safety - control - motion - interface

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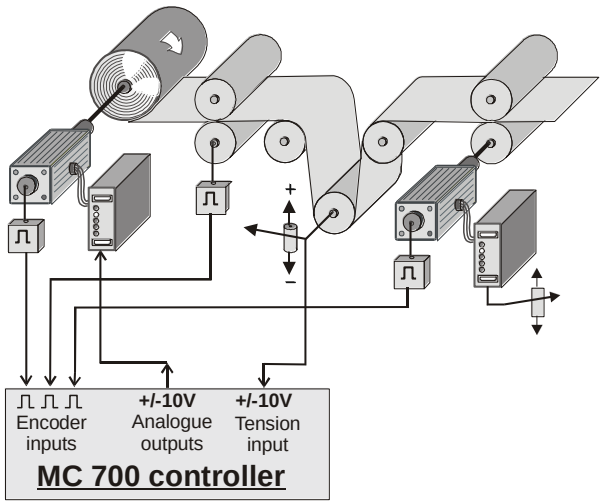
Software Manual

WR 701.02

MC 700 / MC720 Motion Control Firmware for Winding Applications and Traverse Control

Application example



- Suitable for easy control of up to four drives, with 16 of the most common Winding Applications
- Includes tension control functions with dancer roll or load cell feedback
- Provides full traverse control with winding of cables, tapes etc.
- Selectable Virtual Master Axis for precise line speed control
- Can operate in "stand-alone" mode as well as under remote PLC / PC / Fieldbus control

Version:	Description:
WR70102a/hk/lb/Jun2007	Format A5, correction AnaIn1/2, supplement instructions
WR70102b/hk/Jun2007	Corrections of serial codes "General Settings"
WR70102c/ag/Aug2015	Missing parameters supplemented

Table of Contents

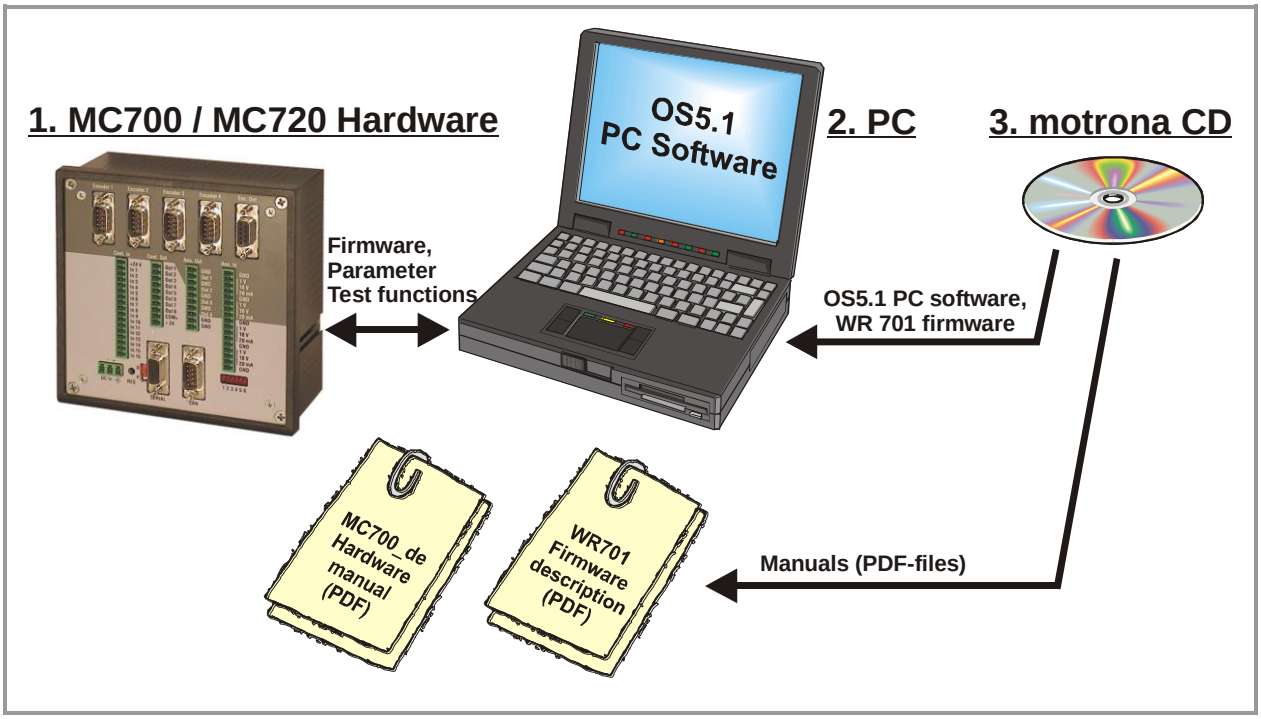
1. Preamble:

