5. OPERATING MODES

5.1 Overview

The stepper driver board has 4 operating modes as listed below :

- § Mode 0 : Off line or Local Mode
- § Mode 1 : On Line DCC Mode (DCC = Device Control Command)
- § Mode 2 : On line HPGL Line mode
- § Mode 3 : On line HPGL File Mode

The purpose and proper operation of each mode will be discussed in more detail in the next sections. Switching from one mode to another can be accomplished by sending appropriate "Escape Sequences" to the board, as listed in the table below.

Table 7 : Mode Switching

FROM	TO	ESCAPE SEQUENCE
Mode 0 : Local	Mode 1 : DCC	<ESC>LI:<CR>
	Mode 2 : HPGL Line	<ESC>LM:<CR>
	Mode 3 : HPGL File	<ESC>FM:<CR>
Mode 1 : DCC	Mode 0 : Local	<ESC>LO:<CR>
	Mode 2 : HPGL Line	<ESC>LM:<CR>
	Mode 3 : HPGL File	<ESC>FM:<CR>
Mode 2 : HPGL Line	Mode 0 : Local	<ESC>.)<CR>
		<ESC>.Z<CR>
	Mode 1 : DCC	Only via Mode 0
	Mode 3 : HPGL File	Only via Mode 0
Mode 3 : HPGL File	Mode 0 : Local	<ESC>.)<EOF><CR>
		<ESC>.Z<EOF><CR>
	Mode 1 : DCC	Only via Mode 0
	Mode 2 : HPGL Line	Only via Mode 0

Remarks :

- § Mode 2 (HPGL Line Mode), allows only to switch to Mode 0 (Local mode), by using the HPGL Plotter Off line escape sequence [<ESC>.);].
- § The same applies to Mode 3 (HPGL File Mode), however in this case the Plotter Off Line escape sequence must be followed by an <EOF> character for proper operation (see also section 5.6).
- § Switching from either HPGL mode directly to DCC mode or the other HPGL mode can be easily implemented under user software control. First switch to Local Mode from within the HPGL mode using the appropriate escape sequence, than let the user software take control and send the required escape sequence to enter the desired mode.
- § In Mode 0 and Mode 1 the escape received sequence will be echoed back to the host

5.2 Power Up Sequence

At power up or after a hardware reset, the system will go through a series of initialisation routines to reset all its internal registers and counters. Subsequently it will check if Auto Homing is enabled.

- If Auto Homing is disabled, the current position of the three axes will be considered as the mechanical home position.
- If Auto Homing is enabled, the system will first perform a home seek on all three axes. First the Z-axis will be homed before homing in X and Y to ensure the tool is in its upmost position before moving in X and Y directions. For more details on the homing mode, see also extended instruction @HM in this manual. Once homing is completed, the actual position of the three axes will be considered as the mechanical home position.

The "Mechanical Home Position" is the position with absolute co-ordinates X=0, Y=0 and Z=0.

The system software will prevent any attempt to move in any negative direction relative to this point.

When the power up sequence is completed, the system will enter Local Mode and the LCD module will display a system ready message.

5.3 Mode 0 : Local Mode

In this mode, the steppers may be operated manually by means of the keyboard.

Please refer to section 2.5.2 for the key references used below.

The arrow keys may be used to jog with the associated axis in the desired direction. Jogging is only possible with one axis at a time. When an arrow key is depressed, the associated axis will start moving in the selected direction. This movement will initially be rather slow to allow for short moves, if the key is held down the motor will accelerate. When the key is released, the motor will stop after a very short deceleration cycle. The display will show the current position of each axis.

The "NEW HOME" key allows to set a new origin anywhere on the working area. Just move the axes to the desired point using the arrow keys, than press "NEW HOME". This will set the current position as the active home position (0,0,0). From here on, all displayed co-ordinates will be relative tot this new home position.

The key "HOME XY" will return all three axes from their current position to the active home position. First the Z-axis will be homed, than the X and Y axes. The key "HOME Z" homes the Z-axis only.

When jogging in negative direction, the axes may be moved to negative co-ordinates with respect to a new home position, but not with respect to the "mechanical home position" as defined in section 5.2 above. In the latter case, the stepper will be stopped once the absolute zero point of that axis is reached. Further depressing of the arrow key will have no effect.

The key "SPD" will toggle the tool motor control output on and off.

The key "PAUSE" is disabled in local mode.

The key "LIN/LOC" will toggle between Local and Line mode.

Switching from local to line mode may also be initiated from the host by having the user software send the appropriate escape sequence as listed in Table 7 above.

5.4 Mode 1 : DCC Mode

DCC mode stands for Device Control Command Mode. This mode comprises a set of escape sequences, primarily intended to perform special functions that are beyond the scope of normal HPGL data processing.

Most of these functions will only be used by the system integrator during the user software development phase. Also, in many cases the user software may prevent the end user from accessing some or all of these DCC functions. It is up to the system integrator to decide which functions the end user may or may not use and to conceive his user software accordingly.

See Table 8 in section 5.7, for a summary of the available functions.

Refer to section 6 for a detailed description of all DCC functions.

5.5 Mode 2 : HPGL Line Mode

In this mode is primarily intended for immediate processing of single HPGL commands or short series of consecutive HPGL commands all combined into a single ASCII string terminated by a <CR> character (hence the name "Line Mode").

The proper way of using this feature is through a user interfacing routine in the user software that allows the user to enter single or consecutive HPGL commands via the keyboard of the host computer. The user software should combine these inputs into a single ASCII string, add a <CR> character at the end of the string and send it to the driver board for processing.

Keep in mind following rules and guidelines when designing the user interface for Mode 2 :

- To enter Mode 2, send the appropriate mode switching escape sequence as listed in Table 7
- All standard and extended HPGL commands are allowed (see also section 5.7)
- The syntax rules of section 7.1 must be respected
- The HPGL command string must be terminated with a <CR> character
- The HPGL command string length is limited to 512 characters, including the <CR> terminator
- Processing will only start after the <CR> terminator has been received by the system
- Some HPGL commands will return data to the host , obviously the user software must be able to handle this feedback if such commands are embedded in the string
- While processing the command string, the system will inhibit further data reception by setting its RTS output in the "busy" state
- After processing the HPGL command string, the system returns its RTS output to the "ready" state to indicate the host that it is ready for a new HPGL command string
- Exiting this mode must be done by sending the appropriate mode switching escape sequence as listed in Table 7 while the RTS output is in the "ready" state

5.6 Mode 3 : HPGL File Mode

This mode is basically identical to mode 2, but rather then operating on a single line of commands entered via the keyboard and limited to 512 characters, it is intended to process HPGL files, limited in size only by the system's DRAM buffer size.

