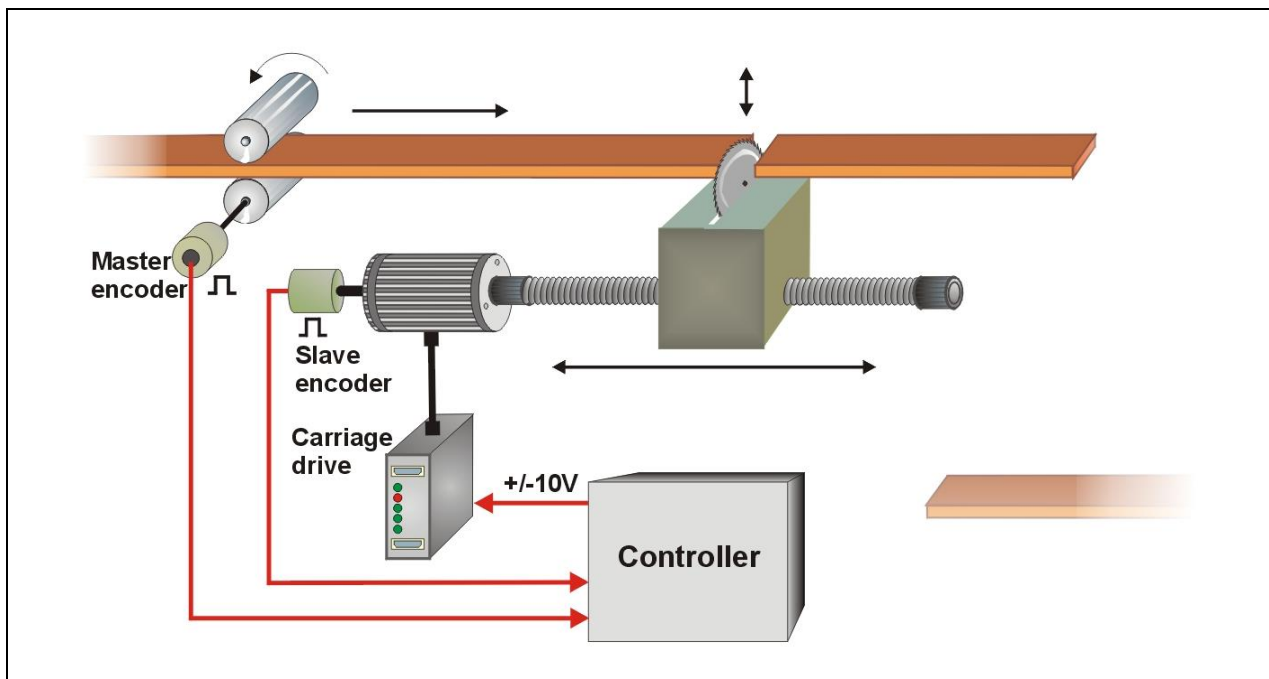# FS 701.11

## MC700 / MC720 Motion Control Firmware
## Motion Control for "Flying Shears and Saws"



- Easy parameter setting instead of sophisticated programming
- Immediately ready to work, with minimum commissioning time
- High dynamic response by means of short cycle time, therefore accurate cutting results also during change of line speed
- High cutting precision due to 400 kHz of feed-back frequency
- Suitable for "stand-alone" operation as well as for connection to field bus systems (CANBUS, PROFIBUS etc.)
- Extremely smooth motion by optimized S-shape profiles
- Useful supplementary functions like print mark control, multiple cutting sequence, gap function etc.

## Operating Instructions

# Safety Instructions

- This manual is an essential part of the unit and contains important hints about function, correct handling and commissioning. Non-observance can result in damage to the unit or the machine or even in injury to persons using the equipment!

- The unit must only be installed, connected and activated by a qualified electrician

- It is a must to observe all general and also all country-specific and application-specific safety standards

- When this unit is used with applications where failure or maloperation could cause damage to a machine or hazard to the operating staff, it is indispensable to meet effective precautions in order to avoid such consequences

- Regarding installation, wiring, environmental conditions, screening of cables and earthing, you must follow the general standards of industrial automation industry

- - Errors and omissions excepted –

| Version: | Changes: |
|---|---|
| FS701 02A / TJ / Mar. 2004 | Preliminary Version |
| FS701 04A / TJ, HK / May 2004 | Additional Cuts, Gap function |
| FS701 05A / TJ / Aug. 2004 | Master reverse movement monitoring, Power low error |
| FS701 05B / TJ / Feb. 2005 | Range of "Virtual Line Speed" and "Max. Line Speed" exceeded to max. 9999999 length units / min.; Table of Error Status register |
| FS701 06A / TJ / Aug. 2007 | Set Length Counter |
| FS701 07A / TJ / July 2008 | Motrona version, free assignment of hardware inputs and outputs, edge of printmark input selectable, virtual printmarks |
| FS701 08A / TJ / Mar. 2009 | Deceleration of stop ramps separately adjustable |
| FS701 09A / TJ / Feb. 2010 | Jog speed and jog ramps for forw./rev. Direction separately settable, return speed adjustable as absolute value, batch counter can be reset by command. New functions for printmark operation: Additional printmark offset, number of printmarks per sheet adjustable, delay compensation for printmark sensor input, printmark window providing alarm and cut with preset length when printmark is missing. New parameter "Sync mode" and input "Sync mode enable". |
| FS701 10A / TJ / Mar. 2011 | Cam output before cut, analogue output for diagnosis purpose |
| FS701 11A / TJ / July 2013 | Negative gap length, Protection of parameter blocks with access code |

# Table of Contents

# 1. Preamble

This document provides all information about the FS701 firmware, including parameters, variables and hints for commissioning.

To implement this application, you will need:

1. A motion controller hardware of type MC700 or MC720
2. A PC with operating system Windows 98, NT, 2000, XP or Windows7
3. The motrona CD containing the PC operator software OS5.1, the FS701 firmware file and the pdf files for the manuals MC700_de.pdf (hardware description, connections, specifications) and FS701xxx.pdf (description of the firmware as actually at hand)

All of above files are also available for free download from our homepage:

http://www.motrona.com
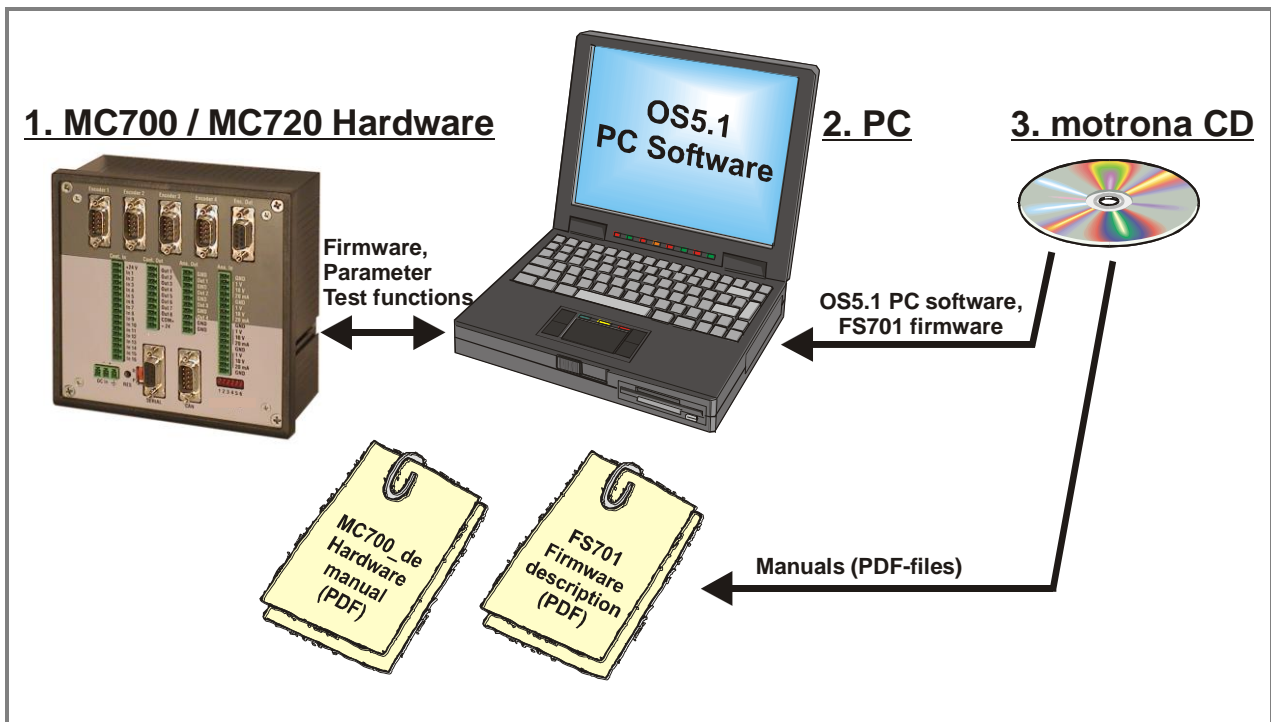


Moreover, on the product sites of the motrona homepage you can watch short demo movies showing typical applications of the firmware described here.

> ⚠ The FS701 firmware is liable to payment of a license fee and can only be used with the corresponding license key

# 2. General Remarks about Functions

## 2.1. Introduction

The FS 701 firmware is suitable for control of "Flying Shears" and "Flying Saws", frequently used for cut-to-length applications with endless material, where the material is in continuous motion and cannot be stopped during the cutting process.

The mechanical construction provides a carriage with a cutting tool, following synchronously the material while the cut is in progress, and then returning to a home position, to wait for the next cut.

This firmware has been designed for the special requirements of flying shear systems, under consideration of maximum efficiency and accuracy, with minimum stress for all mechanical parts. Very short control cycles together with intelligent motion profiles provide excellent performance under all operating conditions.

This unit is very easy to set up. All settings are made by PC, with use of the motrona operator software OS5.1.

All relevant operational parameters and variables are accessible by RS232/RS485 communication and via CANopen interface. For PROFIBUS applications, our PB251 gateway is available. Therefore the user has multiple possibilities for remote control of all batch and cutting parameters via operator terminals, PC or PLC systems

## 2.2. Principle of operation

The shear or saw blade is fixed on a carriage that can move in forward and reverse direction, under control of a +/- 10 volts speed reference signal, with a 4-quadrant DC or Servo or Vector drive.

Initially, the carriage keeps waiting in its rear home position, while the controller counts the current length of the passing material by means of encoder signals from a line roll or a measuring wheel.

As soon as the cutting point approaches an anticipated position, the carriage will accelerate and reach the line speed exactly where the cutting position matches the tool position. A "Ready-to-Cut" output will start the cutting procedure, while the carriage will exactly follow the material. When the cut is done, a remote "Cut completed" signal must tell the controller to decelerate and then return the carriage back to the home position again.

All speed transitions use self-optimizing S-shape profiles for minimum wear and tear of all mechanical parts, unless a linear ramp form has specifically been selected by corresponding parameter setting.
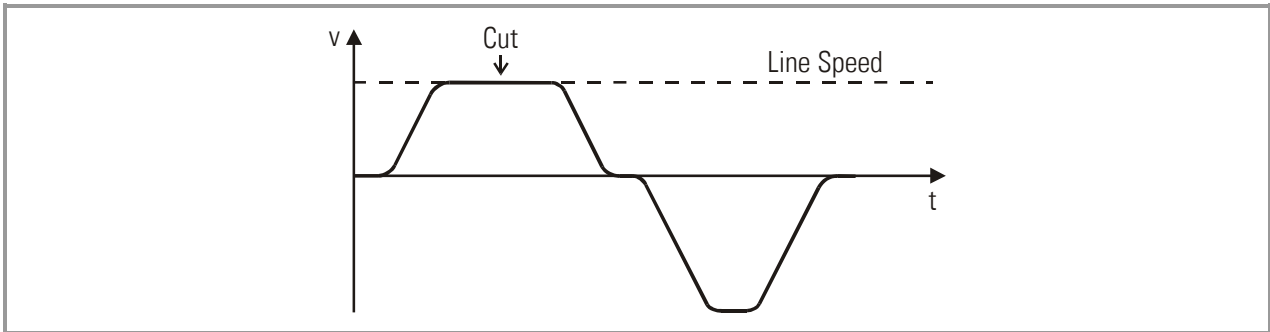
The FS701 control continuously measures the line speed and calculates an anticipation value to start the carriage before the cutting length is reached. Thus the shear will exactly match the cutting position of the material upon completion of the acceleration ramp and no overshoot or oscillation will take place prior to the cut. This saves time and increases the cutting efficiency of the shear system considerably.

## 2.3.  System Configuration

As a master drive, mostly the motor of a feed roll is used. The "master" can also be a measuring wheel equipped with an incremental encoder. For testing and commissioning the shear without material, a "Virtual Master Axis" can be selected, providing simulation of the line encoder at the selected line speed.

**The encoder resolutions should be at least 5 times higher than the maximum acceptable cutting error.**

RS422 quadrature encoders must be used. Where you find you must use 24V encoders with A/B output, please apply a level converter, e. g. motrona type PU202, to generate the proper RS422 quadrature signals required.

At <u>maximum line speed</u>, the master encoder frequency should be <u>at least</u> about 1 kHz, for best resolution of the analogue output. Moreover, the input frequency must not exceed the maximum level of 400 kHz.

It is best to choose the ppr numbers of line and carriage encoders in a way to produce frequencies in the same range. Acceptable ratios are in the range of

<p align="center">5:1  ... 1:1 ...1:5</p>

Mismatching beyond 1:16 and 16:1 are not allowed. Where applicable, the (x1), (x2) or (x4) hardware multiplication of the Master channel or the Slave channel may be used to adapt the frequencies

The line encoder must be connected to input "Encoder 1" and the carriage encoder to input "Encoder 2".

For speed reference of the carriage drive, the analogue output "Ana-Out 2" is used.

At any time the controller needs a remote signal upon completion of the cut ("cut completed") to commence the return motion of the carriage.

The block diagram below shows the principle of wiring of a Flying Shear system:



```
 Measuring Wheel    Line Encoder      Carriage Encoder              Carriage Drive

                        A, /A, B, /B      A, /A, B, /B
                                                              n.c.
                   Encoder 1  Encoder 2  Encoder 3  Encoder 4
                                                                      +/-10V
Control Enable → In 1
Start / Stop    → In 2                              Ana. Out 1              → Diagnosis
Select Virtual Master → In 3                        Ana. Out 2
Run Virtual Master → In 4       MC700/720           Ana. Out 3    n.c.
Immediate Cut   → In 5              +               Ana. Out 4    n.c.
Cut Completed   → In 6        Firmware CT701
Cut Test-Length → In 7                              Ana. IN       n.c.
Clear Error     → In 8
Set Zero Position → In 9                                Out 1    → Ready
Jog Forward     → In 10                                 Out 2    → Ready to Cut
Jog Reverse     → In 11    Control              Control Out 3    → Home
Decr. Batch counter → In 12                            Out 4    → Alarm.
Start Gap       → In 13    Inputs              Outputs Out 5    → Length Pulses
Teach Printmark. → In 14                               Out 6    → Gap completed
Print Mark      → In 15                                Out 7    → Master reverse
n.c.            → In 16  DC IN       SERIAL   CAN       Out 8    → Error

                         24VDC    RS232           CANopen
                                  RS485
                                 (Profibus)
```

**Bold printed signals are mandatory, other signals are optional**

It is necessary to adjust the carriage drive to its maximum dynamic response (no internal ramps, no integral control loop, high proportional gain), because the FS701 will generate the ramps which the drive has to follow with no additional delay

> ⚠ For safety reasons it is mandatory to limit the travelling range of the carriage by independent limit switches at both ends, in order to avoid damage with carriage overshoot upon failure of the electronic control system!

# 3.    Download Procedure

Ex factory, all MC 700- and MC 720 controllers have loaded the MC-Base firmware, which was used for factory testing purposes.