This document provides all information about the WR701 firmware, including parameters, variables and hints for commissioning.

For use and commissioning of this firmware you need:

1. motion controller type MC700 or MC720
2. PC or Laptop operating under Windows 98, 2000, NT or XP
3. the motrona CD containing the PC operator software OS5.1, the control firmware WR701xx.ecr, the hardware instructions MC700_de.pdf and the firmware instructions WR701xx.pdf (as actually in your hands)

All files are also available for free download from our homepage http://www.motrona.de



Running the WR 701 firmware requires a license key
(issued by motrona on request, free of charge)

2. General Remarks about Functions of this Firmware

This firmware is suitable, together with motrona controllers type MC700 or MC720, to control all combinations of drives with winder, line feed, unwinder, tension control and traverse control, as shown in this manual.

Roll diameters are continuously calculated for proper speed control of the winding/unwinding rolls, in order to keep the line speed constant.

All functions are based on digital closed loop speed control of the drives.

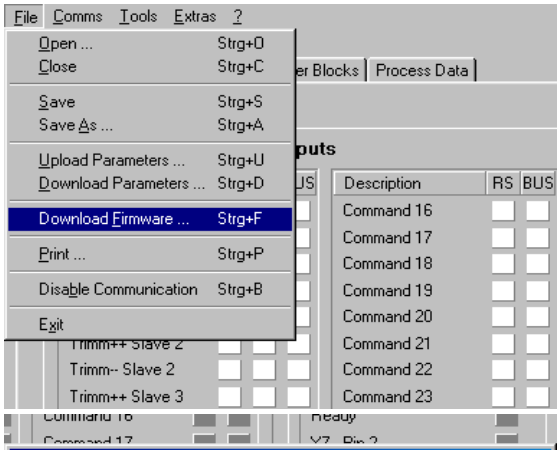
This firmware is based on precision speed control of the winder drives, and therefore will generate Analog speed reference signals only.
The firmware is not suitable for applications requiring pure torque control.

3. Download Procedure

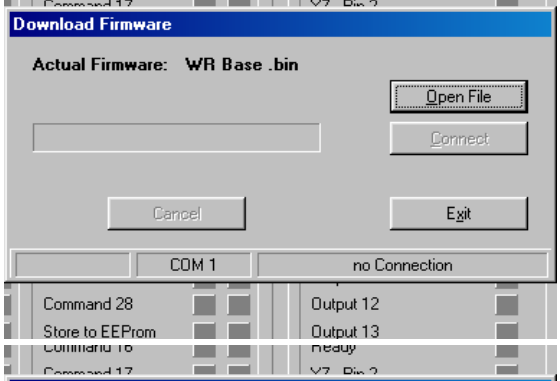
Ex factory, all MC 700- and MC 720 controllers have loaded the MC_Base firmware, which was used for factory testing purposes.