Furthermore, whereas in mode 2 a <CR> character indicates the end of a line and initiates processing of the commands, that is not the case in this mode. This mode is indeed intended to process files that may contain numerous <CR> characters, ultimately even in between each HPGL command. The system will just ignore all these <CR> characters during file processing.

The file should however be terminated properly for correct processing. The system is programmed to recognize the control character combination <EOF><CR> as an end-of-file marker.

Keep in mind following rules and guidelines when designing the user interface for Mode 3 :

- To enter Mode 3, send the appropriate mode switching escape sequence as listed in Table 7

- The HPGL file may contain HPGL escape sequences, HPGL standard commands (even unsupported) and extended commands. (see also section 5.7)
- The syntax rules of section 7.1 must be respected
- The HPGL file must be terminated by <EOF><CR> (without any other characters in between)
- The HPGL file is limited in size only by the board DRAM buffer size
- The system will start processing the HPGL commands after receiving <EOF><CR> or after the first 512 bytes, whichever comes first. In the latter case, data reception remains enabled until the end-of-file marker is received
- Some HPGL commands will return data to the host , obviously the user software must be able to handle this feedback if such commands are embedded in the string
- After receiving the end-of-file marker and whilst still processing the data, the system will inhibit further data reception by setting its RTS output in the "busy" state
- After processing the HPGL command string, the system returns its RTS output to the "ready" state to indicate the host that it is ready for a new HPGL file
- Exiting this mode must be done by sending the appropriate mode switching escape sequence as listed in Table 7 while the RTS output is in the "ready" state

5.7 Command Listings

5.7.1 Escape Sequences

There are two types of escape sequences, the ones used as Device Control Commands and the ones that may be embedded inside HPGL files or direct mode HPGL command lines. Both groups are listed in the tables hereafter.

Table 8 : DCC Escape Sequences

Esc. Seq.	Description
<ESC>BT:	Output Total DRAM capacty in bytes
<ESC>DF:	Restore default configuration parameters
<ESC>FM:	Start HPGL File Mode
<ESC>LI:	Start DCC mode
<ESC>LM:	Start HPGL Line Mode
<ESC>LO:	Return to Local Mode
<ESC>MD:	Output current System Mode
<ESC>NC:	Enter new configuration
<ESC>RS:	Reset System
<ESC>SC:	Output current configuration parameters
<ESC>ST:	Output current configuration in steps
<ESC>TB:	Output acceleration/decceleration tables

Table 9 : HPGL Escape Sequences

Esc. Seq.	Description
<ESC>.(	HPGL Plotter On Command
<ESC>.)	HPGL Plotter OFF Command (return to DCC)
<ESC>.Y	HPGL Plotter On Command
<ESC>.Z	HPGL Plotter OFF Command (return to DCC)
<ESC>MD:	Output current System Mode

5.7.2 HPGL Mode Commands

The HPGL mode command set is split in 2 groups, first there are a number of standard HPGL commands that are supported by the system, next there is a set of extended commands. The latter offers a number of additional features to enhance system performance. Typical examples are instructions that allow for full control of Z-axis motion, a feature normally not needed in pen plotters and hence not available in standard HPGL.

In addition to the supported standard HPGL commands, the system will recognise most other HPGL commands as well. Occurence of such commands within the file sent tot the system will not cause any error. The system will just ignore the command.

The tables hereafter summarize the supported HPGL commands, the extended commands and the recognised but unsupported HPGL commands.

Table 10 : Supported HPGL Commands

COMMAND	DESCRIPTION
DF	Defaults Restore
OA	Output Actual Position
OC	Output Commanded Position
OE	Output Error
OF	Output Scale Factors
OI	Output Identification
PA	Plot Absolute
PD	Pen Down
PR	Plot Relative
PU	Pen Up
SP	Select Pen
VS	Velocity Select

Table 11 : Extended Commands

GENERIC COMMANDS	
COMMAND	**DESCRIPTION**
@CA	Contouring angle set
@CL	Contouring Length of segment
@CP	Contouring Parameters output
@DB	Digital Bit Output
@DI	Digital Input Reading
@DO	Digital Output Setting
@EX	Exit to DCC mode
@HM	Home all 3 axes
@HZ	Home Z-axis only
@NH	Set Current Position as New XYZ-Home
@NO	Set Current Position as New XY-Origin
@NZ	Set Current Position as New Z-Home
@OC	Display & Output absolute position
@SM	Set spindle Motor
@SS	Set Spindle Speed
@TC	Tool Change output
@WT	Wait x msec
@XX	Reset System
@ZA	Z Move Absolute
@ZD	Z Down velocity
@ZP	Z Up/Down Positions setting
@ZR	Z Move Relative
@ZS	Z Up/Down Moving Speed
@ZU	Z Up velocity
@ZV	Z Up/Down Travelling Speed
@ZW	Z Up/Down Waiting Time
PEN RELATED COMMANDS	
COMMAND	**DESCRIPTION**
@Pn	Set Pen n Up/Down Positions (n = 0 .. 9)
@Sn	Set Pen n Up/Down Moving Speeds (n = 0 .. 9)
@Vn	Set Pen n Up/Down Travel Speed Setting (n = 0 .. 9)
@Wn	Set Pen n Up/Down Wait Time Setting (n = 0 .. 9)

Table 12 : Unsupported HPGL Commands

COMMAND	DESCRIPTION
AA	Arc Absolute
AR	Arc Relative
CA	Alternate Character Set
CI	Circle
CP	Character Plot
CS	Standard Character Set
DC	Digitize Clear
DI	Absolute Direction
DT	Define Label Terminator
DP	Digitise Point
DR	Relative Direction
EA	Edge Rectangle Absolute
EW	Edge Wedge
FT	Fill Type
IM	Input Mask
IN	Initialise
IP	Input P1 and P2
IW	Input Window
LB	Label
LO	Label Origin
LT	Line Type
NR	Not ready (send off line)
OD	Output Digitised Point
OH	Output Hard Clip Limits
OO	Output Option
OP	Output P1 and P2
OS	Output Status
OW	Output Window
PS	Paper Size
PT	Pen Thickness
PW	Pen Width
RA	Shade Rectangle Absolute
RO	Rotate Co-ordinate System
RR	Shade Rectangle Relative
SA	Select Alternate Set
SC	Scale
SI	Absolute Character Size
SL	Character Slant
SM	Symbol Mode
SR	Relative Character Size
SS	Select Standard Set
TL	Tick Length
UC	User Defined Character
WG	Shade Wedge
WU	Wait Up ??
XT	X Tick
YT	Y Tick

6. DCC MODE COMMANDS

6.1 DCC Syntax

All DCC escape sequences are made up of 4 characters according following sysntax convention :

Position 1 : <ESC> character (ASCII decimal code 27)
Position 2 : Command character 1, must be in upper case
Position 3 : Command character 2, must also be in upper case
Position 4 : Colon

The DCC string must be terminated with a <CR> character when sending it to the host.