To download an application firmware, please take the following steps:
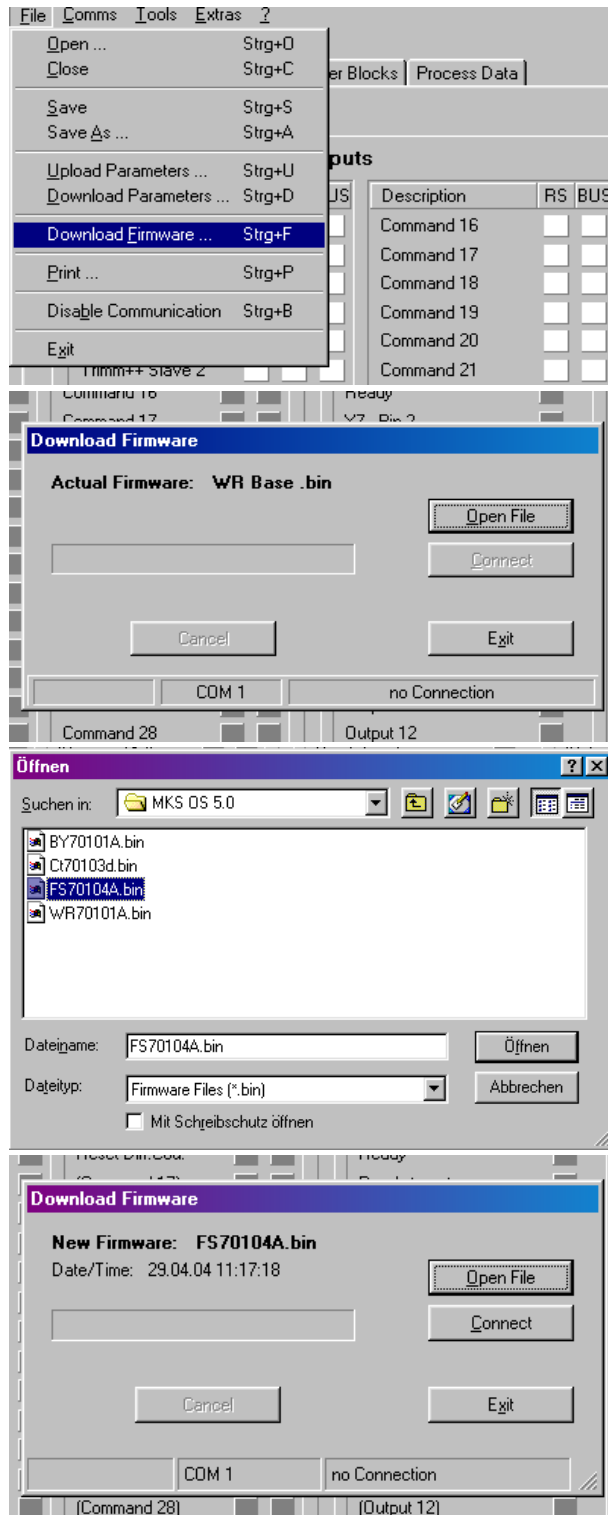


- Connect the PC to the controller, using a RS232 cable (see 3.8 of the hardware manual). Apply power to the controller and start the OS5.1 PC software. Select "Download Firmware" from the "File" menu.



- The screen now indicates the firmware which is actually loaded to the unit, in general "MCBasexx.bin"



- Click to "Open File" and select drive and file name of the download firmware (FS701xxx.bin)



- Then click to "Connect" to download the selected firmware.
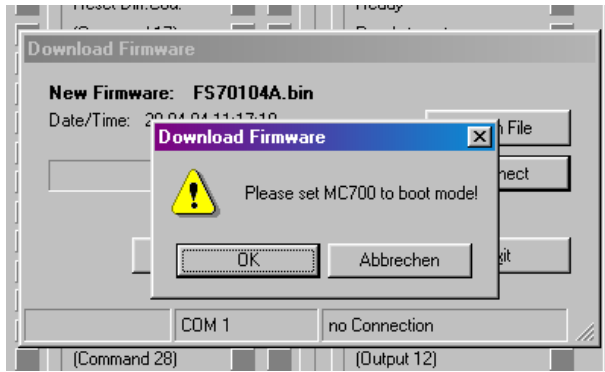
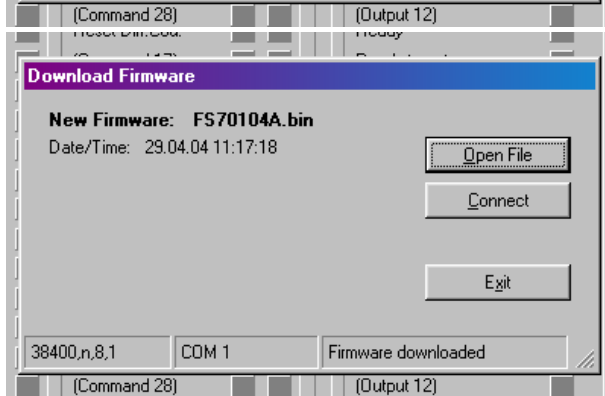- The PC now requests you to set the controller to the "boot mode". To do this, slide the front switch from the "Run" position to the "Program" position and push the Reset button located behind the front plate, by means of a pin



- Click "OK" to start the download
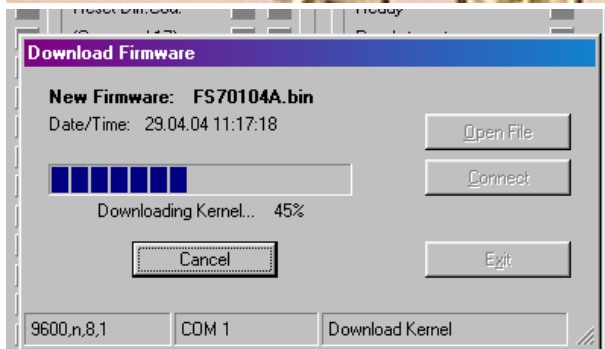


- The download uses several loading steps and the progress is displayed on the screen



- After successful conclusion of the procedure
a. Click to "Exit"
b. Slide the switch back to the "Run" position
c. Activate the Reset button for new initialization of the controller
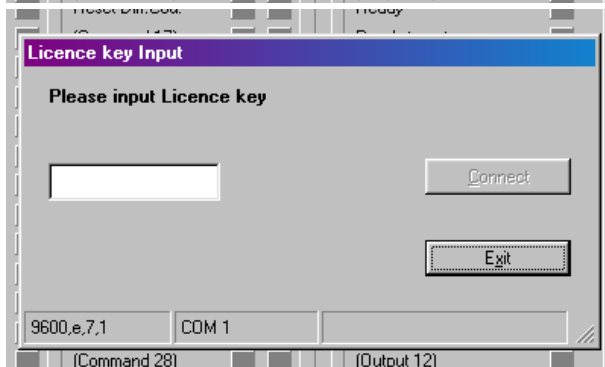


- Finally you must input the license key:
a. Select "Input license key"" from the "File" menu
b. Input the license key and click to "connect"

# 4. How to use the operator software

The OS5.1 software uses a clear structure of register cards and the contents automatically adapt to the firmware of the controller.



| I/Os | General Parameters | Parameter Blocks | Process Data | IO Definition |

**Inputs**

| Description | X6 | RS | BUS | Description | X6 | RS | BUS |
|---|---|---|---|---|---|---|---|
| Control Enable | ■ | | | Reset Diff.Cou. | | | |
| Start / Stop | 2 | | | Reset Batch Cou. | | | |
| Select VirMaster | 3 | | | Sync.Mode Enable | | | |
| Run Virt. Master | 4 | | | (Command 19) | | | |
| Immediate Cut | 5 | | | (Command 20) | | | |
| Cut completed | 6 | | | (Command 21) | | | |
| Cut Test-Length | 7 | | | (Command 22) | | | |
| Clear Error | 8 | | | (Command 23) | | | |
| Set Zero Pos. | 9 | | | (Command 24) | | | |
| Jog forward | 10 | | | (Command 25) | | | |
| Jog reverse | 11 | | | (Command 26) | | | |
| Decr. Batch Cou. | 12 | | | (Command 27) | | | |
| Start Gap | 13 | | | (Command 28) | | | |
| Teach Printmark | 14 | | | Store to EEProm | | | |
| Print Mark | 15 | ■ | | Adjust Program | | | |
| (Command 15) | 16 | | | Test Program | | | |

**Outputs**

| Description | X7,RS,BUS | Description | X7,RS,BUS |
|---|---|---|---|
| Ready | 1 | (Output 16) | |
| Ready to cut | 2 | (Output 17) | |
| Home | 3 | (Output 18) | |
| Alarm | 4 | (Output 19) | |
| Length Pulses | 5 | (Output 20) | |
| Gap completed | 6 | (Output 21) | |
| Master Reverse | 7 | (Output 22) | |
| Error | 8 | (Output 23) | |
| Master in motion | | (Output 24) | |
| Vir.M. in motion | | (Output 25) | |
| No Printmark | | (Output 26) | |
| Printmark Window | ■ | (Output 27) | |
| Virt. Printmark | | (Output 28) | |
| Max. Correction | | (Output 29) | |
| Printm. teached | | (Output 30) | |
| Cam 1 output | | (Output 31) | |

## 4.1. Control Inputs and Outputs

This register card "I/Os" shows the logical state of all digital inputs and outputs.

### 4.1.1. Inputs

Input signals that are in use for the current application are marked with its designation, whereas unused inputs are marked with "Command …" only.
It is possible to assign each input signal to any of the 16 hardware inputs that are accessible via screw terminal X6 (marked "Cont.In"), please see chapter 4.1.3 for details. The number of the hardware input "In…" assigned to the input signal is displayed in column "X6".

> ⚠ **Please note: The "In …" input numbering is not equal to the X6 connector pin numbers!**

Indicator boxes in the column marked "X6" shine blue, when the associated hardware input signal terminal X6 is HIGH, LOW state is white. Where the input signal has not been assigned to any hardware input, the box remains grey.
Indicator boxes in the columns marked "RS" shine blue, when the associated input signal has been switched on via serial link. White box means "signal off". You can switch on and off every input from your PC by clicking to the corresponding indicator box in the "RS" column.

Indicator boxes in the column "BUS" shine blue, when the associated input signal has been switched on via CAN-Bus. White box means again "signal off".
All input signals can be controlled via serial interface or CAN-Bus, independent of they are assigned to a hardware input or not.
All input signals follow a logical "OR" conjunction and the input signal is in "ON" state when at least one of the associated boxes shines blue.

Meaning and function of the input signals:

     ⌐‾      = static operation
     ⌐      = dynamic operation, rising edge
  Ser/Bus = Activation by serial command or by field bus only.

| Control Enable ⌐‾ | OFF: | The whole controller and all functions are disabled. All analogue outputs are zero. All counters are hold in a Reset state. |
|---|---|---|
| | ON: | The controller is enabled |
| Start / Stop ⌐‾ | OFF: | The carriage is held in its home position (closed loop position control). The carriage can be moved into forward and reverse direction by use of the inputs "Jog forw" and "Jog rev". Input "Immediate Cut" allows actuating a cutting cycle. |
| | ON: | The automatic cutting procedure is in progress. Depending on the selected mode of operation, the unit cuts automatically according to length preset or to print marks |
| Select Virt. Master ⌐‾ | OFF: | The line encoder connected to "Encoder1" acts as "Master" |
| | ON: | An internal frequency generator acts as "Master" (Virtual Master Axis) and signals generated by Encoder 1 are not evaluated. This input will work only with the "Start / Stop" input in LOW state, i.e. it is only possible to change between real and virtual master axis while the carriage is in standstill. |
| Run Virt. Master ⌐‾ | OFF: | The virtual master frequency generator is switched off (0 Hz). A transition from HIGH to LOW will ramp down the frequency from its actual value to zero (standstill), according to the ramp time setting. |
| | ON: | The virtual master frequency generator is switched on. A transition from LOW to HIGH will ramp the frequency up from zero (standstill) to the selected speed, according to the ramp time setting. |
| Immediate Cut ⌐ | | A positive edge at this input will immediately start the shear for a cutting cycle, independent on what the actual length is. The subsequent cut will correspond to the preset length again, unless another Flying Cut will be triggered again. This function e.g. allows the operator to cut out bad parts of the material. |

| Cut Completed | ⌐_ | This input must receive a signal when mechanically a cut has been fully completed. The direction of the signal (rising or falling edge) is register selectable. With the selected edge, the controller will start deceleration and reversal in order to put the carriage back to its rear home position. With this signal missing, the carriage will continue to follow the material synchronously. When the carriage reaches the "Alarm position", the "Alarm" output will be set, but the carriage will not automatically stop! |
|---|---|---|
| Cut Test Length ⌐ | OFF: | The controller cuts the normal length as set to the "Cutting Length" register |
| | ON: | The controller cuts the test length as set to the "Test Cut. Length" register. |
| | ⌐_ | When this input receives a short HIGH pulse only, there will be just one single cut of the test length between the regular cuts, with the subsequent cycle. |
| Clear Error | ⌐_ | Resets error states and clears the corresponding error messages |
| Set Zero Position ⌐ | ON: | This input allows defining the "Zero" position of the carriage. It is only active with the "Start/Stop" input in LOW state. The internal carriage position counter is reset and held to Zero while this input is High. All limitation settings and alarms refer to this zero position. Please note that upon power up the carriage position counter will be cleared also and the unit would take any actual position as a Zero position. Where you power the controller down while the carriage is not in at Zero, or where you move the carriage with the controller in powerless state, it is always necessary to redefine "Zero" after power up by a positive signal to this input. |
| Jog forward ⌐ Jog reverse ⌐ | ON: | Moves the carriage in one or the other direction (Jog speed register settable). The carriage automatically stops when it reaches one of the software limit switches (Minimum or Maximum position). After termination of a Jog command, the carriage will be held again in its new position under closed-loop control. From this new home position the carriage will also start to execute the next cut, no matter where it is. The Jog inputs are only active when the Start/Stop input is in stop state. The limitation of the travelling range by the software limit switches will be disabled while you keep the "Set Zero Position" input HIGH. |
| Decrement Batch Counter | ⌐_ | This input will decrement the batch counter by one, and at the same time increment the waste counter by one. It can be used to make batch corrections, if for example one piece is unusable due to fault in the material etc. |

| Start Gap ⌐ | ON: | With use of the "Gap" function (see section 4.3.1) this input will start the gap action after the cut has been made. The input must remain unconnected when the Gap function is not in use. |
|---|---|---|
| Teach Printmark ⌐ | | This input defines the printmark position set point and locates the printmark window: When a printmark is detected while the input is ON, this printmark is selected as valid and the printmark window is located at this printmarks position. When "Teach Printmark" is reset to OFF without a printmark having been detected while it was ON, the falling edge of the input (i.e. the position where it has been reset to OFF) will be taken as printmark position set point. This can be used to teach printmark position when the material line is at standstill. (for more details see also parameter "Printmark Window") |
| Printmark ⌐ | | With print mark mode: input to receive the print mark impulse from a mark sensor or photocell. |
| (Cmd. 15) | | Not in use |
| Reset Differential Counter ⌐ | OFF: | The PI closed loop control is on, error count and position control are active |
| | ON: | The differential error counter is kept to zero; the PI control loop is switched off. The carriage operates "open-loop" with no correction of position errors. |
| Reset Batch Counter ⌐ | ON: | Resets the batch counter to zero. |
| Sync Mode Enable ⌐ | ON: | Selects a different control mode during the synchronous cutting period. Must be used exceptionally only and after consulting motrona. Input remains unconnected with most common applications. |
| (Command 19 … 28) | | Not in use |
| Store to EEProm ⌐ | | Stores all actual registers and parameters to the EEPROM (safe for power-down) |
| Adjust Program | Ser./ Bus | Switches the controller over from normal operation to the "Adjust" program (Control Enable must be OFF). Will be set automatically by PC operator software when you select "Adjust…" in menu "Tools". |
| Test Program | Ser./ Bus | Switches the controller over from normal operation to the "Test" program (Control Enable must be OFF) Will be set automatically by PC operator software when you select "Adjust…" in menu "Tools". |

## 4.1.2. Outputs

Output signals that are in use for the current application are marked with a text; unused outputs are marked with "Output …" only.

It is possible to assign each output signal to any of the 8 hardware outputs that are accessible via screw terminal X7 (marked "Cont.Out"), please see chapter 4.1.3 for details. The number of the hardware output "Out…" assigned to the output signal is displayed in the corresponding lateral indicator box.

The indicator box shines red when the corresponding output signal is on (the assigned hardware output then is HIGH), otherwise the box remains white (the assigned hardware output then is LOW).

All output signals appear on the PC screen and are accessible via serial link or CAN-Bus, independent of they are assigned to a hardware input or not.