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

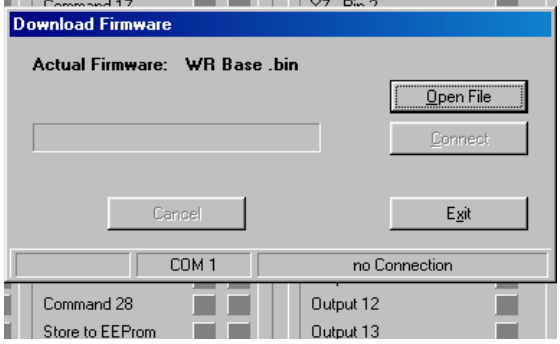
- Connect the PC to the controller, using a RS232 cable (see 3.8 of the hardware manual)

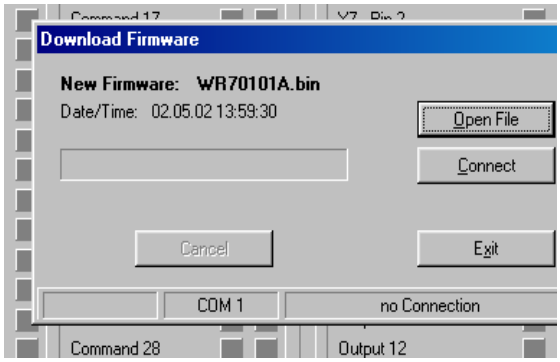


- Apply power to the controller and start the OS5.1 operator software. Select "Download Firmware" from the "File" menu.

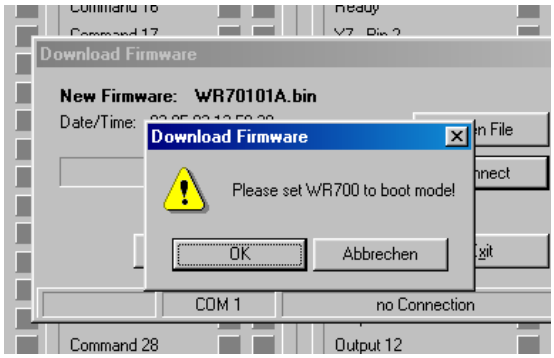


- The screen now indicates the firmware which is actually loaded to the unit, in general "WRBase.bin"



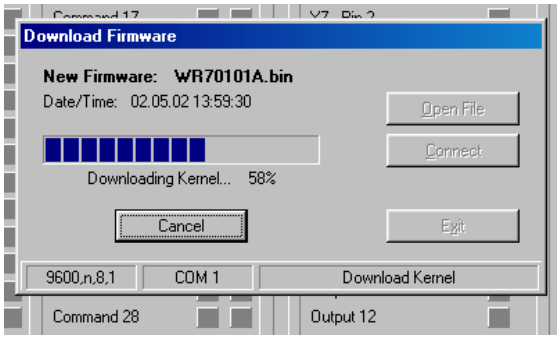


- Click to "Open File" and select drive and file name of the download firmware (e.g. WR70101a.ecr or WR70101a.bin).
- Then click to "Connect"

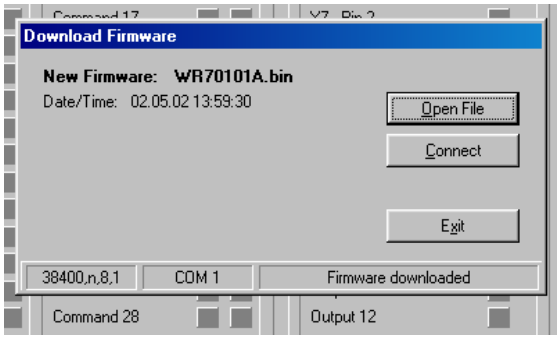


- The PC now requests you to set the controller to the “boot mode”. To do this, slide the front switch from the **Run** position to the **Program** position and push the Reset button located behind the front plate, by means of a pin