6.2 DCC Descriptions

All Device Control Commands are explained in detail hereafter.

OUTPUT BUFFER TOTAL BYTE COUNT <ESC>BT:

Syntax : <ESC>BT:<CR>

Response : <ESC>BT:***1234567890***<CR>

Where ***1234567890*** represents a 10 character ASCII string indicating the total size of the DRAM buffer in bytes (e.g. 0001048576 = 1.048.576 bytes of DRAM buffer).

RESTORE DEFAULT CONFIGURATION <ESC>DF:

Syntax : <ESC>DF:<CR>

Response : <ESC>DF:<CR>

The system will confirm reception of the command by echoing it. Next the system will enter a self reprogramming mode to replace the current configuration settings in the Flash Eprom by the system default values stored in a separate area of the Flash. During this reconfiguring, the LCD display will indicate the system status. Once the display indicates that the reconfiguring is completed, the system needs to be reset to become operational.

For detailed information about system configuration refer to section 9.

**** Make sure jumper JP1 is on before using this instruction.***

START HPGL FILE MODE <ESC>FM:

Syntax : <ESC>FM:<CR>

Response : <ESC>FM:<CR>

The system will confirm reception of the command by echoing it, next it will enter HPGL file mode.

From here on, all data sent to the system must be in accordance with the syntax rules of section 7.1.

Returning to local mode only allowed by using the appropriate HPGL escape sequence listed in Table 9 .

START DCC MODE <ESC>LI:

Syntax : <ESC>LI:<CR>

Response : <ESC>LI:<CR>

This command is used to switch from local to DCC mode. When sent, the system will confirm reception of the command by echoing it to the host and subsequently it will enter DCC mode.

START HPGL LINE MODE <ESC>LM:

Syntax : <ESC>LM:<CR>

Response : <ESC>LM:<CR>

The system will confirm reception of the command by echoing it, next it will enter HPGL line mode.

From here on, all data sent to the system must be in accordance with the syntax rules of section 7.1.

Returning to local mode only allowed by using the appropriate HPGL escape sequence listed in Table 9 .

START LOCAL MODE <ESC>LO:

Syntax : <ESC>LO:<CR>

Response : <ESC>LO:<CR>

This command is used to switch from DCC to local mode. When sent, the system will confirm reception of the command by echoing it to the host and subsequently it will enter local mode.

OUTPUT CURRENT MODE <ESC>MD:

Syntax : <ESC>MD:<CR>

Response : <ESC>MD:***n***<CR>

Where n can be 0, 1, 2 or 3 (in ASCII format), depending on the current mode of the system.

The command may be used in any of the 4 modes. The user software may use it to double check if the system is in the desired mode before sending any further commands. However, when used as a stand alone command from within HPGL file mode (Mode 4) , it must be terminated by <EOF><CR>.

NEW SYSTEM CONFIGURATION <ESC>NC:

Syntax : <ESC>NC:<CR>

Response : see below

This command is intended for reconfiguring the system using a special protocol as outlined in detail in section 9. Please refer to that section for more detailed information.

RESET SYSTEM <ESC>RS:

Syntax : <ESC>RS:<CR>

Response : <ESC>RS:<CR>

The system will first confirm reception of the command by echoing it, subsequently it will perform a reset..

The effect is identical to a hardware reset so the system will be in local mode after completing the reset sequence. Any previously sent HPGL data will be lost.

**** If Auto Home is enabled, the system will also perform a home seek.***

OUTPUT SYSTEM CONFIGURATION <ESC>SC:

Syntax : <ESC>SC:<CR>

Response : <ESC>SC:***configstring***<CR>

Where ***configstring*** represents an ASCII string containing all current configuration settings.

For a detailed description of the ASCII string, refer to section 9.4.

OUTPUT SYSTEM STEP CONFIGURATION <ESC>ST:

Syntax : <ESC>ST:<CR>

Response : <ESC>ST:***step_configstring***<CR>

Where ***step_configstring*** represents an ASCII string containing all current configuration settings that are expressed in step related units. These values are derived from the user definable parameters entered during system configuration.

For a detailed description of the ASCII string, refer to section 9.4.

OUTPUT ACC/DEC TABLES <ESC>TB:

Syntax : <ESC>TB:<CR>

Response : <ESC>TB:***acc/dec_tablestring***<CR>

Where ***acc/dec_tablestring*** represents an ASCII string containing all acceleration and deceleration data as calculated by the system during configuration, using default or user defined configuration parameters.

This command is available to allow the system integrator to check the acceleration/deceleration profiles.

For a detailed description of these tables, refer to section 10

7. HPGL COMMANDS

7.1 Syntax Rules

The generic format for both standard and extended commands comprises :

- A standard or extended command string (see section 5.7, Table 10 & Table 11)
- Optional 1, 2 or more parameters depending on the command
- Parameter separator if more then one parameter
- Command terminator

Each element will now be discussed in detail.

Command String Syntax

The syntax of the command string itself must be exactly as defined in Table 10 and Table 11 of section 5.7 and in the detailed command descriptions contained in the present section.

The command string may be made up of upper or lower case ASCII codes or a combination of both, however there may be no blanks in between the characters that make up the command string.

Parameter Syntax

The parameters that go with the commands must be made up of valid ASCII codes in accordance to the listing below :

- Integers : ASCII characters 0 … 9, minus sign and space (assumes positive value)
- Floating : ASCII characters 0 … 9, dot, minus sign and space (assumes positive value)
- Hex : ASCII characters 0 … 9, A … F

Parameter Separator

Some commands require 2 or more parameters. In this case the parameters must be separated by at least one space character or a comma. In the latter case additional spaces before and/or after the comma will be ignored.

Command Terminator

A command string is considered as being terminated by the occurence of either a semi-colon or a new valid command string.

Ignored Characters

- <SPACE> except when used as a parameter separator
- <CR> except in the end of file marker combination <EOF><CR>

Command Strings Examples

Following strings are valid command sequences :

PA 1000,1000;PD
PA1000,-1000;PU
PA 1000 -1000;PU
PA 1000 1000 ; PD
PA 1000 1000PUPR100 100

Following strings are invalid command sequences :

PA 1000-1000 : Missing parameter separator

PA1000:-1000;PU : Invalid parameter separator
PA 1000 1000X : Invalid command terminator
P A 1000, 1000; : No spaces allowed within the command itself

Unsupported HPGL Commands

All the commands listed in Table 12 will be recognised by the system as valid command strings syntax wise but will be skipped without any action.

All characters following an unsupported command string will be skipped until a valid command separator is encountered. This implies that only the sysntex of the unsopperted command string itself is checked, not the associated parameters, if any.