### Meaning and function of the output signals:

| | |
|---|---|
| Ready | Indicates that the unit is ready to operate after power-up, initialization and successful self-test. The signal however is not a guarantee that all functions really work trouble-free. |
| Ready to Cut | This output goes High when the shear has reached its cutting position with respect to the material and moves fully synchronous with the line. It goes only Low again after the controller has received a remote "Cut completed" signal. |
| Home | A HIGH state of this output indicates that the carriage is in its home position like defined by register "Home Window". The output is LOW whenever the carriage is outside the home window. |
| Alarm | This output goes to HIGH when during forward motion the carriage reaches the "Alarm Position". It can be used to limit the travelling range of the carriage into forward direction during production. If, e.g. for mechanical or other reasons, the carriage could not synchronize with the line, the controller would never generate the "Ready to cut" signal and the carriage would run to the front stop. The output switches High to indicate that the carriage will run out of range if not broken down immediately. |
| Length Pulses | This output generates pulses proportional to the motion of the material line, with scalable engineering units. It is designed for use with remote counters or PLCs to totalize or record the total material length during a certain period. The output duty cycle is always 1:1. |
| Gap completed | With use of the "Gap" function, this output signals that the gap has been completed, and that the controller waits for the "Cut completed" signal to initialize the return cycle of the carriage. |

| | |
|---|---|
| Master Reverse | Master reverse movement monitor<br>This output goes HIGH when the material line moves in reverse direction for a distance greater than set in register "Master Rev. Limit".<br>The output is reset to LOW when the master moves forward again the same distance or when input "Clear Error" is activated. |
| Error | This output goes HIGH when an error is detected during operation (see section "Error messages"). The error is also indicated in the bottom line of the PC operator software. |
| Master in motion | This output is HIGH when the frequency on the "Encoder 1" input is higher than the standstill definition set in register "Zero Freq. Master" |
| Vir. M. in motion | This output is HIGH when the frequency generated by the virtual master axis is higher than the standstill definition set in register "Zero Freq. Master" |
| No Printmark | Indicates that for an adjustable number of sheets no printmark has been detected within the printmark window<br>(see parameter „Missing Printmark") |
| Printmark Window | This output is HIGH while the printmark window is open and detected printmarks are valid.<br>When the printmark window function is disabled, this output is set all the time (every printmark is valid) |
| Virt. Printmark | This Outputs indicates a virtual printmark to be cut<br>(see register "Virt. Printmarks" for details) |
| Max. Correction | This output indicates that the proportional correction value has reached the maximum as set to the "Max. Correction" register, and that possibly the carriage is out of control. |
| Printmark Teached | Indicates that the printmark position set point has successfully been set by input „Teach Printmark". |
| Cam 1 Output | Switching output before cut:<br>This output is set to high when the scheduled cutting position on the material reaches an adjustable position in front of the home position of the saw carriage.<br>See parameters "Cam 1 Distance", "Cam1 Pulse Width" and "Cam1 Delay Time". |
| (Output 15 … 31) | Not in use |

## 4.1.3. Assignment of Hardware Inputs and Outputs

By using register card „IO Definition" nearly all input and output signals can be assigned to the hardware inputs and outputs, respectively:

| Inputs | | | | Outputs | | | |
|---|---|---|---|---|---|---|---|
| Description | Input # | Description | Input # | Description | Outputs # | Description | Outputs # |
| Control Enable | 1 | Reset Diff.Cou. | No Input | Ready | 1 | (Output 16) | No Output |
| Start / Stop | 2 | Reset Batch Cou. | No Input | Ready to cut | 2 | (Output 17) | No Output |
| Select VirMaster | 3 | Sync.Mode Enable | No Input | Home | 3 | (Output 18) | No Output |
| Run Virt. Master | 4 | (Command 19) | No Input | Alarm | 4 | (Output 19) | No Output |
| Immediate Cut | 5 | (Command 20) | No Input | Length Pulses | 5 | (Output 20) | No Output |
| Cut completed | 6 | (Command 21) | No Input | Gap completed | 6 | (Output 21) | No Output |
| Cut Test-Length | 7 | (Command 22) | No Input | Master Reverse | 7 | (Output 22) | No Output |
| Clear Error | 8 | (Command 23) | No Input | Error | 8 | (Output 23) | No Output |
| Set Zero Pos. | 9 | (Command 24) | No Input | Master in motion | No Output | (Output 24) | No Output |
| Jog forward | 10 | (Command 25) | No Input | Vir.M. in motion | No Output | (Output 25) | No Output |
| Jog reverse | 11 | (Command 26) | No Input | No Printmark | No Output | (Output 26) | No Output |
| Decr. Batch Cou. | 12 | (Command 27) | No Input | Printmark Windo | No Output | (Output 27) | No Output |
| Start Gap | 13 | (Command 28) | No Input | Virt. Printmark | No Output | (Output 28) | No Output |
| Teach Printmark | 14 | Store to EEProm | No Input | Max. Correction | No Output | (Output 29) | No Output |
| Print Mark | 15 | Adjust Program | No Input | Printm. teached | No Output | (Output 30) | No Output |
| (Command 15) | 16 | Test Program | No Input | Cam 1 output | No Output | (Output 31) | No Output |

Any hardware input can be assigned to several input signals at the same time if necessary. The hardware input then switches all input functions associated in parallel.
Also any hardware output can be assigned to several output signals at the same time if necessary. Then the output signals are logical OR'd, i.e. the hardware output is set to high if any of the associated output signals is set to on.
Fixed assignments that cannot be changed (e. g. Index signals) are marked in grey colour.
The input/output assignment is stored to EEPROM when leaving this register card.

## 4.2. General Parameters

This register card holds the essential variable settings of general nature
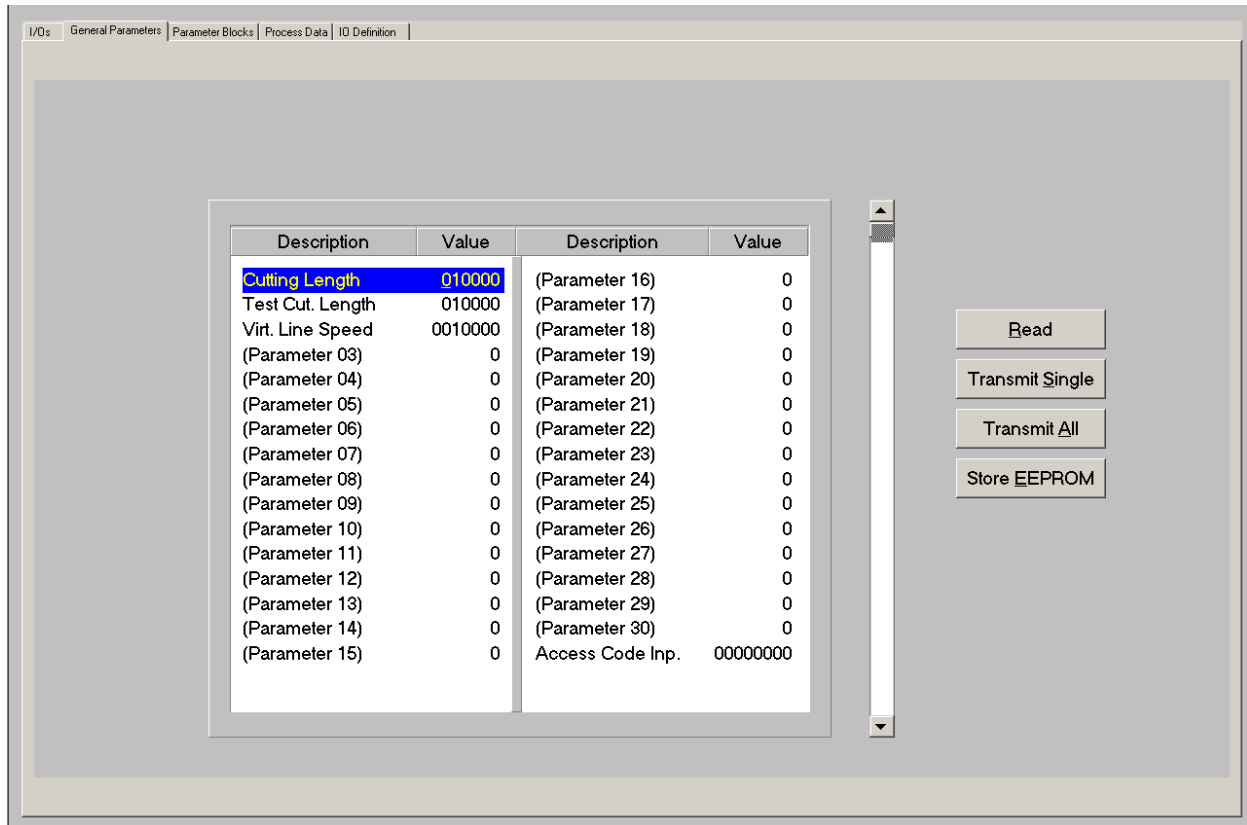


Prior to register setting you must decide which dimensions or length units (LU) you like to use for preset of the cutting length. This could be 0.1mm or 1mm or 0.001 inch or any other resolution you desire. All further settings refer to the Length Units you decided to use. E.g. when you chose to set the length with a 0.1 mm resolution, 1000 LUs will represent a length of 100.0 millimeters with all further entries.

When you transmit new register values during a cutting cycle the new values will not become active before the cutting cycle has been finished and the carriage has returned to the home position.

| Cutting Length | Preset of the desired cutting length, setting in "Length Units". This length will be cut when input "Cut Test Length" is LOW. Setting range 1 - 999 999 length units. |
|---|---|
| Test Cut. Length | Preset of the desired test length, setting in "Length Units". This length will be cut when input "Cut Test Length" is HIGH or was shortly HIGH during the previous cutting cycle. Test length can be used to cut test samples or waste pieces etc. Setting range 1 - 999 999 length units. |

| Virt. Line Speed | Speed set value of the virtual master axis, to be set as Length Units (LU) per minute<br>Range 0 – 9 999 999 LU/min, the setting is limited to the value of register "Max. Line Speed". Internal resolution = 1/2048 of Max Line Speed. |
|---|---|
| (Parameter 03…30) | Not in use |
| Access Code Input | Input of access code for the parameter blocks.<br><br>At parameter "Access Code Def." in parameter block "Protection" you can define an access code for all parameter blocks (see chapter 4.3.6)<br>To read or write the subsequently described parameters you need to enter the correct access code here. If you enter a wrong code, the parameter blocks are protected from any access and the parameter values are shown as "xxxxxxxx". For security reasons, register "Access Code Input" will not be stored to EEPROM. When you close the PC operator software or disconnect the serial connection between PC and MC700 the entered code is automatically reset to 0. |

## 4.3. Parameter Blocks

This field contains more parameters and machine specifications, separated to clearly arranged blocks.
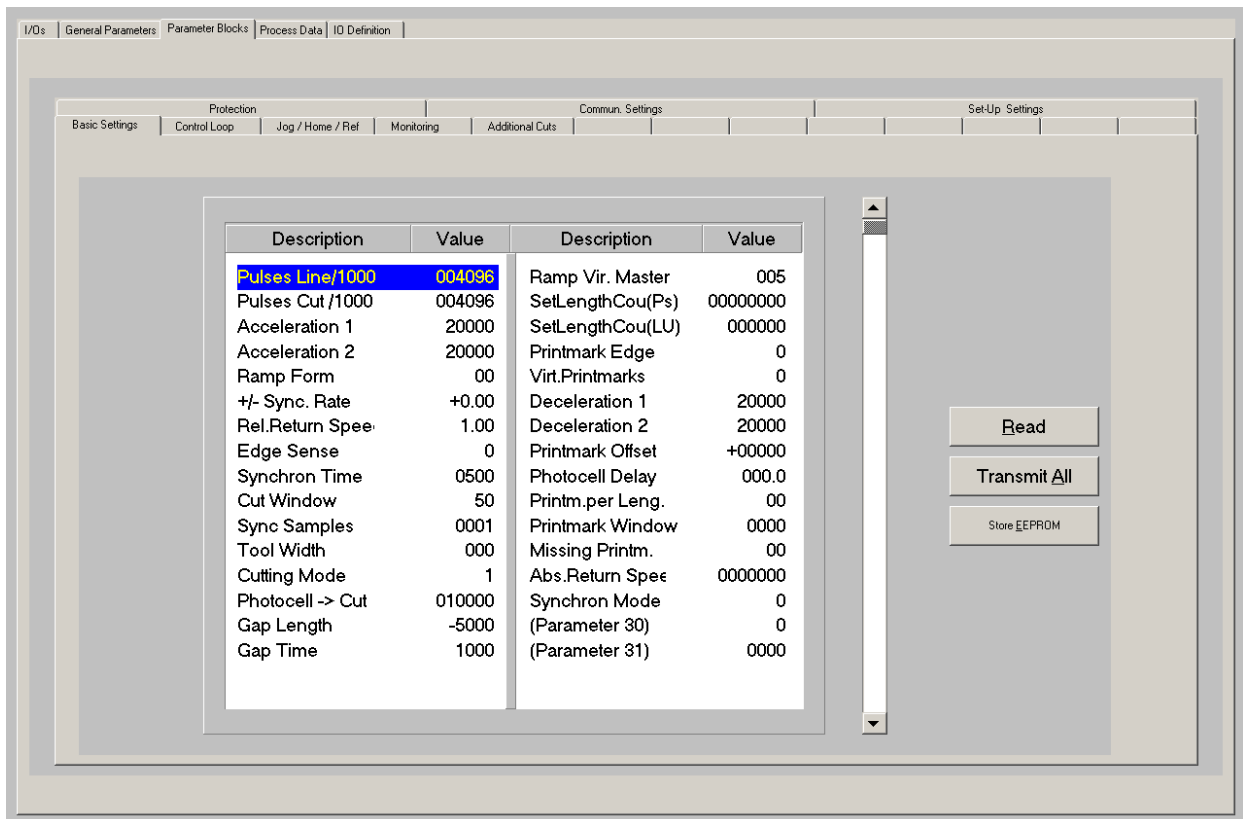
If the parameter protection is active it shows "xxxxxxxx" instead of the parameter values:
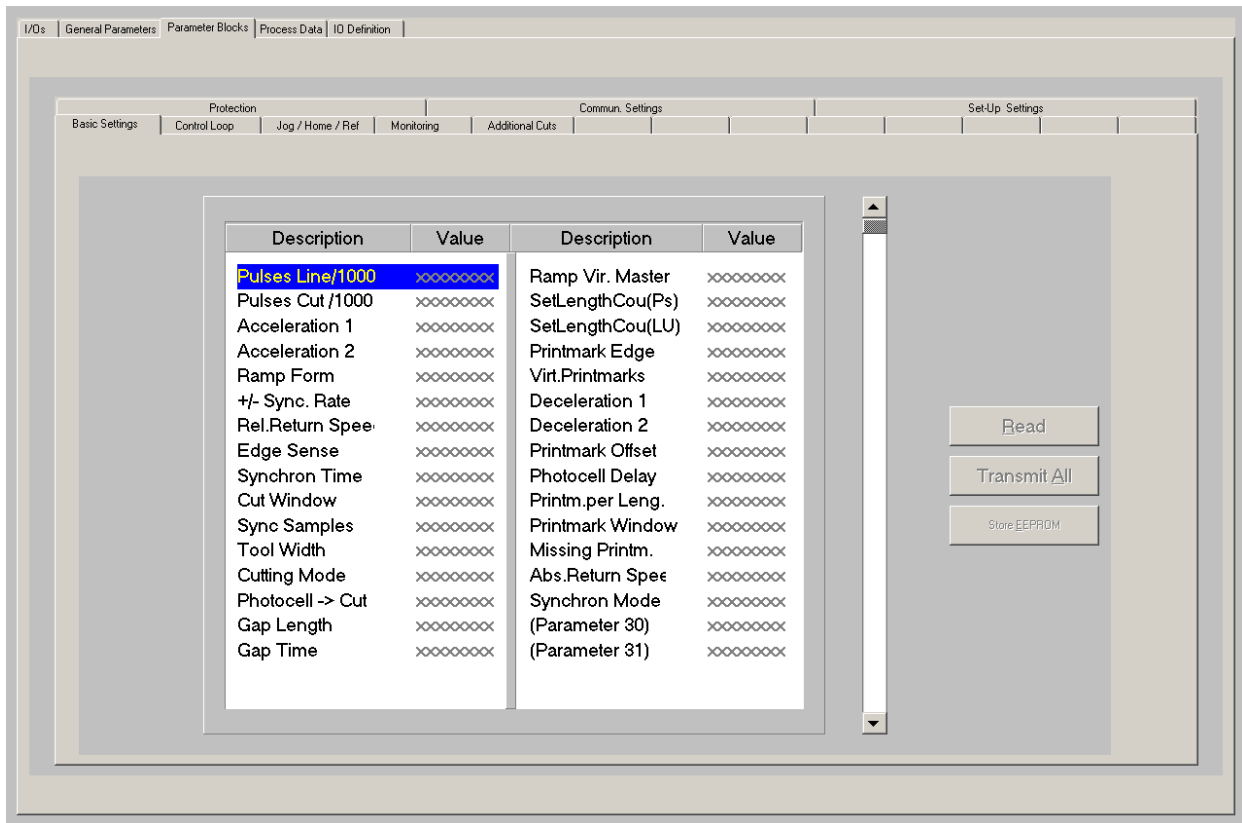


For details of the parameter protection please see parameter "Access Code Input" (chapter 4.2) and parameter "Access Code Definition" in block "Protection" (chapter 4.6.3).