- Click „OK“ to start the download

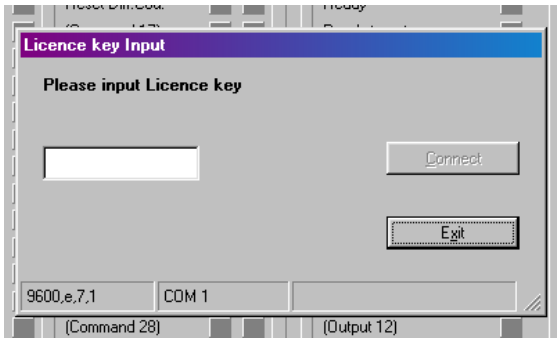


- The download uses several loading steps and the progress is displayed on the screen



- After successful download

a. click to “Exit”
b. slide the switch back to the “Run” position
c. activate the Reset button for new initialization of the controller

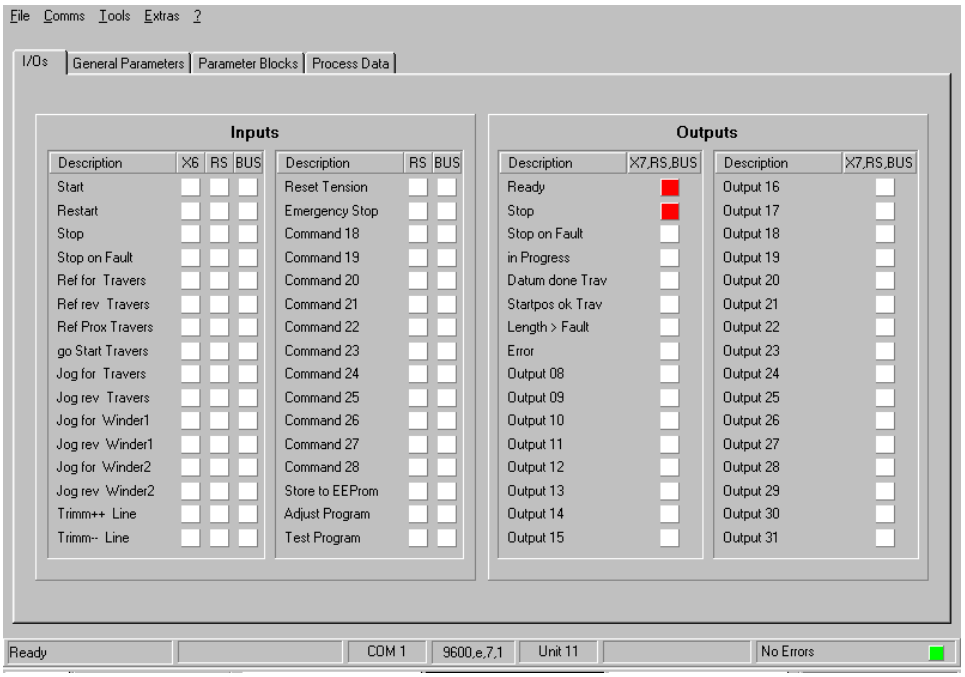


Finally, please enter the license key

a. Select „Input License Key“ from the "Files" menu
b. Enter the key code received from motrona
c. Click to „Connect“

4. How to Use the Operator Software

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



4.1. Digital Control Inputs

This register card shows the logical state of all digital inputs and outputs.

Inputs which are in use for the current application are marked with text, and unused inputs are marked with “Command” only.

Indicator boxes in the column marked “X6” shine blue, when the associated input signal on screw terminal strip X6 is HIGH. LOW state is white.

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 CANBUS. White box means again “signal off”. All input signals follow a logical “OR” conjunction and inputs are in “ON” state when one or several boxes shine blue.

On the connector plate of the MC700 hardware, the inputs are accessible via terminals “In1” to “In16” and the sequence from up to down corresponds to the same layout as visible on the PC screen.