Syntax Error Handling

Whenever a syntax error occurs during the processing of HPGL data the system will stop all motors at their current position and quit further procesing of the HPGL data. The Error Led output will be driven low and the LCD module will display the appropriate error message.

Following error conditions may occur :

- Unknown command
- Invalid command terminator
- Invalid parameter separator
- Invalid ASCII code in parameter value
- Missing parameters

7.2 Standard HPGL Commands

In the this section all supported standard HPGL commands are individually described in detail..

For each command following topis are listed (where applicable) :

- *Syntax : exact command string*
- *Parameters : description, type, range, format*
- *Action : description of what the command does*
- *Serial Output : respons to the host computer via the serial link*
- *LCD Output : output to the LCD module*
- *See also : list of related commands*

Regarding the parameters that go with some commands, following rules apply :

- *Parameters within brackets are optional*
- *Parameters without brackets are mandatory*

The reader may notice that in the command description sections the command string and the parameters are separated by a blank and multiple parameters are separated by a comma although neither is strictly necessary according to the syntax rules above. This is mainly done to improve the readability of the command strings in this manual.

RESTORE DEFAULTS DF

Syntax :

DF;

Parameters :

None

Action :

All settings for pen numbers 0 upto 9 are reset to the system defaults as specified in the configuration tables (see section 9). This applies to following settings :

- PU and PD positions
- Plot speeds with PU and PD
- Z-axis speeds for moving up/down
- PU and PD wait times

If a "New Home" position had been previously set, this setting is now cancelled and the current position is displayed on the LCD module in absolute co-ordinates.

Output to RS-232 :

None

Output to LCD Module :

Shows current position in mm (absolute co-ordinates).

See instruction OA for display format.

See also :

OA, @Pn, @Sn, @Vn, @Wn, @NH, @NZ, @NO

Section 9. SYSTEM CONFIGURATION

OUTPUT ACTUAL POSITION OA

Syntax :

OA;

Parameters :

None

Action :

Outputs the XYZ co-ordinates of the current position in mm to the host via the serial link and displays them on the LCD module.

, Attention !

The output values are always relative to the currently active home position ! So, if a new home has been set previously, the output values may be positive or negative.

Output to RS-232 :

An ASCII string comprising 42 characters terminated by a <CR> character. The string comprises 3 substrings of 14 characters each with following format :

- § Position 1 : Character X or Y or Z indicating the axis
- § Position 2 : Colon
- § Position 3 : Sign (<SPACE> = plus sign)
- § Positions 4 … 9 : Integer part of co-ordinate in mm
- § Position 10 : Decimal point
- § Positions 11 … 13 : Fractional part of co-ordinate in mm
- § Position 14 : Semi-colon as co-ordinate terminator

Example of a co-ordinates output string :

X: 000247.250;Y:-000789.250;Z: 000010.000;<CR>

Output to LCD Module :

Shows the current position in mm according following format :

```
X 0247.250|Z 010.000
Y-0789.025|Pos in mm
```

See also :

OC, @OC, @NH, @NZ, @NO, DF

OUTPUT COMMANDED POSITION OC

Syntax :

OC;

Parameters :

None

Action :

Outputs the XYZ co-ordinates of the current position in user units (uu) to the host via the serial link and displays them on the LCD module.

Since 1 uu is the smallest unit, all output values will be integers.

, Attention !

The output values are always relative to the currently active home position ! So, if a new home has been set previously, the output values may be positive or negative.

Output to RS-232 :

An ASCII string comprising 30 characters terminated by a <CR> character. The string comprises 3 substrings of 10 characters each with following format :

- Position 1 : Character X or Y or Z indicating the axis
- Position 2 : Colon
- Position 3 : Sign (<SPACE> = plus sign)
- Positions 4 … 9 : Co-ordinate in user units
- Position 10 : Semi-colon as co-ordinate terminator

Example of a co-ordinates output string :

X: 009890;Y:-031561;Z: 000400;<CR>

Output to LCD Module :

Shows the current position in mm according following format :

```
X 009890|Z 000400
Y-031561|Pos in mm
```

See also :

OA, @OC, @NH, @NZ, @NO, DF

OUTPUT ERROR CODE OE

Syntax :

OE;

Parameters :

None

Action :

Outputs the current error code to the host computer via the serial link. If this command is given while the system is in normal operating mode, it will output code 00.

Output to RS-232 :

A 2 character string representing the error code in ASCII, followed by a <CR>.

For a list of error codes, refer to section 11. SYSTEM ERRORS

Output to LCD Module :

In case the system is in normal operating mode (no error condition), the display will remain unchanged.

In case the system has stopped due to the occurence of an error, the display will already show the error code and a brief description. So again, the display will remain unchanged.

See also :

@XX

Section 11. SYSTEM ERRORS

OUTPUT SCALE FACTORS OF

Syntax :

OF;

Parameters :

None

Action :

Outputs the scale factors for the 3 axes to the host and displays them on the LCD module.

By definition :

SCALE FACTOR = NUMBER OF USER UNITS PER MILLIMETER

Example :

1 HPGL Unit is 0.025 mm, so the HPGL scale factor is 40 (1mm/0.025 mm)

Output to RS-232 :

An ASCII string comprising 18 characters terminated by a <CR> character. The string comprises 3 substrings of 6 characters each with following format :

- Position 1 : Character X or Y or Z indicating the axis
- Position 2 : Colon
- Position 3 … 5 : Scale Factor
- Position 6 : Semi-colon as co-ordinate terminator

Example of a co-ordinates output string :

X:040;Y:040;Z:040;<CR>

Output to LCD Module :

Shows the current scale factors according following format :

```
User Units per mm :
X:040;Y:040;Z:040;
```

See also :

Section 9. SYSTEM CONFIGURATION

OUTPUT IDENTIFICATION OI

Syntax :

OI;

Parameters :

None

Action :

Outputs system identification to the host and displays it on the LCD module.

Output to RS-232 :

An ASCII string with system ID terminated by <CR> according following format :

STEPMASTER V1.0<CR>

Where V1.0 indicates the actual software version.

Output to LCD Module :

Displays the system identification as shown below :

```
STEPMASTER V 1.0
```

See also :

Section 9. SYSTEM CONFIGURATION

PLOT ABSOLUTE PA

Syntax :

PA (x1, y1 (,x2, y2, ...));

Parameters :

x1, y1, x2, y2 … : Absolute X and Y co-ordinates in user units

Range : -2^{23} … $+2^{23}$ (only integers allowed !!)

The total number of parameters following the command MUST always be an even number !

Action :

§ ***PA instruction without parameters***

The command PA without any parameters will result in activating the absolute plot mode. From this point on, all XY co-ordinates following PU or PD commands will be considered to be absolute. This mode stays in effect until a PR command is received.

§ ***PA instruction with parameters***

Will result in a XY-vector move towards the specified absolute co-ordinates. If more than one pair of co-ordinates is given, the associated absolute moves will be executed sequentially.