### 4.3.1. Basic Settings

| Pulses Line / 1000 | This register is for scaling of the line encoder. Find out how many pulses you receive when the line moves 1000 length units (LU) forward. Set the proper number of pulses here. Range 0-999 999 |
|---|---|
| Pulses Cut / 1000 | This register is for scaling of the carriage. Find out how many pulses you receive when the carriage moves 1000 length units (LU) forward. Set the proper number of pulses here. Range 0-999 999 |
| Acceleration 1 *) | Acceleration rate of the carriage during forward motion. Scaled in Length units per second squared. Range 0 – 99999 LU/s² |
| Acceleration 2 *) | Acceleration rate of the carriage during reverse motion. Scaled in Length units per second squared. Range 0 – 99999 LU/s² |

*) Deceleration rates to be set separately by parameters "Deceleration1" and "Deceleration2"

| | • The controller generates ramps of a constant gradient. Therefore, the ramp times depend on the acceleration settings and the actual line speed. When, for example, the unit is scaled to entire millimeters, an acceleration setting of 5000 mm/s² would mean that the carriage accelerates from zero to a speed of 5 m/s (= 300 m/min) within 1 second. Therefore it would need 100 ms when the real speed is 30 m/min only etc.<br>• You must only use acceleration settings that the drive is really able to follow. Settings outside of the physical capability of the drive will result in malfunction or even failure of the whole system.<br>• The acceleration settings refer to linear ramp forms. When you use S-ramps (see next parameter), the maximum acceleration at the steepest position of the S-profile will be by factor 1.25 higher. |
| --- | --- |

| Ramp Form | Selects the shape of the ramps of the carriage speed profile. Two types of ramps are available: linear and S-shaped ramps. The selection can be made independently for each of the four ramps of the speed profile by setting the corresponding bit of the parameter "Ramp Form" either to 0 or to 1:<br>Bit 0:   forward acceleration ramp<br>Bit 1:   forward deceleration ramp<br>Bit 2:   backward acceleration ramp<br>Bit 3:   backward deceleration ramp<br>A ramp is S-shaped when the corresponding bit is 0 and it is linear when the corresponding bit is 1.<br>Example: Ramp Form = 00 means that all ramps are S-shaped, Ramp Form = 01 means that only the forward acceleration ramp is S-shaped, and Ramp Form = 15 means that all ramps are linear.<br>S-shaped ramps are recommended when using drives with high response (e.g. servo drives) whereas linear ramps are recommended for drives with lower response (e.g. big DC drives). |
| --- | --- |
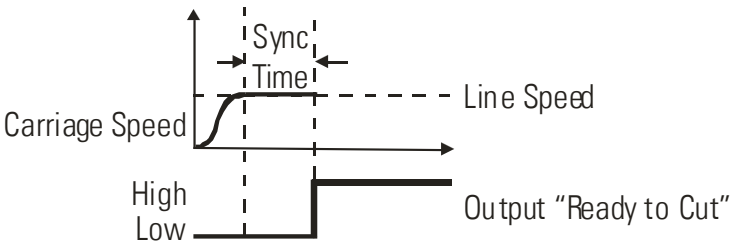
v

Cut

Line Speed

Acceleration 1
Ramp Form, Bit 0

Deceleration 1
Ramp Form, Bit 1

t

Acceleration 2
Ramp Form, Bit 2

Deceleration 2
Ramp Form, Bit 3

| | |
|---|---|
| +/- Sync Rate | This register allows slightly varying the synchronous speed in a range of +/- 9.99%. In general, this register will be set to 0.00 and the carriage will synchronize with the line exactly according to the encoder information. Some applications with extrusion lines need to adapt the sync speed, because the material is hot and cools down on the way between the measuring wheel and the cutting position. This will cause shrink, which can be compensated by the +/- Synchron Rate register. This setting affects the synchronous speed only, but not the cutting length. |
| Rel. Return Speed | Sets the ratio between the actual line speed and the maximum return speed. Setting Range 0.01 - 9.99.<br>Setting 2.00 says that, if necessary, the return speed is permitted to be the double of the actual line speed. The controller will however use this maximum return speed only if really required from the cutting process.<br>**Only active when register "Abs Return Speed" is set to 0** |
| Edge Sense | Sets the active edge of the remote "Cut Completed signal".<br>0: A rising edge at the "Cut Completed" input will conclude the synchronous cutting phase and initialize the return cycle of the carriage.<br>1: A falling edge at the "Cut Completed" input will conclude the synchronous cutting phase and initialize the return cycle of the carriage. |
| Synchron Time | This is an adjustable delay time between reaching the synchronous speed and switching on the "Ready to cut" output.<br>Setting range 1-9999 milliseconds.<br>Under regular conditions the carriage will be in the correct cutting position immediately after completion of the acceleration ramp, and the Sync Time register can be set to its minimum value of 1 ms.<br>With mechanically unstable carriage constructions it may however be applicable to leave a short stabilization time before activating the cut.<br><br> |
| Cut Window | Sets a tolerance window around the cutting position where the carriage must be before the "Ready to cut" signal is switched on.<br>Setting is directly in number of increments of the carriage encoder.<br>Range 1-99 increments.<br>We recommend setting this window not too small, because no cut will be activated when for any reasons we do not reach this window (carriage will then run to the front stop). |

| Sync. Samples | Filter for the cut window. The purpose of this parameter is to ensure that the carriage has reached a stable position within the cut window and does not leave the window again right after the "ready to cut"-output has been switched on. Sync Samples = n means that during n consecutive control cycles the carriage must be inside the window, before the "ready to cut"-signal is switched on. <br><br>This function should only be used for systems with poor dynamic performance. Please note that too high settings of this parameter may cause the controller to never set the "ready to cut"-signal. <br><br>Setting range: 1 – 9999, recommended setting: 1 |
|---|---|
| Tool Width | Provides compensation of the width of the saw blade or cutting tool. <br>Setting 0-999 length units |
| Cutting Mode | Operation mode. <br>1: Cut to length according to length preset <br>    (without print mark) <br>2: Cut according to the print marks on the material <br>3. Cut according to print marks, with several sub-cuts between marks (see section 4.3.5) |
| Photocell -> Cut* | Distance between the print mark sensor and the home position of the carriage. Setting range 0 – 999 999 LU. <br>This setting is only relevant with print mark operation (cutting mode 2 or 3). The controller will store in a FIFO shift register up to 64 print marks between sensor and carriage, and control the cut according to the momentary actual mark. The unit will switch to Error state when more than 64 marks have been detected between the sensor and the carriage home position. <br><br> |
| Gap Length | With some applications it is desirable, after the cut, to produce a gap between following material and the piece actually cut, by short acceleration of the tool prior to removing it from its cutting position. <br>The gap width can be set directly in length units, range +/-9999 LU. <br>Negative values can be used for double processing in one movement cycle: The carriage then decelerates after the cut and moves (relative to the material line) backwards behind the cutting position. <br>**With most applications, this function remains unused (Gap Length = 0).** <br>To use the gap function, the following timing of signals must be observed: |

*) For printmark operation only

| | |
|---|---|
| | Cut   Short acceleration or deceleration period after cut<br>Line Speed<br>Gap Time<br>t<br>Return<br>Output "Ready to Cut"<br>Input signal "Start Gap"<br>Output "Gap completed"<br>Input signal "Cut completed" |
| **Gap Time** | Preset time to make the gap. Setting range 1 – 9999 ms.<br>Please leave the drive an appropriate time to accelerate and decelerate for making the gap, according to the desired gap width and the dynamic performance and maximum speed of the carriage system. |
| **Ramp Vir. Master** | Sets the ramp time of the virtual master axis between standstill and maximum speed (acceleration and deceleration) Range 0 – 999 s. |
| **Set Length Cou (Pulses)** | Set value for material length counter at start of automatic length operation, scaled in master encoder pulses. When input "Start" is set to high the material length counter is set to this value. Afterwards, the register "Set length Counter" is cleared to zero (set value only used one time).<br>Range 0 – 99999999 Increments. |
| **Set Length Cou (LU)** | As above, but scaled in Length units.<br>Range 0 – 999999 LU<br>Parameters "Set length Counter" can be used to include a material remainder of the discontinued last cut to the first cut when starting the machine |
| **Printmark Edge*** | Sets the active edge of the printmark sensor signal:<br>0:   Rising edge (input "Print Mark" is HIGH while a print mark is detected)<br>1:   Falling edge (input "Print Mark" is LOW while a print mark is detected) |
| **Virt. Printmarks*** | With print mark operation only: Generation of virtual print marks at start.<br>0:   Virtual printmark function disabled<br>1:   When input "Start" is set to high, the printmark buffer will be filled with virtual printmarks located between printmark sensor position and cutting position. This will lead the saw to cut as soon as possible without waiting until the first printmark has reached cutting position and avoids waste pieces |
| **Deceleration 1** | Deceleration rate of the carriage during forward motion.<br>Scaled in Length units per second squared. Range 0 – 99999 LU/s² |
| **Deceleration 2** | Deceleration rate of the carriage during reverse motion.<br>Scaled in Length units per second squared. Range 0 – 99999 LU/s² |

| | |
|---|---|
| Printmark Offset* | Fine adjustment of the desired cutting position with respect to the print mark. Setting to 0 results in placement of the cut to the edge of the print mark (rising or falling edge according to register "Printmark Edge"). A positive value moves the cut forward (leading the printmark), a negative value moves the cut backwards (lagging behind the printmark). Range +/- 99999 length units. |
| Photocell Delay* | Compensation of delay time of printmark sensor: Here you can set the latency time (dead-time) of the printmark sensor (e.g. photocell) scaled in milliseconds. The detected position of the printmark will be automatically corrected according to the delay time set here. Range 000.0 – 500.0 ms. |
| Printmarks per Length* | Set this register to 1 when you have only one print mark with each cut. Set it to the number of print marks between two cuts, when you find several marks, but the cut should only be executed with one specific mark. Range: 1 – 99. |
| Printmark Window* | Defines a symmetric window around the edge of the print mark sensor signal. The print mark is supposed to appear inside this window and signals outside the window will not trigger the print mark registration. The position of the window is determined by input "Teach Printmark" Range 0-9999 length units. Setting 0 disables printmark window function, then every printmark will be detected. <br><br>Clarification: <br>When using print mark operation, many times you can find several marks on one size of the sheet to be cut, and only one of these marks is valid for registration to define the cutting position. The unit can automatically blank out the other marks by defining a printmark window around the position of the valid printmark. To set the correct position of the printmark window, set input "Teach Print-mark" to high when the valid print mark is close to the print mark sensor, but is not yet sensed. Move the line slowly until the sensor detects the active edge of the mark (according to register "Printmark Edge"). The "Teach Print-mark" counter input must go back to low state before the sensor generates the next rising edge from the following mark. This stores the position of the valid print mark and the unit will not trigger to the other marks between. |
| Missing Printmarks* | Monitoring of printmarks within the printmark window: This register sets the number of sheets without printmark until output "No printmark" is set. Range 0 – 99. Setting 0 disables the printmark monitoring. |
| Abs. Return Speed | Sets the return speed to an absolute value independent of the line speed. Scaled in length units per minute, setting range 0 … 9999999 LU/min. **When "Abs. Return Speed" is set to 0, the register "Rel. Return Speed" (relative return speed according to actual line speed) is valid.** |

| Sync Mode | Provides the possibility to change the control characteristics of the carriage during the synchronous cutting phase. Input "Sync.Mode Enable" switches over from normal mode to the selected Sync Mode.<br>**This parameter must always be set to 0,** except for very special applications with external clamping mechanism during the cut.<br>Please ask motrona before using settings different from zero. |
|---|---|
| **(Parameter 30)** | -Not in use- |
| **(Parameter 31)** | -Not in use- |

## 4.3.2.  Control Loop settings
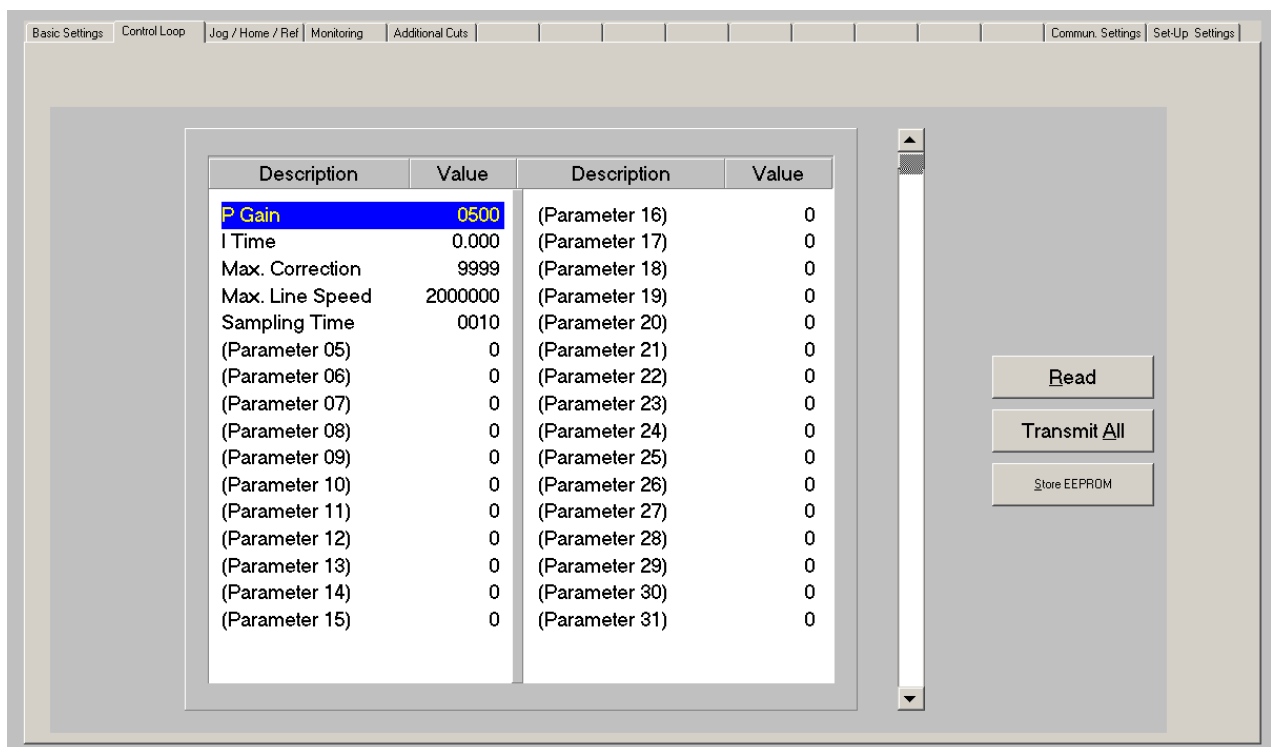


| P Gain | Proportional gain for compensation of relative errors of the carriage position with respect to the scheduled position.<br>Setting range: 0 – 9999 Recommended settings: 500 – 2500. |
|---|---|
| I Time | Sets the integration time (seconds) to compensate for position and cutting errors caused by non-linearity of the carriage drive.<br>0.000 = Integration off, proportional control only<br>0.001 = very fast integration at 1 ms time base<br>1.000 = slow integration at 1 s time base etc.. |

| | |
|---|---|
| Max. Correction | Limitation of the active correction signal resulting from the proportional position control loop. When the correction has reached this limit, the analogue output will no more follow to further increase of the error, but the error record itself will be continued in the background.<br>Setting range: 0 – 9999 mV Recommended settings: ≥ 1000 mV |
| Max. Line Speed | Setting of the maximum applicable line speed.<br>Setting range 1 – 9 999 999 LU/min.<br>This setting is used for internal scaling and resolution of the line speed. For best resolution, this value should not be set higher than really necessary for the application. Upper limit to the value of register "Virt. Line Speed". |
| Sampling Time | Provides digital filtering of the feed forward signal generated from the line encoder.<br>Range 0001 - 9999 ms.<br>Normal setting: 1 ms.<br>For applications with unsteady line speed or bumpy motion of the measuring wheel, settings like 10 ms or even 100 ms can be advantageous for smoother motion of the carriage and increased accuracy.<br>Please note that higher settings result in lower response to actual changes of the line speed, i.e. you should consider increasing the ramp times of your line drive to ensure that your cutting accuracy remains good also during changes of the line speed. |
| Parameter 05…31 | -Not in use- |

### 4.3.3.   Jog / Home

| Home Window | Sets a window around the home position of the carriage.<br>Setting range 1-999 LU.<br>The output "Home" indicates by High state that the carriage position is inside this window.<br>The unit will go to Alarm state when a new cutting cycle would need to start before the carriage has returned to the home window from the previous cut. |
|---|---|
| Minimum Position,<br><br>Maximum Position | Programmable software limit switches for the extreme forward and rear carriage position.<br>Setting range  -999 999 to + 999 999 LU.<br>The settings refer to the "Zero" Position, which is set by the "Set Zero Position" input. In general (but this is not a "must"), the Zero position is also used as the "Home" Position. In this case, the Min Pos must always be set to negative and the Max Pos must always be set to positive values.<br>When the Start/Stop input is in Stop state (Low), these two software limit switches will limit the travelling range with Jog operations.<br>With automatic operation (Start/Stop = HIGH), only the rear "Min. Position" switch remains active and sets the unit to an Error state when touched during production.<br>The front "Max. Position" switch however is out of operation. Instead, the "Alarm position" switch is monitoring the forward carriage motion and sets an alarm output when touched during a cutting cycle.<br>The following drawings explain the function of the software limit switches, based on the following settings (example): "Min.Position" = -20 LU, "Max.Position" = +2500 LU, "Alarm Position" = 2000 LU:<br><br>**Input Start/Stop = Low, Jog operation:**<br><br>Carriage travel range<br><br>Carriage disabled in backward direction   No function   Carriage disabled in forward direction<br><br>-20 Min Pos.   0 Zero Pos.   +2000 Alarm Pos.   +2500 Max Pos.<br><br>**Input Start/Stop = High, automatic cutting cycle or immediate cut:**<br><br>Carriage travel range<br><br>Unit trips to Error state, when Min. Pos. is touched   Output "Alarm" ist HIGH while carriage is beyond Alarm Pos., no Error trip<br><br>-20 Min Pos.   0 Zero Pos.   +2000 Alarm Pos.   +2500 Max Pos. |

- The <u>Home Position</u> of the carriage for executing a cut is always the position where the carriage is located at the moment where the "Start/Stop" input changes from LOW to HIGH.

