm will move back
simultaneously.

Parameter: NR
Nr. of Units

Range : 1 - 4
Default : 1
Unit : -

Function
The number of part support arms that can be controlled.

Description
In the default situation you require one DBT01 card with which one part support arm is controlled with Y-brake feedback to the DM01 module.

For each extra part support axis you require a separate DBT01 control card. Two or more part support arms can be controlled in two ways:

- Synchronised. In this case all part support arms are used or are not used: together 'On' or together 'off'. The Y-brake feedback of the latest DBT01 is connected to the DM01 module. See also connection diagram dual part support as an example of two synchronised part support arms.

  Program 'Number of units' for synchronised control always the value 1.

- Separate. In this case you can specifiy which part support arms should be used or not. To control the part support arms separately you have to program some flags in the sequencer program. The control data for each part support arm should be matched on a digital output on the DM01. These digital outputs have to be connected to the DBT01 output (C18) to disable the control of the valve card or the motor drive. The Y-brake feedback may not be connected in this case!

  See also the 'Delem Sequencer Programming Language' manual for information about programming the sequencer for driving separate part support arms.

  Program 'Number of units' for separate control equal to the number of part support arms.

Parameter: 14
Default value

Range : 0000 - 1111 (binary values)
Default : 0000
Unit   : -

Function
Toggle on/off function for each part support unit.

Description
A "1" means that the part support axis is used for the active bending (is switched ON), "0" means that the part support axis is not used (is switched OFF).

Example
1000 means that for a specific bending one part support axis is enabled, i.e the part support axis on the first position.

Parameter: SA
Safety stop angle

Range : 0.0 - 90.0
Default : 0.0
Unit   : degrees (°)

Function
Angle at which the part support arm is stopped in the retour movement.
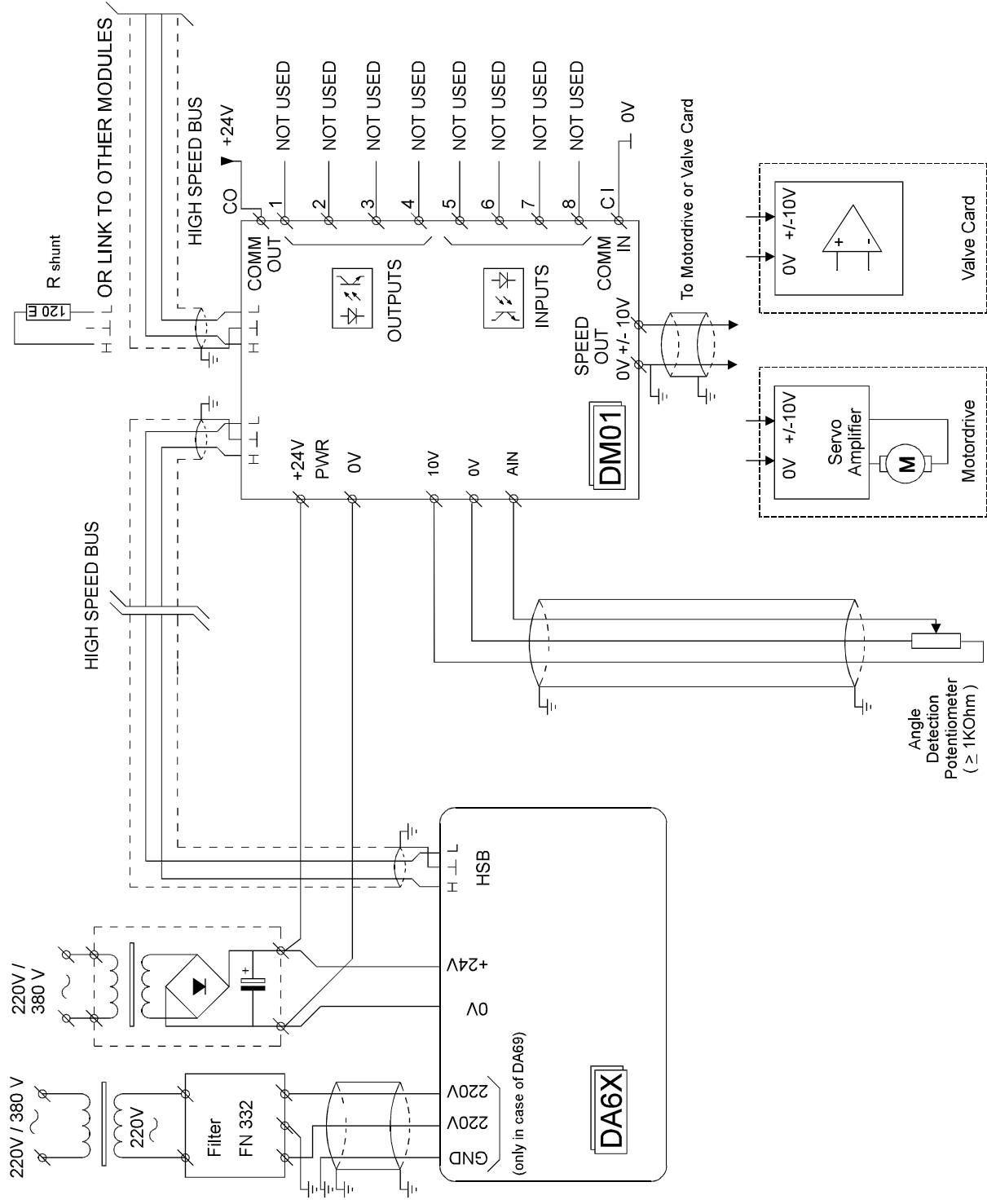
Parameter: MS
Max. angle speed

Range : 0 - 255
Default : 1
Unit   : degrees per second (°/s)

Function
The maximum angle speed at which the support arm can move.

OR LINK TO OTHER MODULES

HIGH SPEED BUS

R shunt

120 E

HIGH SPEED BUS

COMM OUT

OUTPUTS

INPUTS

COMM IN

CO +24V

1 NOT USED
2 NOT USED
3 NOT USED
4 NOT USED
5 NOT USED
6 NOT USED
7 NOT USED
8 NOT USED
CI 0V

SPEED OUT
0V +/- 10V

DM01

+24V PWR
0V
10V
0V
AIN

To Motordrive or Valve Card

0V +/-10V
0V +/-10V

Valve Card

0V +/-10V
0V +/-10V

Servo Amplifier

M

Motordrive

HIGH SPEED BUS

Angle Detection Potentiometer (≥ 1KOhm)

HSB

+24V

0V

220V / 380 V

220V / 380 V

Filter FN 332

220V

220V
220V
GND

(only in case of DA69)

DA6X