, Attention !

Prior to executing the move(s), the system will check if the displacement might not be part of a curve according to the algorithm outlined in section 8.

Output to RS-232 :

None

Output to LCD Module :

Position in mm after completing the vector move..

See also :

PD, PR, PU, VS, @CA, @CL, @ZV, @Vn

Section 8 CIRCULAR INTERPOLATION

PEN DOWN PD

Syntax :

PD (x1, y1 (,x2, y2, ...));

Parameters :

x1, y1, x2, y2 … : X and Y co-ordinates in user units

Range : -2^{23} … $+2^{23}$ (only integers allowed !!)

The total number of parameters following the command MUST always be an even number !

Action :

§ ***PD instruction without parameters***

When the instruction is given without any parameters it will result in the Z-axis moving to the PD position. The actual PD position depends on wether or not the default value has previously been overwritten with extended instruction @ZP or by using SPn to select pen number n that had its PU & PD positions previously set with extended instruction @Pn. If a PD wait time has been set previously, the system will wait the specified time before executing the next instructuion.

§ ***PD instruction with parameters***

First the Z-axis will be moved in the same way as described above. Subsequently, a XY-vector move towards the specified co-ordinates will be executed (after the specified PD Wait time, if any). If more than one pair of co-ordinates is given, the associated moves will be executed sequentially.

The co-ordinates will be interpreted as absolute positions or relative displacements depending on wether PA or PR was the last plot instruction preceeding the current PD instruction.

, Attention !

Prior to executing the move(s), the system will check if the displacement might not be part of a curve according to the algorithm outlined in section 8.

Output to RS-232 :

None

Output to LCD Module :

Position in mm after completing the vector move..

See also :

PA, PR, PU, SP, VS, @CA, @CL, @ZP, @ZS, @ZV, @ZW, @Pn, @Sn, @Vn, @Wn

Section 8 CIRCULAR INTERPOLATION

PLOT RELATIVE PR

Syntax :

PR (Δx1, Δy1 (,Δx2, Δy2, ...));

Parameters :

Δx1, Δy1, Δx2, Δy2 … : X and Y displacements relative to current position, in user units

Range : -2^{23} … $+2^{23}$ (only integers allowed !!)

The total number of parameters following the command MUST always be an even number !

Action :

§ ***PR instruction without parameters***

The command PR without any parameters will result in activating the relative plot mode. From this point on, all XY co-ordinates following PU or PD commands will be considered to be relative. This mode stays in effect until a PA command is received.

§ ***PR instruction with parameters***

Will result in a XY-vector move towards the specified relative displacements. If more than one pair of co-ordinates is given, the associated relative moves will be executed sequentially.

, Attention !

Prior to executing the move(s), the system will check if the displacement might not be part of a curve according to the algorithm outlined in section 8.

Output to RS-232 :

None

Output to LCD Module :

Position in mm after completing the vector move..

See also :

PA, PR, PU, VS, @CA, @CL, @ZV, @Vn

Section 8 CIRCULAR INTERPOLATION

PEN UP PU

Syntax :

PU (x1, y1 (,x2, y2, ...));

Parameters :

x1, y1, x2, y2 … : X and Y co-ordinates in user units

Range : -2^{23} … $+2^{23}$ (only integers allowed !!)

The total number of parameters following the command MUST always be an even number !

Action :

§ ***PU instruction without parameters***

When the instruction is given without any parameters it will result in the Z-axis moving to the PU position. The actual PU position depends on wether or not the default value has previously been overwritten with extended instructions @ZP or by using SPn to select a pen that had its PU & PD positions previously set with extended instruction @Pn. If a PU wait time has been set previously, the system will wait the specified time before executing the next instructuion.

§ ***PU instruction with parameters***

First the Z-axis will be moved in the same way as described above. Subsequently, a XY-vector move towards the specified co-ordinates will be executed (after the specified PU Wait time, if any). If more than one pair of co-ordinates is given, the associated moves will be executed sequentially.

The co-ordinates will be interpreted as absolute positions or relative displacements depending on wether PA or PR was the last plot instruction preceeding the current PD instruction.

, Attention !

Prior to executing the move(s), the system will check if the displacement might not be part of a curve according to the algorithm outlined in section 8.

Output to RS-232 :

None

Output to LCD Module :

Position in mm after completing the vector move..

See also :

PA, PD, PR, SP, VS, @CA, @CL, @ZP, @ZS, @ZV, @ZW, @Pn, @Sn, @Vn, @Wn

Section 8 CIRCULAR INTERPOLATION

SELECT PEN SP

Syntax :

SP (n);

Parameters :

n : pen number 0 … 9 in ASCII (codes 30h ... 39h)

Action :

§ ***SP without pen number***

The default PU and PD values defined in the configuration tables will be activated. Previously defined pen related PU/PD settings will remain unchanged in the pen settings buffer and may always be activated by selecting the associated pen number as outlined below.

§ ***SP with pen number***

Activates all the settings related to the selected pen number that were previously set using extended instructions @Pn, @Sn, @Vn and @Wn.

If some or all of these settings were not defined previous to this command, the default values will be used instead.

Output to RS-232 :

None

Output to LCD Module :

None

See also :

@Pn, @Sn, @Vn, @Wn

Section 9. SYSTEM CONFIGURATION

VELOCITY SELECT VS

Syntax :

VS (v);

Parameters :

v : XY plotting speed in mm/sec, resolution 0.1 mm/sec

Action :

§ ***VS without parameter***

No action

§ ***VS with parameter***

The specified plotting speed is set as the actual working speed for XY vector moves with either PU or PD. Any working speed settings previously activated by a Select Pen command will be replaced by the new working speed value. However, the pen settings buffer itself will NOT be overwritten. These settings can always be activated with the Select Pen # command.

Output to RS-232 :

None

Output to LCD Module :

None

See also :

@ZV, @Vn

Section 9. SYSTEM CONFIGURATION

7.3 Extended Commands

In addition to the standard HPGL commands described in the previous section, the system also offers a number of extended commands for improved performance and flexibility.

There are 2 groups of extended commands :

§ *Generic Extended Commands*

As with standard commands, these extended commands result in immediate action.

§ *Pen Related Extended Commands*

These command will modify a setting associated with the specified pen number. However, the setting will not be activated immediately, but will be stored in a "pen settings buffer". Activating the settings for a particular pen is achieved through the SPn command (Select Pen n).

At power up, after a reset or after the standard instruction DF, all the settings of all the pen numbers will be reset to the default values specified in the configuration tables.

In the this section all extended commands are individually described in detail..