- The <u>Zero position</u> however is the position where the carriage is located while the controller is powered up, or where it stands during the falling edge of the "Set Zero Position" input signal.

- Therefore "Home" must not necessarily be "Zero" at the same time!

| | |
|---|---|
| Alarm Position | Sets an alarm position for the forward motion of the carriage during automatic cutting operation. Setting range 0 – 999 999 LU.<br>The "Alarm" output indicates by HIGH state that the actual carriage position is beyond the "Alarm Position" setting. See also parameters "Min.Position", "Max.Position" and output "Alarm". |
| Jog Speed Forw. | Preset of the desired carriage speed for Jog operations in forward direction with use of input "Jog forward".<br>Setting range 000 – 100%,where 100% corresponds to the "Maximum Line Speed" setting. |
| Jog Ramp Up Forw. | Acceleration ramp time for Jog operation in forward direction<br>Setting range 01 – 99 s with respect to speed changes between standstill and maximum line speed. |
| Jog Ramp Dw. Forw. | Deceleration ramp time for Jog operation in forward direction<br>Setting range 01 – 99 s with respect to speed changes between maximum line speed and standstill. |
| Jog Speed Rev. | Preset of the desired carriage speed for Jog operations in backward direction with use of input "Jog reverse".<br>Setting range 000 – 100%,where 100% corresponds to the "Maximum Line Speed" setting. |
| Jog Ramp Up Rev. | Acceleration ramp time for Jog operation in backward direction<br>Setting range 01 – 99 s with respect to speed changes between standstill and maximum line speed. |
| Jog Ramp Dw. Rev. | Deceleration ramp time for Jog operation in backward direction<br>Setting range 01 – 99 s with respect to speed changes between maximum line speed and standstill. |
| (Parameter 10…31) | -Not in use- |

## 4.3.4. Monitoring



| Zero Speed Master | Standstill definition for the line encoder. |
|---|---|
| | Output "Master in Motion" is switched ON when the speed detected on input "Encoder 1" is higher than the setting of this register. |
| | Setting range: 0 – 999 999 LU/min. |
| Zero Speed Vir. Master | Standstill definition for the virtual master. |
| | Output "Vir. M. in Motion" is switched ON when the speed generated by the virtual master is higher than the setting of this register. |
| | Setting range: 0 – 999 999 LU/min. |
| LED Function | Selects the function of the 6 LEDs located on the connector plate of the controller. |
| | 0:  The LEDs display the switching state of the hardware outputs Out1 – Out6 |
| | 1:  The LEDs indicate the actual position error of the carriage. |
| | See section "Function of LED display. |
| Length per Pulse | Scaling factor for the auxiliary "Length Pulses" output. |
| | Setting range 1 - 99 999 LU per pulse. |
| | When e.g. the whole system is calibrated in "Millimeters" and you have set this register to 1000, this means that the output will generate one pulse every 1000 millimeters of forward motion of the line. |
| Mast. Rev. Limit | Master reverse movement limitation (see output "Master Reverse"). |
| | Setting range 0 – 99 999 LU. |
| | Setting 0 disables the Master reverse movement monitoring. |

| | |
|---|---|
| Sel.Diag.AnaOut1 | Selects the actual value from the menu "Process Data", which should appear at analogue output "Ana Out 1" for diagnosis purpose.<br>Setting range 0 - 31 (number of actual value)<br>See chapter 4.4 and table in chapter 10 for selection. |
| | Parameter **Ana Out1 Gain** from the Set-up register card (see chapter 4.3.7) allows the scaling of the analogue diagnosis signal:<br>Output voltage [V] = (Ana Out 1 Gain x actual value) / 2048<br>Setting Ana Out1 Gain to 10.00, for example, means that a digital value of 2048 will cause a full scale analogue output of 10 volts. |
| Cam 1 Distance | Switching position of "Cam 1 Output":<br>"Cam 1 Output" is set to high when the scheduled cutting position on the material is at the distance set here in front of the carriage home position.<br>Setting range 0 – 999 999 length units. |
| Cam 1 Pulse Width | Pulse width of "Cam 1 output" in ms.<br>Setting range 1 – 999 ms. |
| Cam 1 Delay Time | Compensation of reaction time of actor connected to "Cam 1 output":<br>When this parameter is set to 100 for example, "Cam 1 output" is set to high 100 ms <u>before</u> it reaches its real switching position as defined by parameter "Cam 1 Distance".<br>Setting range 0 – 999 ms.<br>Setting 0 disables delay time compensation. |
| (Parameter 09…15) | -Not in use- |
| Batch Counter | Counts the number of cuts made with the normal cutting length during automatic operation.<br>Hint: Counter will not automatically be saved to the EEPROM upon power-down! |
| Waste Counter | Counts the number of waste pieces. Increments with every "Immediate cut" and "Test Length" cut.<br>Hint: Counter will not automatically be saved to the EEPROM upon power-down! |
| (Parameter 18…31) | -Not in use- |

## 4.3.5.   Printmark Operation with Multiple Cuts

The unit is able to execute several cuts in sequence, triggered by one print mark, when parameter "Cutting Mode" is set to 3 (see "Basic Settings").
Besides the cut to the mark itself, 3 additional cuts can be set, i.e. the piece between two print marks can be divided into totally 4 pieces max. (3 pieces with adjustable length and the remaining tail).

All settings for the use of the multiple cut function can be found under "Additional Cuts":



| Additional Cuts | Number of supplementary cuts per print mark. Setting range: 0 – 3 |
|---|---|
| | **0:** No supplementary cut, only one cut to the print mark |
| | **1:** Cut to print mark and one supplement cut ("Add. Cut 1 Length") |
| | **2:** Cut to print mark and two supplement cuts ("Add. Cut 1 Length", "Add. Cut 2 Length") |
| | **3:** Cut to print mark and three supplement cuts (all 3 "Add. Cut Length") |
| Add. Cut 1 Length | Length of the first additional cut. Setting range 0 – 999 999 LU |
| Add. Cut 2 Length | Length of the second additional cut. Setting range 0 – 999 999 LU |
| Add. Cut 3 Length | Length of the third additional cut. Setting range 0 – 999 999 LU |
| (Parameter 04 ... 31) | -Not in use- |

Additional cuts are executed with the following sequence:

(a): Cut to the previous print mark

(b): Tail

(c): Add. Cut 3 Length

(d): Add. Cut 2 Length

(e): Add. Cut 1 Length = Trigger print mark
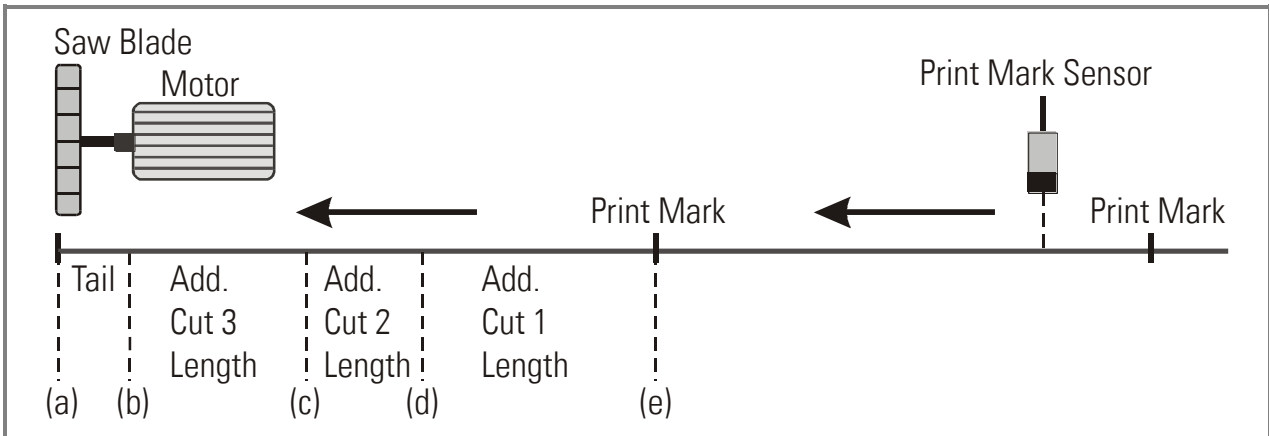


Parameter "Tool Width" will be considered with all additional cuts, too.

Therefore, when your setting provides a tool width ≠ 0, the remaining tail piece will always be shorter than calculated from the total print mark distance and the total sum of all cuts.

Additional cutting positions are calculated and stored to the cutting sequence register upon detection of the print mark. Therefore, changes of "Multiple Cut" parameters become active not before all the cuts of already registered print marks and their associated additional cuts have been fully completed.

The print mark position register can totally store up to 64 cutting positions. So when using the "multiple Cut" option, the total number of print marks allowed between sensor and carriage reduces correspondingly:

| Additional cuts: | Max. number of printmarks between print mark sensor and carriage: |
|---|---|
| 0 | 64 |
| 1 | 32 |
| 2 | 21 |
| 3 | 16 |

## 4.3.6. Protection settings



| Access Code Definition | Definition of an access code for the parameter blocks protection.<br>Setting = 0:   The parameter block protection is disabled.<br>                All parameter values in the parameter blocks can be read and written without restriction.<br>Setting > 0:   The parameter block protection is enabled.<br>                The access code as defined here must be entered at parameter "Access Code Input" to get read and write access to the parameter blocks.<br>Setting range 0 – 99999999. |
|---|---|
| (Parameter 01…31) | -Not in use- |

## 4.3.7. Communication settings

This register card sets the communication parameters for the CAN interface and the serial link. Settings and operation of the CANopen interface are explained separately in the manual **CI700**, which is available on our homepage or on our CD-ROM.
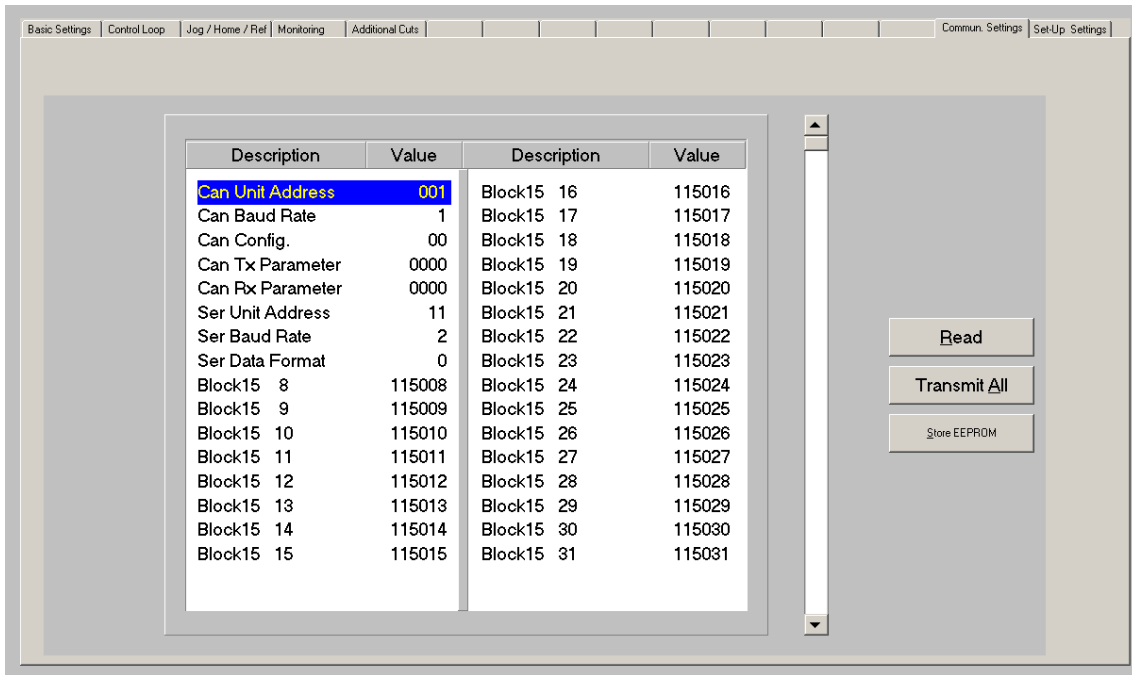
The serial link uses the following parameters:

| Ser. Unit Address | Serial unit address.<br>Range 11 ... 99.<br>Address numbers containing zeros like 01, 02, 03, ..., 10, 20, etc. are not permitted because these are reserved for broadcast messages (collective addressing of several units).<br>**Factory default address is always 11**. | | | |
|---|---|---|---|---|
| Ser. Baud Rate | Serial baud rate:<br>0: 38400 Bit/s<br>1: 19200 Bit/s<br>2: 9600 Bit/s<br>3: 4800 Bit/s<br>4: 2400 Bit/s<br>**Factory default setting: 2** | | | |
| Serial Data Format | Setting | Data bits | Parity | Stop bits |
| | 0 | 7 | even | 1 |
| | 1 | 7 | even | 2 |
| | 2 | 7 | odd | 1 |
| | 3 | 7 | odd | 2 |
| | 4 | 7 | none | 1 |
| | 5 | 7 | none | 2 |
| | 6 | 8 | even | 1 |
| | 7 | 8 | odd | 1 |
| | 8 | 8 | none | 1 |
| | 9 | 8 | none | 2 |
| | **Factory default setting: 0** | | | |