Ser/Bus =	Activation by serial command or by Fieldbus only.
⌐ =	static operation at HIGH
↑ =	dynamic operation, rising edge
*) =	only when traverse control active

No.	Text	Function
In01 ↑	Start	Starts a winding cycle. At the same time, the internal length counter is reset to zero
In02 ↑	Restart	Restarts a winding cycle which has been interrupted. The internal length counter is not reset to zero
In03 ↑	Stop	Ramps all drives down to standstill
In04 ↑	Stop on Fault	Latches the actual length count and ramps all drives down to standstill. Allows to turn back the winder to the position where the fault occurred (example: insulation fault with a wire winding application)
In05 ↑	Ref. for. Traverse*)	Starts the traverse drive in forward direction until the rising edge of the reference switch is detected. Then reverses at slow speed, until the falling edge of the reference switch is detected again. Sets reference register to datum and indicates "Datum done"
In06 ↑	Ref. rev. Traverse*)	Fully similar to „In05", but all directions vice-versa.
In07 ⌐	Ref.prox. Traverse*)	Input for signal of a limit switch marking the reference position of the traverse.
In08 ↑	go Start Traverse*)	Moves the traverse drive from any actual position to the start position as defined
In09 ⌐	Jog for. Traverse*)	Moves the traverse drive in forward direction
In10 ⌐	Jog rev. Traverse*)	Moves the traverse drive in reverse direction
In11 ⌐	Jog for. Winder1	Moves the winder drive in forward direction
In12 ⌐	Jog rev. Winder1	Moves the winder drive in reverse direction
In13 ⌐	Jog for. Winder2	Moves the unwinder drive in forward direction
In14 ⌐	Jog rev. Winder2	Moves the unwinder drive in reverse direction
In15 ⌐	Trimm++ Line	Increases the speed of the line drive (if available) temporary, for the duration of the input, by a constant differential speed
In16 ⌐	Trimm- - Line	Decreases the speed of the line drive (if available) temporary, for the duration of the input, by a constant differential speed

No.	Text	Function
Ser Bus	Reset Tension	Switches off the control loop for the tension control
Ser Bus	Emergency Stop	Forces all drives to standstill, using the emergency stop ramp
Ser Bus	Store to EEProm	Stores all actual parameters and variables to the EEProm
Ser Bus	Adjust Program	Starts the Adjust program for testing and commissioning
Ser Bus	Test Program	Starts the Test program for testing and commissioning

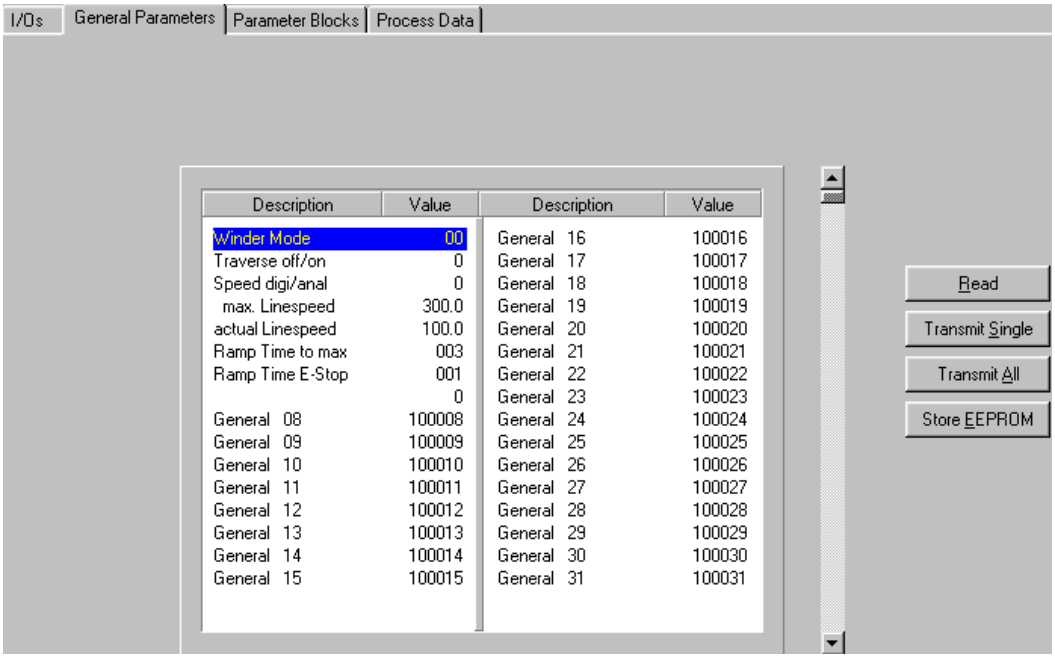
4.2. Digital Control Outputs:

Outputs which are in use for the current application are marked with a text, and unused outputs are marked with "output" only. The indicator box shines red when the corresponding output is HIGH, otherwise the box remains white. Outputs on the screen appear in the sequence of their mechanical layout on the connector panel

No.	Text	Function
Out1	Ready	Indicates that the unit is ready to work after power-up, initialization and self-test. This output, however, is not a guarantee for trouble-free operation of all functions.
Out2	Stop	Indicates that the machine is in Stop state. This, however, is not a guarantee that really all parts of the machine are in standstill.
Out3	Stop on Fault	Indicates that the machine has reached standstill after the controller received a signal on the „Fault stop" input (In4).
Out4	In progress	Indicates that the winding process is in progress
Out5	Datum done Trav	Indicates that the traverse drive has successfully concluded a referencing cycle and stored the datum position
Out6	Startpos. ok. Trav.	Indicates that the traverse drive is in its start position as defined.
Out7	Length >Fault	Serves to re-find the position where a fault in the material has been detected (input In4). This output switches from HIGH to LOW, when with reverse motion the faulty position has been reached again.
Out8	Error	Collective error output. Details about the error can be found by readout of the error register.

4.3. General Parameters

This register card requires a few settings of general nature, for definition of the desired application. Registers marked “General08” to “General31” are reserved for parameters with other applications, but not used with standard winding applications.



Text	Function
Winder Mode	Select one of 16 possible application modes (00 – 15, as described in detail later).
Traverse off/on	For applications with winding of cables or tapes, the controller provides also a traverse control function. 0 = traverse control off 1 = traverse control on
Speed digi / ana	When the controller should also control the line speed, there are two possibilities of setting: 0 = digital setting: Set the speed by either serial link (PC, operator terminal) or via CANBUS network or by keypad (MC720). 1 = Analog setting: Use a remote Analog signal (i.e. from a speed potentiometer) to set the speed. For Analog speed setting, the hardware uses always Analog input No.1 (i.e. terminals 1 and 3 of the Analog input connector when using a 0-10V voltage signal) Of course, the controller can also synchronize to the current speed of a remote feed-in process. In this case, no speed preset is necessary at all.

Text	Function
Max. Line speed	Setting of this maximum speed is necessary for proper scaling of all Analog outputs to provide a 0-10V speed reference to the drives. Speeds higher than this setting are out of the range of control. Range 000.0 - 999.9 meters/min.
Actual line speed	When digital speed preset has been selected, this register determines the actual production line speed. MC720 allows setting also by the own keypad, otherwise the register is accessible via serial link or CANBUS. Range 000.0 - 999.9 meters/min.
Ramp time to max	Ramp time for acceleration of the line from standstill to maximum speed, as defined above (or vice-versa). For production speeds lower than the maximum speed, the acceleration time becomes correspondingly shorter. Range 001 – 999 sec.
Ramp time E-stop	Ramp time for deceleration of the line from maximum speed to standstill in case of an emergency stop input signal. Range 000 – 999 sec. Setting to 000 results in a sudden jump of the speed reference signal to zero.