For each command following topis are listed (where applicable) :

§ *Syntax* : *exact command string*

§ *Parameters* : *description, type, range, format*

§ *Action* : *description of what the command does*

§ *Serial Output* : *respons to the host computer via the serial link*

§ *LCD Output* : *output to the LCD module*

§ *See also* : *list of related commands*

The command descriptions hereafter are organised as follows :

§ First the generic extended commands in alphabetic order (@CA … @ZW)

§ Next the pen related commands, also in alphabetic order (@Pn … @Wn)

Regarding the parameters that go with some commands, following rules apply :

§ *Parameters within brackets are optional*

§ *Parameters without brackets are mandatory*

The reader may notice that in the command description sections the command string and the parameters are separated by a blank and multiple parameters are separated by a comma although neither is strictly necessary according to the syntax rules above. This is mainly done to improve the readability of the command strings in this manual.

CONTOURING ANGLE @CA

Syntax :

@CA a;

Parameters :

a : maximum inter vector angle for consecutive curve vectors

Range : 0° … 90°, only integer values allowed !

Action :

Sets the maximum value of the inter-vector angle, used by the circular interpolation algorithm to detect curved motions.

Setting the inter-vector angle to 0 (@CA 0;) will disable the circular interpolation.

Please refer to section 8. CIRCULAR INTERPOLATION

Output to RS-232 :

None

Output to LCD Module :

None

See also :

PA, PD, PR, PU, @CL, @CP

Section 8. CIRCULAR INTERPOLATION

CONTOURING SEGMENT LENGTH @CL

Syntax :

@CL d;

Parameters :

d : maximum X and Y displacement in user units

Range : 0 … 32767 (must be an integer !)

Action :

Sets the maximum X and Y displacement used by the circular interpolation algorithm to decide if a vector might be part of a curve or not.

Setting the value to 0 (@CL 0;) will disable the circular interpolation.

Please refer to section 8. CIRCULAR INTERPOLATION

Output to RS-232 :

None

Output to LCD Module :

None

See also :

PA, PD, PR, PU, @CA, @CP

Section 8. CIRCULAR INTERPOLATION

CONTOURING PARAMETERS OUTPUT @CP

Syntax :

@CP;

Parameters :

None

Action :

Outputs actual settings of @CA and @CL to the host and displays them on the LCD module.

Output to RS-232 :

An ASCII character string with current CA and CL values according following format :

CL: 00100;CA: 00010<CR>

Output to LCD Module :

```
CL: 00100 CA: 00010
```

See also :

PA, PD, PR, PU, @CA, @CL

Section 8. CIRCULAR INTERPOLATION

DIGITAL BIT OUTPUT @DB

Syntax :

@DB n, b;

Parameters :

n : bit position (range 0 … 7)

b : bit value (0 or 1)

Action :

Bit position n of the general purpose 8-bit output port is set in accordance with value b.

, Attention !

The general purpose digital outputs are all open collector types. Writing a logical '0' (i.e. clearing) to a bit position will turn off the OC output while writing a logical '1' (i.e. setting) will turn it on.

Output to RS-232 :

None

Output to LCD Module :

None

See also :

@DI, @DO

DIGITAL INPUT @DI

Syntax :

@DI;

Parameters :

None

Action :

Reads the status of the 8-bit digital input port and sends the result to the host as 2 hexadecimal ASCII characters.

Output to RS-232 :

An ASCII string with following format :

HH<CR>

Where HH represent the ASCII codes of 2 hexadecimal nibbles.

Output to LCD Module :

None

See also :

@DB, @DO

DIGITAL BYTE OUTPUT @DO

Syntax :

@DO HH;

Parameters :

HH : Two ASCII codes representing an 8-bit value in hex format

Valid characters for HH are the ASCII codes for hex symbols 0 … 9 and A … F

Action :

The general purpose 8-bit digital output port is set to value HH

, Attention !

The general purpose digital outputs are all open collector types. Writing a logical '0' (i.e. clearing) to a bit position will turn off the OC output while writing a logical '1' (i.e. setting) will turn it on.

Output to RS-232 :

None

Output to LCD Module :

None

See also :

@DB, @DI

EXIT TO DCC MODE @EX

Syntax :

@EX;

Parameters :

None

Action :

System leaves HPGL mode and switches to DCC mode.

Output to RS-232 :

None

Output to LCD Module :

The LCD module displays the DCC mode message as shown below :

```
SYSTEM READY - V1.0
ON LINE MODE
```

See also :

Section 6 DCC MODE COMMANDS

HOME ALL @HM

Syntax :

@HM;

Parameters :

None

Action :

First the Z-axis will be homed by driving it in negative direction using the homing speed specified in the system configuration table, until the Z-axis home switch is actuated. After a short delay, the Z-axis will be driven in positive direction, using the Z-axis back-off speed specified in the system configuration table, until the home switch releases again. Finally the axis will be moved an additional back-off distance away from this point (specified by the back-off distance parameter in the system configuration table).

After having homed the Z-axis, the same method is applied to Y and X axes consecutively using the related homing speed, back-off speed and back-off distance as specified in the system configuration table.

When all 3 axes have been homed, the absolute position counters are cleared to zero and the physical location of the three axes is now considered to be the mechanical origin of the system. Attempts to move in negative direction with respect to this point will result in a system error.

Output to RS-232 :

None

Output to LCD Module :

First phase :

HOMING Z-AXIS

Second phase :

HOMING X & Y AXIS

When done :

X 0000.000|Z 000.000
Y 0000.000|Pos in mm

See also :

Section 3.1 DIP-Switch S1

Section 9. SYSTEM CONFIGURATION

HOME Z	@HZ

Syntax :

@HZ;

Parameters :

None

Action :

The Z-axis will be homed by driving it in negative direction using the homing speed specified in the system configuration table, until the Z-axis home switch is actuated. After a short delay, the Z-axis will be driven in positive direction, using the Z-axis back-off speed specified in the system configuration table, until the home switch releases again. Finally the axis will be moved an additional back-off distance away from this point (specified by the back-off distance parameter in the system configuration table).

After completion, the Z-axis absolute position counters will be reset to zero and the current position of the axis will be considered as its mechanical origin. Attempts to move the axis in negative direction with respect to this point will result in system error.

The positions of X and Y remain unchanged.

Output to RS-232 :

None

Output to LCD Module :

While homing :

HOMING Z-AXIS

When done :

X xxxx.xxx|Z 000.000
Y yyyy.yyy|Pos in mm

Where xxxx.xxx and yyyy.yyy represent the current XY co-ordinates.

See also :

Section 3.1 DIP-Switch S1

Section 9. SYSTEM CONFIGURATION

NEW HOME @NH

Syntax :

@NH;

Parameters :

None

Action :

The current absolute position of the three axes is set as active home position.

All subsequent absolute XY or Z co-ordinates will be interpreted as being relative to this new home, enabling the use of negative values with absolute moves.