## 4.3.8. Setup Settings

These settings define all important hardware properties of inputs and outputs of the MC700 controller.
You must only make settings for those functions that are really used and wired with this application.
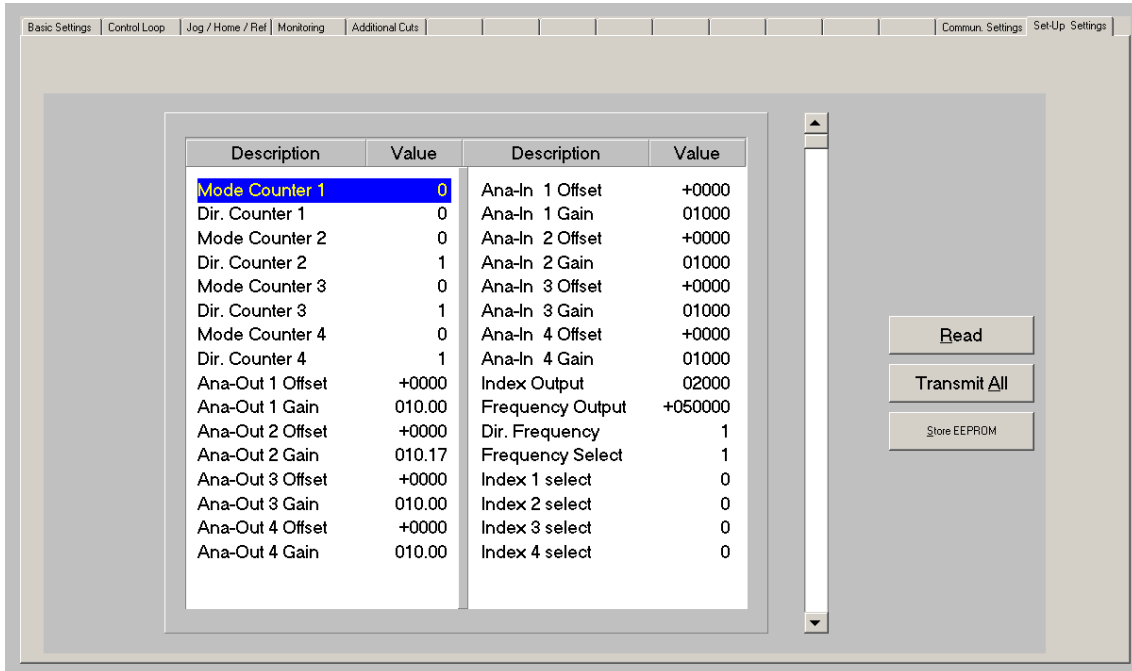


| Mode Counter (1–4) | Determines the number of edges counted from the four incremental encoder inputs: $$0 = x1, \quad 1 = x2 \quad 2 = x4$$ |
|---|---|
| Dir. Counter (1–4) | Assigns a counting direction (up / down) to the corresponding encoder input, depending on the quadrature A/B phase displacement. These parameters are found out and set best in the Test menu or the Adjust menu |
| Ana-Out Offset (1–4) | Sets the zero position of the corresponding analogue output. This parameter uses a numeric range from **-2047… 0000 …  +2047** corresponding to -100% …   0   … +100% of full-scale output. The normal setting is "0" |
| Ana-Out Gain (1-4) | Sets the full-scale output of the corresponding analogue output, directly in volts. **0 – 10,00** means 0 – 10 volts or 20 mA output |
| Ana-In 1-4 Offset | Not used with this application |
| Ana-In 1-4 Gain | Not used with this application |

| | |
|---|---|
| Index Output | Not used with this application |
| Frequency Output | -For factory testing purpose only- |
| Dir. Frequency | Sets the counting direction of the virtual master frequency:<br>**1** = forward, **0** = reverse |
| Frequency Select | Selects the source of the output frequency appearing at connector "Encoder Output", used for cascading and other purpose:<br>**0:** The output frequency is the same signal as applied to input "Encoder1"<br>**1:** The output frequency is the signal generated by the virtual master axis |
| Index 1 select | Not used with this application |
| Index 2 select | Not used with this application |
| Index 3 select | Not used with this application |
| Index 4 select | Not used with this application |

## 4.4. Process data (actual values)

You can follow all real process data assigned to this firmware, when you open the register card "Process data". These actual values are updated continuously.
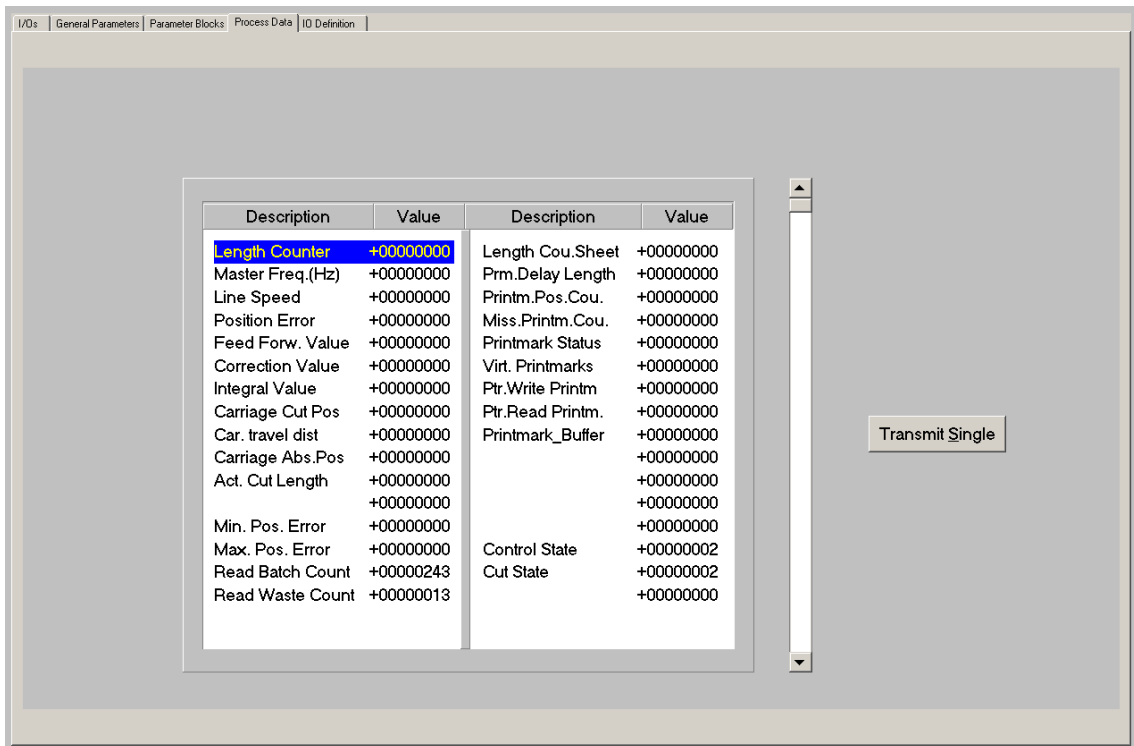


You can find more details about the actual process data values in the corresponding table of chapter 11.

# 5.   Function of the LED indicators

The function of the 6 red LEDs on the connector plate of the unit can be set by register "LED Function" on the register card "Monitoring".
LED Function = 0 indicates the state of the digital outputs Out1 to Out6 (from left to right)
LED Function = 1 indicates the momentary proportional error (position error) of the carriage with respect to the scheduled position.
The error display operates with a special scaling of encoder increments, as shown by the figure below. Because the LEDs are updated within microseconds, they provide a simple, but also very useful means for observation of the dynamic performance of the control loop.
With MC720 hardware, the front LEDs operate in a similar way.
As soon as a functional error comes up (see next section) all LEDs start to flash at a frequency of approx. 1 Hz, independent of the LED function setting, until the error has been cleared.



Error in encoder increments
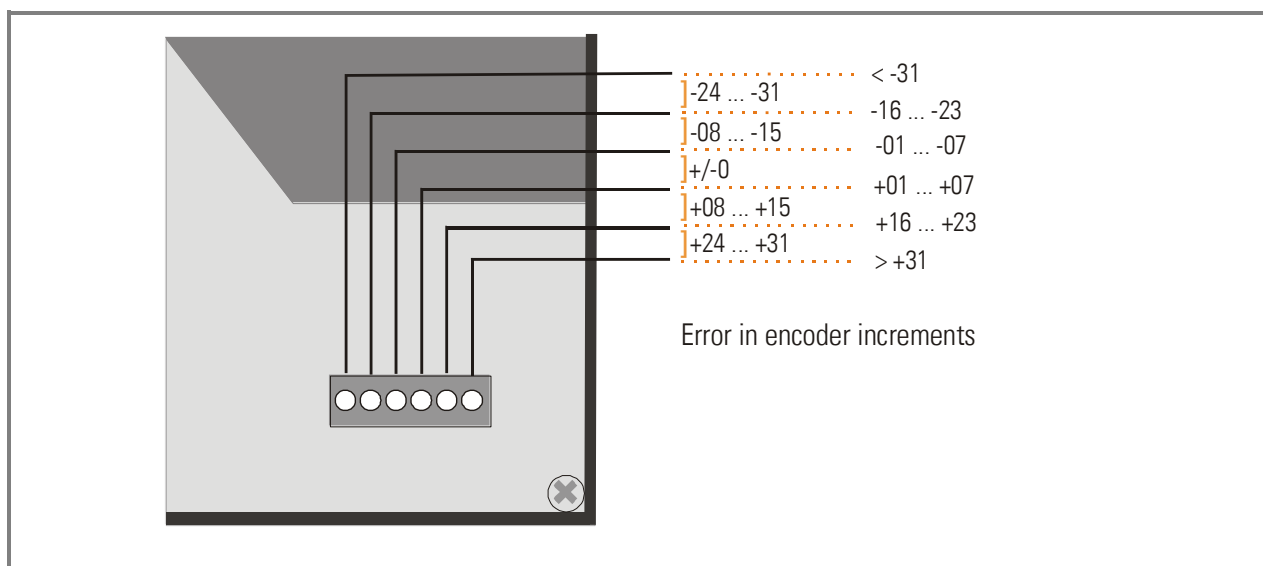
Positive errors (LEDs on right site of centre position) indicate that the carriage lags the line.
Negative errors (LEDs on left site of centre position) indicate that the carriage leads the line.
Under regular production conditions and with good adjustment of the control loop, you should find between 2 and 4 of the centre LEDs on or blinking, which indicates at the same time that the cutting accuracy is fine.
Where you find one of the extreme left or right LEDs on, this indicates that the controller is not adjusted well, or that the dynamic response of the drive is not sufficient. This however does not really mean that your cutting accuracy must be bad, because errors repeating continuously may eliminate themselves.

# 6.   Error messages

Upon detection of an error, the carriage remains in a closed-loop standstill position after termination of the current cut. Output "Error" switches to HIGH and all LEDs on the connector plate are flashing. Where your PC with OS5.1 software is online, you can read the error message at the bottom of the screen.

To clear an error state (for exceptions see below):

- activate input "Clear Error" or

- switch off the "Control Enable" input or

- Press the Reset button located behind the hole in the connector plate or

- cycle the power supply of the unit

Please note that the unit will immediately return to the error state if the cause for the error has not been eliminated

| | |
|---|---|
| Error 00: DPRAM Error | An error was detected when checking the internal Dual Port RAM. The DPRAM is used for data exchange with the CAN network, therefore no CAN communication will be possible while this error exists. This error appears in the display only but will not stop the carriage. It can only be reset by cycling the power supply. |
| Error 01: Power Low | The power supply voltage is too low. This error is reset automatically when the power supply voltage recovers and exceeds the minimum power supply voltage level. |
| Error 02: Cut not possible | A cut is declared as "not possible" when the carriage already should start into forward direction before it has fully returned to Home position from the previous cut. This, in general, will happen with too short cutting lengths at too high line speed. |
| Error 03: Limit Switch | This error indicates that during automatic cutting operation the rear software limit switch has been touched. See drawing under parameter "Minimum Position" |
| Error 04: Printmark Buffer | Overflow of the print mark buffer register, this means too many print marks have been detected between the print mark sensor and the carriage home position. |
| Error 05: Val. Range exceed | The ratio between the number of line encoder pulses and the number of carriage encoder pulses is outside the permitted range (see section 2.3 "system configuration") |

# 7. Steps for Commissioning

For set-up and commissioning of all drives, the "Adjust" menu is available under "Tools" in the main menu of the screen. To start the Adjust menu, input "Control Enable" must first be LOW.

**At this time, all drives must be adjusted to a proper and stable operation over the full speed range. The carriage drive needs a maximum of dynamics and response (set ramps to zero, switch of any integral or differential component of the internal speed control loop, operate the drive with proportional speed control only, with the proportional Gain as high as possible).**

For the set-up procedure it is recommended to mechanically disconnect the motor shaft from the carriage, so you can run the motor continuously and need not to observe the mechanical limitations of the carriage.
Before you start the Adjust menu, make sure that all parameters on the required register cards are set correctly. Where you find the possibility for integration, please switch it off for the first steps (set "I-Time" to 0)
The Adjust Program is used to set the directions of rotation of the encoders and to adjust the analogue output levels and the Proportional Gain. Also, the screen displays the actual encoder frequency.

| | For the adjustment procedure, the carriage drive will always use the virtual master axis as reference, fully independent of the input "Select Virtual Master" |
|---|---|

## 7.1. Preparations

Use register card "Adjust Carriage" to set up the carriage drive (all other register cards in the Adjust-menu are disabled).
The controller will generate the speed reference voltage to move the drive. For this, the following settings must be made:

- <u>Vir. Master Speed:</u> Set the virtual speed that you would like to use for adjusting the Slaves. This setting is in LU/min. and the default value is 10% of the maximum line speed you have set before (= Recommended speed for adjustments).

- <u>Ramp Time:</u> This ramp time is used for all acceleration and deceleration during the adjust procedure.

- <u>P-Gain</u>: An initial setting of 500 is recommended.

- <u>Ana-Out-Gain</u>: Start with the default value of 1000, which corresponds to a maximum analogue output of 10.00 volts.
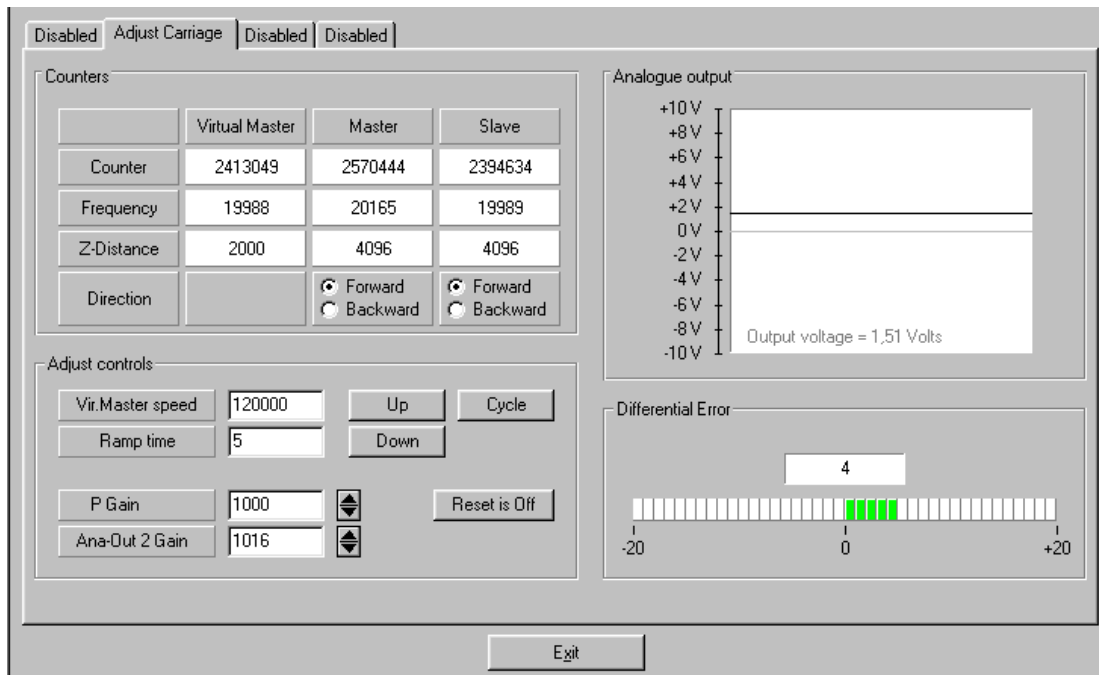
## 7.2. Direction of Rotation

This definition must be met for the master (line encoder) and the slave (carriage drive encoder).
Master:

- Move your line encoder into forward direction (manually or by means of a remote speed signal to the line drive)
- Observe the counter in the "Master" column. It must count up (increment)! Where you find it counts down, please click to the unchecked direction box of the "Master" column (Forward or Reverse) to change the direction.

Slave:

- Click to the "Up" key to start the slave drive. The Slave will ramp up to the speed according to your previous ramp and frequency settings.
- Please observe the carriage: Does it move into forward direction? If it does not, the polarity of the analogue speed reference is not correct or the direction setting of the drive is wrong.
- It is a must that the Counter in the "Slave" column counts up (increments). Where you find it counts down, please click to the other direction box (Forward or Reverse) to force it to upwards count.
- Once we count up, click to the "Down" key to stop the drive again. The definition of direction of rotation is finished now.

> Only when both counters (Master and Slave) count up while the encoders are moving forward, the definition of the encoder directions is correct!