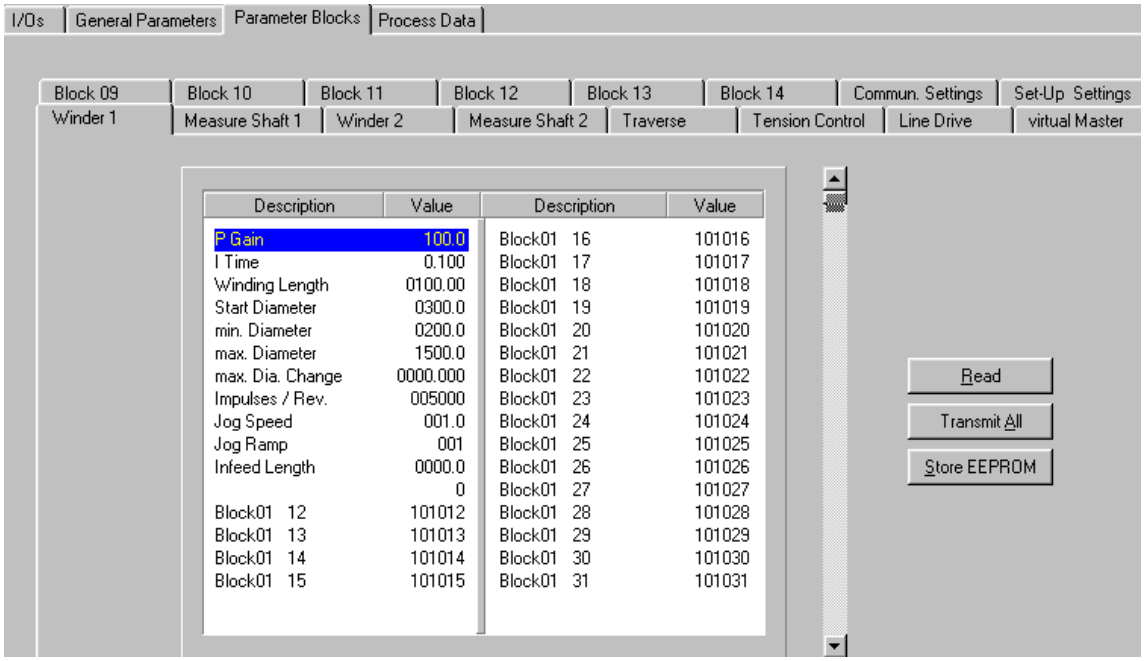
4.4. Parameter Blocks

This field contains individual blocks with specific parameters for every functional component used within the application. Used blocks and parameters are marked with texts like “Winder1” and “PGain”, and unused register cards or parameters are marked with “Block xx” and "Reserved" only.

Registers within a block must only be set, when this function is physically used with the actual application.

4.4.1. Winder1 (rewinder)

This block is reserved for rewinding always (if applicable), whereas the block "Winder2" always is responsible for unwinding, when required.



Text	Function
P-Gain	Proportional gain for the control loop of the winder drive speed with respect to the actual roll diameter. Range **000.0 – 999.9 %**
I-Time	Integration time constant for compensation of proportional errors. Setting 0.000 results in a fully proportional operation with no integration. The register is scaled to seconds. Range **0.001 - 9.999 seconds** (extremely fast - very slow).
Winding Length	Preset of the desired total winding length. Shortly before reaching the preset length, all drives ramp down to standstill and a digital output indicates that the preset length has been reached (spool completed). Setting 000 results in unlimited winding with no length control. Range **9999.99 meters.**
Start Diameter	Raw diameter of the empty spool or roll upon start of the winding process. This entry serves for immediate correct RPM after exchange of the spool. Range **0 – 9999.9 millimeters**
Min. Diameter	Preset of the smallest core diameter that ever will be used (i.e. when several types of spools are in use). The controller will calculate the absolute maximum RPM of the winder from this entry, and further on be unable to control rolls with a lower core diameter. Range **0 – 9999.9 mm**