However, the target position must still have positive absolute co-ordinates with respect to the mechanical origin or a system error will occur.

Output to RS-232 :

None

Output to LCD Module :

```
X 0000.000|Z 000.000
Y 0000.000|Pos in mm
```

See also :

DF, OA, OC, PA, PD, PR, PU, @OC, @ZA, @ZR

NEW XY-ORIGIN @NO

Syntax :

@NO;

Parameters :

None

Action :

The current position of X and Y axes will be set as the new XY-origin without changing the Z-origin.

All subsequent absolute XY co-ordinates will be interpreted as being relative to this new XY origin, enabling the use of negative values with absolute moves.

However, the target position must still have positive absolute co-ordinates with respect to the mechanical origin or a system error will occur.

Output to RS-232 :

None

Output to LCD Module :

```
X 0000.000|Z zzz.zzz
Y 0000.000|Pos in mm
```

Where zzz.zzz represents the current position of the Z-axis.

See also :

DF, OA, OC, PA, PD, PR, PU, @OC

NEW Z-ORIGIN @NZ

Syntax :

@NZ;

Parameters :

None

Action :

The current position of Z-axis will be set as the new Z-origin without changing the XY-origin.

All subsequent absolute Z co-ordinates will be interpreted as being relative to this new Z-origin, enabling the use of negative values with absolute moves.

However, the target position must still have positive absolute co-ordinates with respect to the mechanical origin or a system error will occur.

Output to RS-232 :

None

Output to LCD Module :

```
X xxxx.xxx|Z 000.000
Y yyyy.yyy|Pos in mm
```

Where xxxx.xxx and yyyy.yyy represent the current XY co-ordinates.

See also :

DF, OA, OC, PD, PU, @OC, @ZA, @ZR

OUTPUT ABSOLUTE COMMANDED POSITION @OC

Syntax :

@OC;

Parameters :

None

Action :

Outputs the co-ordinates of the current position with respect to the mechanical home position and displays them on the LCD module as well.

The output values are in user units and therefore always integer numbers.

This instruction is an extension of standard instruction OC that outputs the user units co-ordinates with respect to the active home position. This implies that in case no new home has been previously defined both OC and @OC will output the same values.

Output to RS-232 :

An ASCII string comprising 30 characters terminated by a <CR> character. The string comprises 3 substrings of 10 characters each with following format :

- Position 1 : Character X or Y or Z indicating the axis
- Position 2 : Colon
- Position 3 : Sign (<SPACE> = plus sign)
- Positions 4 … 9 : Co-ordinate in user units
- Position 10 : Semi-colon as co-ordinate terminator

Example of a co-ordinates output string :

X: 009890;Y: 031561;Z: 000400;<CR>

Output to LCD Module :

Shows the current position in user units relative to the mechanical home position.

```
X 009890  |Z 000400
Y 031561  |Pos in uu
```

See also :

DF, OA, OC, @NH, @NZ, @NO

SPINDLE MOTOR @SM

Syntax :

@SM p;

Parameters :

p : 0 of 1

Action :

Used to control the open collector output labelled SPDL (Connector TBD, pin # TBD) intended to switch the tool motor on and off via software control.

- @SM 0; will turn off the OC output.
- @SM 1; will turn on the OC output

Output to RS-232 :

None

Output to LCD Module :

None

See also :

@SS, @TC

SPINDLE SPEED @SS

Syntax :

@SS s;

Parameters :

s : 0, 1, 2 of 3

Action :

This instruction controls the states of the SP1 and SP0 open collector outputs. These may be used to select 1 of 4 preset speeds for the tool spindle motor.
The state of these two outputs will reflect teh parameter value as shown below :

s	SP1	SP0
0	Off	Off
1	Off	On
2	On	Off
3	On	On

Output to RS-232 :

None

Output to LCD Module :

None

See also :

@SM, @TC

TOOL CHANGE @TC

Syntax :

@TC p;

Parameters :

p : 0 of 1

Action :

Used to control the open collector output labelled TCHG (Connector TBD, pin # TBD) intended to switch the tool changer on and off via software control.

- § @TC 0; will turn off the OC output.
- § @TC 1; will turn on the OC output

Output to RS-232 :

None

Output to LCD Module :

None

See also :

@SM, @SS

WAIT @WT

Syntax :

@WT w;

Parameters :

w : integer in the range 0 … 32767

Action :

Will wait w msec before executing the next instruction.

While waiting, the Pause Led output will be driven low.

Output to RS-232 :

None

Output to LCD Module :

None

See also :

@Wn

RESET SYSTEM @XX

Syntax :

@XX;

Parameters :

None

Action :

Resets the system.

This instruction may be used to exit an error condition via software.

Output to RS-232 :

None

Output to LCD Module :

None

See also :

OE

Section 11 SYSTEM ERRORS

Z-AXIS ABSOLUTE MOVE @ZA

Syntax :

@ZA z;

Parameter :

z : Absolute Z-axis co-ordinate in user units.

Range : -2^{23} … $+2^{23}$ (integers only).

Action :

Results in the Z-axis moving to position z (in user units)..

Output to RS-232 :

None

Output to LCD Module :

New position after executing the instruction

See also :

@ZR

Z-AXIS MOVE DOWN SPEED @ZD

Syntax :

@ZD sd;

Parameter :

sd : speed used to move the Z-axis downwards expressed in mm/sec

Maximum resolution is 0.1 mm/sec

Action :

Sets the given speed value as the working speed for downwards movements of the Z-axis.

Pen related Z-down speeds previously set with the instruction @Sn will remain in the pen settings buffer and can always be re-activated by selecting the associated pen using the SPn instruction.

If the speed value following the instruction is higher than the absolute maximum speed of the Z-axis specified in the configuration table, then the maximum speed will be used as working speed.

Output to RS-232 :

None

Output to LCD Module :

None

See also :

SPn, @ZU, @ZS, @Sn

Section 9. SYSTEM CONFIGURATION

Z-AXIS PU/PD POSITIONS @ZP

Syntax :

@ZP pu, pd;

Parameters :

pu : PU position in user units

pd : PD position in user units

Range for pu & pd : -2^{23} ... $+2^{23}$ (integers only)

Action :

Sets the specified values as the new Pen Up and Pen Down positions.

Pen related PU/PD positions previously set with the instruction @Pn will remain in the pen settings buffer and can always be re-activated by selecting the associated pen using the SPn instruction.

Output to RS-232 :

None

Output to LCD Module :

None

See also :

PD, PU, SPn, @Pn

Z-AXIS RELATIVE MOVE @ZR

Syntax :

@ZR Δz;

Parameter :

Δz : Relative Z-axis displacement in user units.

Range : -2^{23} … $+2^{23}$ (integers only).

Action :

Will move the Z-axis over a distance Δz relative to its current position.