When you have also wired the marker pulses of your encoders, the window "Z-Distance" shows the ppr number of your encoders. This provides at the same time a useful test for correct wiring of the encoder channels.

## 7.3. Tuning the Analogue Output

- Start the drive again by clicking "Up". Now switch the Reset to OFF by clicking to the Reset key showing actually "Reset On". This activates the closed loop control.

- Observe the colour bar and the differential counter in the field "Differential Error". There are two possibilities:

  a) The bar graph moves to the right and the counter counts up (+):
     This indicates that the analogue signal is too low. Please increase the setting of "Ana-Out Gain" by overtyping the figures or by scrolling up with the arrow key.

  b) The bar graph moves to the left and the counter counts down (-):
     This indicates that the analogue signal is too high. Please decrease the setting of "Ana-Out Gain" by overtyping the figures or by scrolling down with the arrow key.
     "Ana-Out Gain" is set correctly when the bar graph remains in its centre position and the differential counter swings around zero (e.g. +/-8)

  Hint: You can reset the differential counter to zero at any time between, by cycling the "Reset" command.

## 7.4. Setting of the proportional Gain

The setting of register "P-Gain" determines how strong the controller responds to position and speed errors of the drive. In principle, this setting therefore should be as high as possible. However, depending on dynamics and inertia of the whole system, too high gain values will produce stability problems.

Please try to increase the setting of P-Gain from 500 to 1000, 1500, 2000 etc. However, as soon as you find unsteady operation, noise or oscillation, you must reduce the setting again correspondingly.

We also recommend using the "Cycle" function for observations of the stability. When clicking to this key, the drive will continuously ramp up and down while you can check the differential counter for stable operation.

Once you have done these steps, you can leave the Adjust menu by pressing the "Exit" button. Now your machine is ready for operation and you can run initial test cuts without material (see next chapter).

## 7.5. Tuning the controller

When during commissioning you cannot get the "Cut completed" signal because the carriage drive is mechanically disconnected to the machine, it is legal to link the "Ready to cut" output directly to the "Cut completed" input.

This however is allowed for testing purpose without material only!
To do this, set parameter "Edge Sense" to 0 and "Sync Time" to the desired synchronous time. The carriage will then start the return cycle after lapse of this synchronous time, regardless of the tool position.

- Set the "Control Enable" input to HIGH to enable the controller

- Use the Jog function to put the carriage to the desired Home position. Where your software limit switches should bar you from reaching the position, keep input "Set Zero Pos." HIGH. This will prevent limitation by the software switches because the counter for the carriage position is kept to zero.

- Make sure that – with respect to your definition of the zero position – your software limit switches are set correctly, so that the carriage can move inside the designated travelling range, but cannot leave it.

- For the very first trials you should use a long length setting ("Cutting Length") and a slow virtual line speed ("Set Freq. Vir. Ma.")

- Switch input "Select Virtual Master" ON while input "Start/Stop" is still LOW (Stop). The line simulation will work now and on your PC screen you can see the indicator box "Length Pulses" blinking

- Activate input "Immediate Cut" and see how the controller executes a first cutting cycle.

- Switch the Start/Stop input to HIGH. The carriage will wait for expiration of the length and then execute a cutting cycle

- Change over to register card "Process Data" to see actual values like the progress of the length or the virtual line speed etc.

- Observe the display of the "Position Error" and the LEDs on the connector plate (provided that LED Function is set to 1). During the whole cycle the position error should not exceed values like 30 and the LEDs should remain in the centre area all the time. Increase the virtual line speed step by step and continue the observations.

- If during forward acceleration your "Position Error" takes high positive values and the LED moves to the extreme right position, this indicates that the carriage drive cannot follow the acceleration ramp and you should decrease the "Acceleration 1" setting. The same is valid for "Acceleration 2", when during reverse acceleration you observe high negative errors and the LEDs move to the extreme left.

- Where you find your position error remains small enough all the time, you are free to increase the Acceleration settings. This will cause steeper ramps and increase your total cutting output.

All this assumes that you have properly adjusted your Analogue Gain values in a way that the LEDs remain in centre position when the carriage moves at constant speed.

Remark: Position errors will not affect the cutting accuracy, unless they occur directly during the cut.

At this time we can try to optimize also other settings:

- Reduce "Cut Window" to e.g. 20 and change "I-Time" to e.g.30. This would be a very typical practical setting.
- Increase the setting of "Return Speed" to save time with the fly back of the carriage. If necessary, the carriage then will take higher return speed, which increases again the total cutting output.
- Increase the "Acceleration" settings as far as more dynamic motion is desirable and the drive can follow.
- Keep the cutting time (penetration time of the tool or saw blade) as short as possible to achieve maximum efficiency

**This concludes the procedure of commissioning of your Flying shear system**. We recommend saving all parameter settings on hard disc or disc. In case of repeat applications (machine with similar specifications), or after exchange of the controller, you just need to download the settings and are immediately ready to go.

# 8. Hints for controller type MC720 with integrated operator terminal

Controllers type MC720 are equipped with a keypad and a LCD display, providing all entries and operations of the controller.

> The keyboard of MC720 allows parameter changes only in the Stop state with the carriage in standstill (Start/Stop input LOW, no immediate cut, no Jog)!
> For all changes of settings "on the fly" (while the machine is moving), you must use remote communication via serial interface or CANBUS / PROFIBUS.

## 8.1. Setting of parameters and registers

All the menu structure of the LCD display is fully similar to the structure of the register cards with the PC software. To start the menu, press **F1**. Select the menus and sub-menus by using the arrow keys and confirm your choice by Enter. With all further actions, **Enter** will go **forward** and **PRG** go **back** in the menu structure.

For all operations, just follow the hints given on the LCD menu. Once you have studied section 4 of this manual, all keypad and LCD operations will be self-explaining.

## 8.2. Display of actual process values

During normal production, you can use the LCD for display of interesting actual values and process data. The PC operator software allows you to define and to scale these values and to add text comments according to your choice.

The menu "LCD Definitions" can be found under "Extras" of the headline menu.
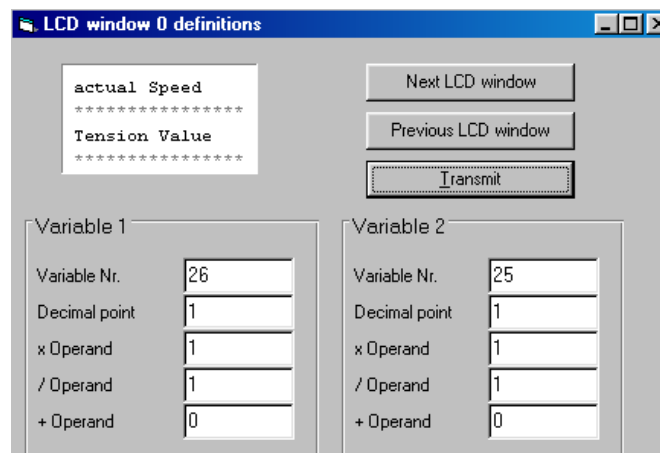
- There are totally four LCD windows accessible (0 – 3) and the actual window number appears in the blue headline. To change from one window to another, use the keys "Next LCD window" or "Previous LCD window".

- Each window allows displaying two actual values with two text comments. The line with asterisks ******* serves as space holder for the values displayed later on the LCD. When you click to the text line, you can edit the text comments according to your need (max. 16 characters for each text comment)

- <u>Variable Nr:</u> Defines which of all available values should appear in the display. Please choose one of the 32 available actual values (00 – 31) as shown on the screenshot "Process Data" in chapter 4.4 and in the corresponding table in chapter 11.

- <u>Decimal point:</u> Defines the position where a decimal point should appear on the LCD display (0=no decimal point).

- <u>xOperand, /Operand, +Operand:</u>

  These 5-decade operands can be used to change the scaling of your display value to the desired engineering units.

$$\text{LCD display} = \text{register value} \times \frac{\text{xOperand}}{\text{/Operand}} + \text{+/-Operand}$$

When you have entered your specifications to a window, click to "Transmit" to store your definitions to the controller.

In production state, you can use the key **F2** to switch from one of the four windows to the next and to read the actual values you have assigned.

| Key **F1:** | Enter into the menu for setting or modifying parameter |
|---|---|
| Key **F2:** | Cycle from one window to next to read actual process values |

# 9.    Accuracy considerations

It is easy to understand that the controller functions are based on correct information from the encoders. When you observe the LEDs <u>at the moment when a cut takes place</u>, you can easily see what the theoretical cutting error can be (see section 5.) In practical applications, with the drive and the unit properly adjusted, the cutting error should be limited to 4-7 encoder increments and the resolution of the encoders will provide the real error expressed in length units.

**Where you find the real cutting errors are higher than indicated by the LED, it is absolutely for sure that there are external reasons, and you should check for the following items:**

- Do feed roll or the measuring wheel slip?

- Is the measuring wheel not exactly orthogonal to the material surface or to the direction of the line, or is it not exactly round, or is there tolerance in diameter?

- Is there any length change of the material between the measuring wheel and the position where the cut takes place (i.e. shrinking of hot material that cools down or stretching due to mechanical deformation prior to cut)?

- Is there clearance or backlash of the carriage drive or the cutting tool etc.?

- EMC: Is there noise on the line encoder signal or the carriage encoder signal? Noise on the encoder signals can cause cutting errors as well. Noise on the carriage encoder signal can easily be detected because it causes the home position of the carriage to shift. Noise on the line encoder signal can be detected by reading the "Z-Distance" field in the Adjust menu. This window must always contain the number of pulses of the line encoder (including multiple edge count). If the content of this register varies by more than +/- 1 encoder increment there is noise on the line encoder signal that involves cutting errors.

  Using this function requires the Z and Z' outputs of the line encoder to be connected

- Is the synchronous ratio correct?

  An incorrect synchronous ratio (values of parameters "Pulses Line/1000" or "Pulses Cut/1000" incorrect) can cause considerable cutting errors that are particularly big with changes of the line speed.

If all of the above points have been checked and eliminated the remaining cutting errors can basically consist of two components: The electronic cutting error caused by the controller (indicated on the LED display) and the error caused by the length measurement (slip of the measuring wheel etc.). There is a fundamental difference between these two errors: The electronic error is independent of the cutting length, and the length measurement error is proportional to the cutting length.

We clearly point out that the LEDs provide an absolutely reliable means for evaluation of the electronic cutting accuracy. For a rough estimation of the electronic accuracy, also the actual values "Min. Pos. Error" and "Max. Pos. Error" can be used. They record the maximum position error of the carriage between the signals "Ready to Cut" and "Cut completed" (the units are "encoder increments" of the carriage encoder which must be converted to length units correspondingly).

When the material or carriage motion is bumpy or vibrating, you may see 4 or more LEDs on at the same time. In general this is not relevant for the accuracy, because the LEDs are updated within microseconds and therefore display also very small and fast vibrations, whereas the drive responds with some inertance and will follow the average of what the LEDs say.

# 10. Limitations of cutting length and line speed

Flying shears have physical limitations with respect to short cutting length at high line speeds, i.e. not every length can be cut at any line speed. This should be shown by the following example:

When we would need to cut pieces of 1 meter length at a line speed of 60 meters/minute, this means we must execute <u>one cut every second</u>. If our saw blade would take one full second to perform the cut, it is easy to understand that this cannot work (There is no time left to accelerate, decelerate and return to home position).

For calculation and display of speed profiles, based on customer-programmable cutting parameters, motrona offers the users a special PC software, suitable for easy judgment of demands and limits of Flying Shear systems.

# 11.  Parameter Tables

| General Parameters | | | | | | |
|---|---|---|---|---|---|---|
| Name | Unit | Serial Code (Hex) | Serial Code (Dec) | Minimum | Maximum | Default |
| Cutting Length | Length units | 0000 | 0 | 1 | 999999 | 1000 |
| Test Cut. Length | Length units | 0001 | 1 | 1 | 999999 | 1000 |
| Virtual Line Speed | Len. units/min. | 0002 | 2 | 0 | 9999999 | 10000 |
| (Parameter 03) | | 0003 | 3 | 0 | 0 | 0 |
| … | | … | … | | | |
| (Parameter 30) | | 001E | 30 | 0 | 0 | 0 |
| Access Code Input | | 001F | 31 | 0 | 99999999 | 0 |

| Parameter Blocks | | | | | | |
|---|---|---|---|---|---|---|
| Basic Settings | | | | | | |
| Name | Unit | Serial Code (Hex) | Serial Code (Dec) | Minimum | Maximum | Default |
| Pulses Line / 1000 | Incr. | 0100 | 256 | 1 | 999999 | 1000 |
| Pulses Cut / 1000 | Incr. | 0101 | 257 | 1 | 999999 | 1000 |
| Acceleration 1 | Len. units / s² | 0102 | 258 | 1 | 99999 | 1000 |
| Acceleration 2 | Len. units / s² | 0103 | 259 | 1 | 99999 | 1000 |
| Ramp Form | | 0104 | 260 | 0 | 15 | 0 |
| +/- Sync Rate | % | 0105 | 261 | -9.99 | +9.99 | 0.00 |
| Return Speed | | 0106 | 262 | 0.01 | 9.99 | 1.00 |
| Edge Sense | | 0107 | 263 | 0 | 1 | 0 |
| Synchron Time | ms | 0108 | 264 | 1 | 9999 | 1 |
| Cut Window | Length units | 0109 | 265 | 1 | 99 | 50 |
| Sync Samples | | 010A | 266 | 1 | 9999 | 1 |
| Tool Width | Length units | 010B | 267 | 0 | 999 | 0 |
| Cutting Mode | | 010C | 268 | 1 | 3 | 1 |
| Photocell -> Cut | Length units | 010D | 269 | 1 | 999999 | 1000 |
| Gap Length | Length units | 010E | 270 | -9999 | 9999 | 0 |
| Gap Time | ms | 010F | 271 | 10 | 9999 | 10 |
| Ramp Vir. Master | s | 0110 | 272 | 0 | 999 | 1 |
| Set Length Cou (Ps) | Increments | 0111 | 273 | 0 | 0 | 0 |
| Set Length Cou (LU) | Length units | 0112 | 274 | 0 | 99999999 | 0 |
| Printmark Edge | | 0113 | 275 | 0 | 999999 | 0 |
| Virt. Printmarks | | 0114 | 276 | 0 | 1 | 0 |
| Deceleration 1 | Len. units / s² | 0115 | 277 | 0 | 1 | 0 |
| Deceleration 2 | Len. units / s² | 0116 | 278 | 1 | 99999 | 1000 |
| Printmark Offset | Length units | 0117 | 279 | -99999 | +99999 | 0 |

## Basic Settings (continued)

| Name | Unit | Serial Code (Hex) | Serial Code (Dec) | Minimum | Maximum | Default |
|---|---|---|---|---|---|---|
| Photocell Delay | ms | 0118 | 280 | 000.0 | 500.0 | 0 |
| Printm. per Length | | 0119 | 281 | 0 | 99 | 0 |
| Printmark Window | Length units | 011A | 282 | 0 | 9999 | 0 |
| Missing Printmarks | | 011B | 283 | 0 | 99 | 0 |
| Abs. Return Speed | Len. units/min | 011C | 284 | 0 | 9999999 | 0 |
| Freeze Mode | | 011D | 285 | 0 | 2 | 0 |
| (Parameter 30) | | 011E | 286 | 0 | 0 | 0 |
| (Parameter 31) | | 011F | 287 | 0 | 0 | 0 |

## Control Loop Settings

| Name | Unit | Serial Code (Hex) | Serial Code (Dec) | Minimum | Maximum | Default |
|---|---|---|---|---|---|---|
| P-Gain | | 0120 | 288 | 0 | 9999 | 1000 |
| I Time | s | 0121 | 289 | 0.000 | 9.999 | 0.000 |
| Max. Correction | Incr. | 0122 | 290 | 1 | 9999 | 9999 |
| Max. Line Speed | Len. units/min. | 0123 | 291 | 1 | 9999999 | 100000 |
| Sampling Time | ms | 0124 | 292 | 1 | 1000 | 1 |
| (Parameter 05) | | 0125 | 293 | 0 | 0 | 0 |
| … | | … | … | | | |
| (Parameter 31) | | 013F | 319 | 0 | 0 | 0 |