Output to RS-232 :

None

Output to LCD Module :

New position after executing the instruction

See also :

@ZA

Z-AXIS MOVE UP/DOWN SPEED @ZS

Syntax :

@ZS su, sd;

Parameters :

su : speed to move Z-axis upwards expressed in mm/sec

sd : speed to move Z-axis downwards expressed in mm/sec

Maximum resolution 0.1 mm/sec

Action :

Sets the given speed values as the active working speeds for moving the Z-axis upwards and downwards respectively.

Pen related Z-up and Z-down speeds previously set with the instruction @Sn will remain in the pen settings buffer and can always be re-activated by selecting the associated pen using the SPn instruction.

If the speed value following the instruction is higher than the absolute maximum speed of the Z-axis specified in the configuration table, then the maximum speed will be used as working speed.

Output to RS-232 :

None

Output to LCD Module :

None

See also :

SPn, @ZD, @ZU, @Sn

Section 9. SYSTEM CONFIGURATION

Z-AXIS MOVE UP SPEED @ZU

Syntax :

@ZU su;

Parameter :

su : speed used to move the Z-axis upwards expressed in mm/sec

Maximum resolution is 0.1 mm/sec

Action :

Sets the given speed value as the working speed for upwards movements of the Z-axis.

Pen related Z-up speeds previously set with the instruction @Sn will remain in the pen settings buffer and can always be re-activated by selecting the associated pen using the SPn instruction.

If the speed value following the instruction is higher than the absolute maximum speed of the Z-axis specified in the configuration table, then the maximum speed will be used as working speed.

Output to RS-232 :

None

Output to LCD Module :

None

See also :

SPn, @ZD, @ZS, @Sn

Section 9. SYSTEM CONFIGURATION

Z-AXIS PLOT VELOCITY @ZV

Syntax :

@ZV vu, vd;

Parameters :

vu : XY plotting velocity with Pen Up, expressed in mm/sec

vd : XY plotting velocity with Pen Down. Expressed in mm/sec

Maximum resolution is 0.1 mm/sec

Action :

Sets the specified velocities as working speeds for plotting in the XY plane with the Z-axis in Pen Up or Pen Down position respectively.

Pen related settings previously defined with @Vn will remain in the pen settings buffer and can always be re-activated by selecting the associated pen using the SPn instruction.

If the speed value following the instruction is higher than the absolute maximum speed of the XY-axes specified in the configuration table, this maximum speed will be used as working speed.

Example :

Assuming the absolute maximum speed of X and Y axes is set to 25 mm/sec in the system configuration table, than the instruction @ZV 30, 15; will result in :

XY Plotting speed with PU will be 25 mm/sec

XY Plotting speed with PD will be 15 mm/sec

Output to RS-232 :

None

Output to LCD Module :

None

See also :

SPn, @Vn, VS

Section 9 SYSTEM CONFIGURATION

Z-AXIS PU/PD WAIT @ZW

Syntax :

@ZW wu, wd;

Parameters :

wu : waiting time in msec after moving to Pen Up position

wd : waiting time in msec after moving to Pen Down position

Range : 0 … 32767 (integers only).

Action :

Sets the given values as actual waiting times, expressed in msec, after moving to PU or PD positions respectively.

When the instructions PU and/or PD are used in conjunction with co-ordinates, the system will first execute the PU/PD move, than wait for the set time before executing the XY move.

Pen related settings previously defined with @Wn will remain in the pen settings buffer and can always be re-activated by selecting the associated pen using the SPn instruction.

Output to RS-232 :

None

Output to LCD Module :

None

See also :

SPn, @Wn

Section 9. SYSTEM CONFIGURATION

PEN RELATED PU/PD POSITIONS @Pn

Syntax :

@Pn pu, pd;

Where n represents a pen number 0 … 9

Parameters :

pu : PU position in user units

pd : PD position in user units

Range for pu & pd : -2^{23} ... $+2^{23}$ (integers only)

Action :

Writes the given pu and pd values to the buffer for pen number n.

Previously defined values, if any, are overwritten.

, Warning !

This instruction only writes the settings to the pen buffer without activating them ! The settings will be activated by selecting the associated pen number using instruction SPn.

After power off/on, reset or instruction DF all pen related settings will be lost and replaced by the default values from the system configuration table.

Output to RS-232 :

None

Output to LCD Module :

None

See also :

SPn, @ZP

Section 9. SYSTEM CONFIGURATION

PEN RELATED UP/DOWN SPEEDS @Sn

Syntax :

@Sn su, sd;

Where n represents a pen number 0 … 9

Parameters :

su : speed to move Z-axis upwards expressed in mm/sec

sd : speed to move Z-axis downwards expressed in mm/sec

Maximum resolution 0.1 mm/sec

Action :

Writes the given su and sd values to the buffer for pen number n.

Previously defined values, if any, are overwritten.

, Warning !

This instruction only writes the settings to the pen buffer without activating them ! The settings will be activated by selecting the associated pen number using instruction SPn.

After power off/on, reset or instruction DF all pen related settings will be lost and replaced by the default values from the system configuration table.

Output to RS-232 :

None

Output to LCD Module :

None

See also :

SPn, @ZS

Section 9. SYSTEM CONFIGURATION

PEN RELATED PLOT VELOCITIES @Vn

Syntax :

@ZV vu, vd;

Where n represents a pen number 0 … 9

Parameters :

vu : XY plotting velocity with Pen Up, expressed in mm/sec

vd : XY plotting velocity with Pen Down. Expressed in mm/sec

Maximum resolution is 0.1 mm/sec

Action :

Writes the given vu and vd values to the buffer for pen number n.

Previously defined values, if any, are overwritten.

, Warning !

This instruction only writes the settings to the pen buffer without activating them ! The settings will be activated by selecting the associated pen number using instruction SPn.

After power off/on, reset or instruction DF all pen related settings will be lost and replaced by the default values from the system configuration table.

Output to RS-232 :

None

Output to LCD Module :

None

See also :

SPn, @ZV

Section 9. SYSTEM CONFIGURATION

PEN RELATED PU/PD WAITS @Wn

Syntax :

@ZW wu, wd;

Where n represents a pen number 0 … 9

Parameters :

wu : waiting time in msec after moving to Pen Up position

wd : waiting time in msec after moving to Pen Down position

Range : 0 … 32767 (integers only).

Action :

Writes the given wu and wd values to the buffer for pen number n.

Previously defined values, if any, are overwritten.

, Warning !

This instruction only writes the settings to the pen buffer without activating them ! The settings will be activated by selecting the associated pen number using instruction SPn.

After power off/on, reset or instruction DF all pen related settings will be lost and replaced by the default values from the system configuration table.

Output to RS-232 :

None

Output to LCD Module :

None

See also :

SPn, @ZW

Section 9. SYSTEM CONFIGURATION