## Jog / Home / Ref. Settings

| Name | Unit | Serial Code (Hex) | Serial Code (Dec) | Minimum | Maximum | Default |
|---|---|---|---|---|---|---|
| Home Window | Length units | 0140 | 320 | 1 | 999 | 100 |
| Minimum Position | Length units | 0141 | 321 | -999999 | 0 | -999999 |
| Maximum Position | Length units | 0142 | 322 | 0 | 999999 | 999999 |
| Alarm Position | Length units | 0143 | 323 | 0 | 999999 | 999999 |
| Jog Speed Forw. | % | 0144 | 324 | 1 | 100 | 10 |
| Jog Ramp Up Forw. | s | 0145 | 325 | 0 | 99 | 1 |
| Jog Ramp Dw. Forw. | s | 0146 | 326 | 0 | 99 | 1 |
| Jog Speed Rev. | % | 0147 | 327 | 1 | 100 | 10 |
| Jog Ramp Up Rev. | s | 0148 | 328 | 0 | 99 | 1 |
| Jog Ramp Dw. Rev. | s | 0149 | 329 | 0 | 99 | 1 |
| (Parameter 10) | | 014A | 330 | 0 | 0 | 0 |
| … | | … | … | | | |
| (Parameter 31) | | 015F | 351 | 0 | 0 | 0 |

## Monitoring Settings

| Name | Unit | Serial Code (Hex) | Serial Code (Dec) | Minimum | Maximum | Default |
|---|---|---|---|---|---|---|
| Zero Speed Master | Len. units/min. | 0160 | 352 | 0 | 999999 | 0 |
| Zero Speed Vir. Ma. | Len. units/min. | 0161 | 353 | 0 | 999999 | 0 |
| LED Function | | 0162 | 354 | 0 | 1 | 0 |
| Length per Pulse | Length units | 0163 | 355 | 1 | 50000 | 1000 |
| Master Rev. Limit | Length units | 0164 | 356 | 0 | 99999 | 0 |
| Se.Diag.AnaOut1 | | 0165 | 357 | 0 | 31 | 0 |
| Cam 1 Distance | Length units | 0166 | 358 | 0 | 999999 | 0 |
| Cam 1 Pulse Width | ms | 0167 | 359 | 1 | 999 | 100 |
| Cam 1 Delay Time | ms | 0168 | 360 | 0 | 999 | 0 |
| (Parameter 09) | | 0169 | 361 | 0 | 0 | 0 |
| … | | … | … | 0 | 0 | 0 |
| (Parameter 15) | | 016F | 367 | 0 | 0 | 0 |
| Batch Counter | | 0170 | 368 | 0 | 999999999 | 0 |
| Waste Counter | | 0171 | 369 | 0 | 999999999 | 0 |
| (Parameter 18) | | 0172 | 370 | 0 | 0 | 0 |
| … | | … | … | | | |
| (Parameter 31) | | 017F | 383 | 0 | 0 | 0 |

## Additional Cuts

| Name | Unit | Serial Code (Hex) | Serial Code (Dec) | Minimum | Maximum | Default |
|---|---|---|---|---|---|---|
| Additional Cuts | | 0180 | 384 | 0 | 3 | 0 |
| Add. Cut 1 Length | Length units | 0181 | 385 | 0 | 999999 | 0 |
| Add. Cut 2 Length | Length units | 0182 | 386 | 0 | 999999 | 0 |
| Add. Cut 3 Length | Length units | 0183 | 387 | 0 | 999999 | 0 |
| (Parameter 04) | | 0184 | 388 | 0 | 0 | 0 |
| … | | … | … | | | |
| (Parameter 31) | | 019F | 415 | 0 | 0 | 0 |

## Protection

| Name | Einheit | Ser. Code (Hex) | Ser. Code (Dec) | Minimum | Maximum | Werksein-stellung |
|---|---|---|---|---|---|---|
| Access Code Def. | | 02A0 | 672 | 0 | 99999999 | 0 |
| (Parameter 01) | | 02A1 | 673 | 0 | 0 | 0 |
| … | | … | … | | | |
| (Parameter 31) | | 02BF | 703 | 0 | 0 | 0 |

| Communication Settings | | | | | | |
|---|---|---|---|---|---|---|
| Name | Unit | Serial Code (Hex) | Serial Code (Dec) | Minimum | Maximum | Default |
| Can Unit Address | | 02C0 | 704 | 001 | 127 | 001 |
| Can Baud Rate | | 02C1 | 705 | 0 | 7 | 1 |
| Can Config. | | 02C2 | 706 | 000 | 255 | 000 |
| Can Tx Par | | 02C3 | 707 | 000 | 255 | 000 |
| Can Rx Par | | 02C4 | 708 | 000 | 255 | 000 |
| Ser Unit Address | | 02C5 | 709 | 11 | 99 | 11 |
| Ser Baud Rate | | 02C6 | 710 | 0 | 4 | 2 |
| Ser Data Format | | 02C7 | 711 | 0 | 9 | 0 |
| (Block 15 8) | | 02C8 | 712 | 0 | 0 | 0 |
| … | | … | … | | | |
| (Block 15 31) | | 02DF | 735 | 0 | 0 | 0 |

| Setup-Up Settings | | | | | | |
|---|---|---|---|---|---|---|
| Name | Unit | Serial Code (Hex) | Serial Code (Dec) | Minimum | Maximum | Default |
| Mode Counter 1 | | 02E0 | 736 | 0 | 2 | 0 |
| Dir. Counter 1 | | 02E1 | 737 | 0 | 1 | 1 |
| Mode Counter 2 | | 02E2 | 738 | 0 | 2 | 0 |
| Dir. Counter 2 | | 02E3 | 739 | 0 | 1 | 1 |
| Mode Counter 3 | | 02E4 | 740 | 0 | 2 | 0 |
| Dir. Counter 3 | | 02E5 | 741 | 0 | 1 | 1 |
| Mode Counter 4 | | 02E6 | 742 | 0 | 2 | 0 |
| Dir. Counter 4 | | 02E7 | 743 | 0 | 1 | 1 |
| Ana-Out Offset 1 | | 02E8 | 744 | -2047 | +2047 | 0 |
| Ana-Out Gain 1 | | 02E9 | 745 | 000.00 | 320.00 | 1000 |
| Ana-Out Offset 2 | | 02EA | 746 | -2047 | +2047 | 0 |
| Ana-Out Gain 2 | | 02EB | 747 | 000.00 | 320.00 | 1000 |
| … | | … | … | | | |
| Dir. Frequency | | 02FA | 762 | 0 | 1 | 1 |
| Frequency Select | | 02FB | 763 | 0 | 1 | 1 |
| Index 1 select | | 02FC | 764 | 0 | 2 | 0 |
| Index 2 select | | 02FD | 765 | 0 | 2 | 0 |
| Index 3 select | | 02FE | 766 | 0 | 2 | 0 |
| Index 4 select | | 02FF | 767 | 0 | 2 | 0 |

| No. | Name | Unit | Serial Code (Hex) | Serial Code (Dec) | Explanation |
|---|---|---|---|---|---|
| | | | Process Data (Actual values) | | |
| 0 | Length Counter | Incr. | 0800 | 2048 | Material Length Counter (Line Encoder) |
| 1 | Master Frequency | Hz | 0801 | 2049 | Frequency of Line Encoder |
| 2 | Line Speed | Length Units / min. | 0802 | 2050 | Line Speed |
| 3 | Position Error | Incr. | 0803 | 2051 | Actual carriage position error |
| 4 | Feed Forw. Value | | 0804 | 2052 | Internal value for feed forward set point |
| 5 | Correction Value | | 0805 | 2053 | Proportional correction set point |
| 6 | Integral Value | | 0806 | 2054 | Integral correction set point |
| 7 | Carriage Cut Pos | Incr. | 0807 | 2055 | Carriage position counter during cut cycle (related to home position) |
| 8 | Car. travel dist. | Incr. | 0808 | 2056 | Carriage travel distance during cut cycle |
| 9 | Carriage Abs.Pos | Incr. | 0809 | 2057 | Carriage absolute position counter (related to zero position) |
| 10 | Act. Cut Length | Incr. | 080A | 2058 | Actual cutting length |
| 11 | | | 080B | 2059 | |
| 12 | Min. Pos. Error | Incr. | 080C | 2060 | Min./max carriage position error during cut |
| 13 | Max. Pos. Error | Incr. | 080D | 2061 | |
| 14 | Read Batch Count | | 080E | 2062 | Batch counter value (read only) |
| 15 | Read Waste Count | | 080F | 2063 | Waste counter value (read only) |
| 16 | Length Cou. Sheet | Incr. | 0810 | 2064 | Length Counter within one sheet |
| 17 | Prm. Delay Length | Incr. | 0811 | 2065 | Delay of printmark sensor converted to length |
| 18 | Printm. Pos. Cou. | Incr. | 0812 | 2066 | Counter for printmark position |
| 19 | Miss. Printm. Cou. | | 0813 | 2067 | Counter for missing printmarks |
| 20 | Printmark Status | | 0814 | 2068 | State of printmark operation |
| 21 | Virt. Printmarks | | 0815 | 2069 | Number of virtual printmarks |
| 22 | Ptr. Write Printm. | | 0816 | 2070 | Pointer for writing printmark to buffer |
| 23 | Ptr. Read Printm. | | 0817 | 2071 | Pointer for reading printmark from buffer |
| 24 | Printmark Buffer | | 0818 | 2072 | Printmark buffer |
| 25 | | | 0819 | 2073 | |
| 26 | | | 081A | 2074 | |
| 27 | | | 081B | 2075 | |
| 28 | | | 081C | 2076 | |
| 29 | Control State | | 081D | 2077 | Actual state of controller |
| 30 | Cut State | | 081E | 2078 | Actual state of cut cycle |
| 31 | Test Counter | | 081F | 2079 | |

| | Commands | | | | |
|---|---|---|---|---|---|
| Name | Serial Code for single Command | | Bit # of "Serial Commands" (Code 0B01 Hex)/ "CAN Commands" (Code 0B02 Hex) | Possible assignment to hardware input X6 "Cont.In" | Explanation → Chapter 4.1 |
| | (Hex) | (Dec) | | | |
| Control Enable | 0900 | 2304 | 0 | In 1 … 16 | |
| Start / Stop | 0901 | 2305 | 1 | In 1 … 16 | |
| Select VirMaster | 0902 | 2306 | 2 | In 1 … 16 | |
| Run Virt. Master | 0903 | 2307 | 3 | In 1 … 16 | |
| Immediate Cut | 0904 | 2308 | 4 | In 1 … 16 | |
| Cut completed | 0905 | 2309 | 5 | In 1 … 16 | |
| Cut Test-Length | 0906 | 2310 | 6 | In 1 … 16 | |
| Clear Error | 0907 | 2311 | 7 | In 1 … 16 | |
| Set Zero Pos. | 0908 | 2312 | 8 | In 1 … 16 | |
| Jog forward | 0909 | 2313 | 9 | In 1 … 16 | |
| Jog reverse | 090A | 2314 | 10 | In 1 … 16 | |
| Decr. Batch Cou. | 090B | 2315 | 11 | In 1 … 16 | |
| Start Gap | 090C | 2316 | 12 | In 1 … 16 | |
| Teach Printmark | 090D | 2317 | 13 | In 1 … 16 | |
| Print Mark | – | – | – | In 15 (fix) | |
| (Command 15) | 090F | 2319 | 15 | In 1 … 16 | |
| Reset Diff.Cou. | 0910 | 2320 | 16 | In 1 … 16 | |
| Reset Batch Cou. | 0911 | 2321 | 17 | In 1 … 16 | |
| Sync Mode Enable | 0912 | 2322 | 18 | In 1 … 16 | |
| (Command 19) | 0913 | 2323 | 19 | In 1 … 16 | |
| (Command 20) | 0914 | 2324 | 20 | In 1 … 16 | |
| (Command 21) | 0915 | 2325 | 21 | In 1 … 16 | |
| (Command 22) | 0916 | 2326 | 22 | In 1 … 16 | |
| (Command 23) | 0917 | 2327 | 23 | In 1 … 16 | |
| (Command 24) | 0918 | 2328 | 24 | In 1 … 16 | |
| (Command 25) | 0919 | 2329 | 25 | In 1 … 16 | |
| (Command 26) | 091A | 2330 | 26 | In 1 … 16 | |
| (Command 27) | 091B | 2331 | 27 | In 1 … 16 | |
| (Command 28) | 091C | 2332 | 28 | In 1 … 16 | |
| Store to EEProm | 091D | 2333 | 29 | In 1 … 16 | |
| Adjust Program | 091E | 2334 | 30 | – | |
| Test Program | 091F | 2335 | 31 | – | |

| Outputs | | | | | |
|---|---|---|---|---|---|
| Name | Serial Code for single output | | Bit No. of "Output Status" (Code 0B04 Hex) | Possible assignment to hardware output X7 "Cont.Out" | Explanation → Chapter 4.1 |
| | (Hex) | (Dec) | | | |
| Ready | 0A00 | 2560 | 0 | Out 1 … 8 | |
| Ready to cut | 0A01 | 2561 | 1 | Out 1 … 8 | |
| Home | 0A02 | 2562 | 2 | Out 1 … 8 | |
| Alarm | 0A03 | 2563 | 3 | Out 1 … 8 | |
| Length Pulses | 0A04 | 2564 | 4 | Out 1 … 8 | |
| Gap Completed | 0A05 | 2565 | 5 | Out 1 … 8 | |
| Master Reverse | 0A06 | 2566 | 6 | Out 1 … 8 | |
| Error | 0A07 | 2567 | 7 | Out 1 … 8 | |
| Master in motion | 0A08 | 2568 | 8 | Out 1 … 8 | |
| Vir.M. in motion | 0A09 | 2569 | 9 | Out 1 … 8 | |
| No Printmark | 0A0A | 2570 | 10 | Out 1 … 8 | |
| Printmark Window | 0A0B | 2571 | 11 | Out 1 … 8 | |
| Virt. Printmark | 0A0C | 2572 | 12 | Out 1 … 8 | |
| Max. Correction | 0A0D | 2573 | 13 | Out 1 … 8 | |
| Printm. Teached | 0A0E | 2574 | 14 | Out 1 … 8 | |
| Cam 1 Output | 0A0F | 2575 | 15 | Out 1 … 8 | |
| (Output 16) | 0A10 | 2576 | 16 | Out 1 … 8 | |
| (Output 17) | 0A11 | 2577 | 17 | Out 1 … 8 | |
| (Output 18) | 0A12 | 2578 | 18 | Out 1 … 8 | |
| (Output 19) | 0A13 | 2579 | 19 | Out 1 … 8 | |
| (Output 20) | 0A14 | 2580 | 20 | Out 1 … 8 | |
| (Output 21) | 0A15 | 2581 | 21 | Out 1 … 8 | |
| (Output 22) | 0A16 | 2582 | 22 | Out 1 … 8 | |
| (Output 23) | 0A17 | 2583 | 23 | Out 1 … 8 | |
| (Output 24) | 0A18 | 2584 | 24 | Out 1 … 8 | |
| (Output 25) | 0A19 | 2585 | 25 | Out 1 … 8 | |
| (Output 26) | 0A1A | 2586 | 26 | Out 1 … 8 | |
| (Output 27) | 0A1B | 2587 | 27 | Out 1 … 8 | |
| (Output 28) | 0A1C | 2588 | 28 | Out 1 … 8 | |
| (Output 29) | 0A1D | 2589 | 29 | Out 1 … 8 | |
| (Output 30) | 0A1E | 2590 | 30 | Out 1 … 8 | |
| (Output 31) | 0A1F | 2591 | 31 | Out 1 … 8 | |

| Errors | | | |
|---|---|---|---|
| Error No. | Description | Bit No. of "Error Status" (Code 0B05 Hex) | Explanation → Chapter 6 |
| 00 | DPRAM Error | 0 | |
| 01 | Power Low | 1 | |
| 02 | Cut not possible | 2 | |
| 03 | Limit switch | 3 | |
| 04 | Printmark buffer | 4 | |
| 05 | Value Range Exceed | 5 | |
| 06 | — | 6 | |
| 07 | — | 7 | |
| 08 | — | 8 | |
| 09 | — | 9 | |
| 10 | — | 10 | |
| 11 | — | 11 | |
| 12 | — | 12 | |
| 13 | — | 13 | |
| 14 | — | 14 | |
| 15 | — | 15 | |

| Status of Commands, Outputs and Errors | | | |
|---|---|---|---|
| Description | Serial Code | | Bit # see tables above |
| | (Hex) | (Dec) | |
| Hardware Commands ("Cont.In" X6) | 0B00 | 2816 | |
| Serial Commands | 0B01 | 2817 | |
| CAN Commands | 0B02 | 2818 | |
| All Commands | 0B03 | 2819 | |
| Output Status | 0B04 | 2820 | |
| Error Status | 0B05 | 2821 | |