Text	Function
Max. Diameter	Preset of the largest end diameter permitted to a spool. The controller calculates the total speed range for the winder drive from this entry. Range: **0 – 9999.9 mm**
Max. Dia Change	Filter to avoid jumps and jerks with the continuous diameter calculation. Jumps in diameter can be caused by mechanical effects, i.e. when a cable accidentally jumps from one layer to the next. This parameter defines how much the maximum change of diameter can be from one layer to the next. Mechanical failures will therefore be filtered and not affect the stability of the control loop. Range **0 – 9999.9 mm**
Impulses/rev.	Number of incremental impulses that the controller receives with one full revolution of the winding roll (from the roll encoder or an encoder simulation) Range **999 999 impulses/rev**
Jog speed	Rotary speed of the winding roll with a manual jog command. Range **000.0 – 999.9 %**
Jog ramp	Ramp time for acceleration to 100% jog speed with a remote jog command Rang **0 – 999 seconds**
Infeed Length	Serves for compensation of the material length needed at the beginning of a spool for Infeed. The Infeed length will be subtracted from the total winding length. Range **0 – 99.99 m**
U at min. Diameter	A analogue signal 0 – 10V at analogue input 3 for Winder1 (Winder2 = analogue input 4) can be used to preset the parameter "Start Diameter". This parameter represents the analogue voltage of the smallest diameter (ref. "Min. Diameter"). **Range 0 – 10.00V**
U at max. Diameter	This parameter represents the analogue voltage of the largest diameter (ref. "Max. Diameter"). **Range 0 – 10.00V**

When your application uses one of the tension control modes where the Winder drive is responsible to build up and keep the tension, it is important to set parameter "PGain" of "Winder 1" to 0.

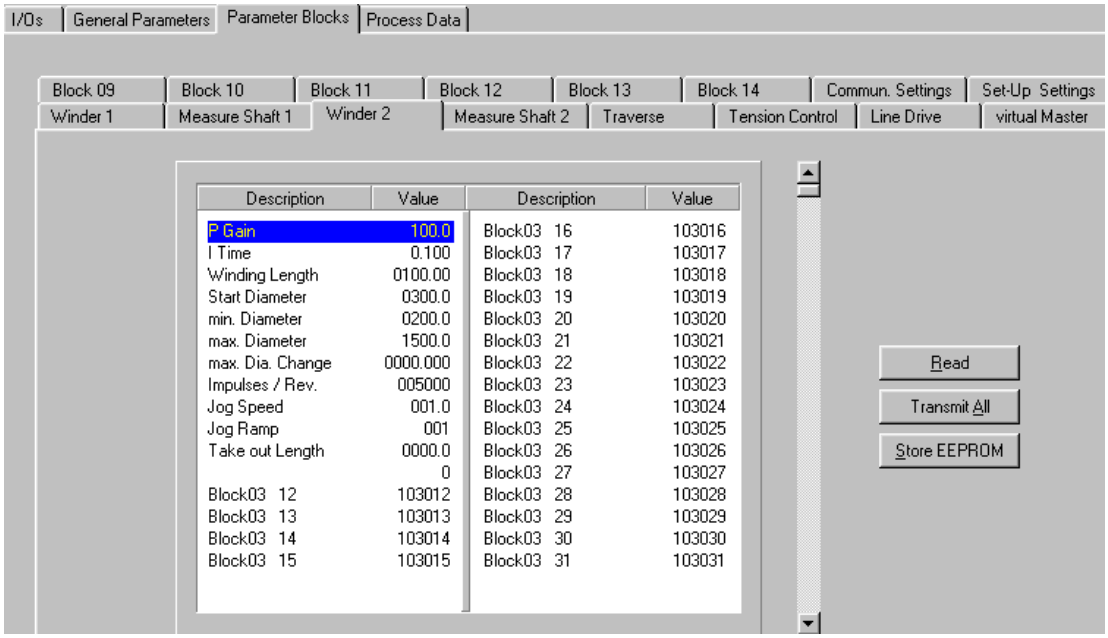
4.4.2. Measure shaft 1:

This register card defines the properties for measuring of the line speed and needs only two parameters:

Text	Function
Diameter	Diameter of the feed roll or the measuring wheel detecting the line speed. Range **0 – 9999,9 mm**
Impulses/rev.	Number of encoder increments of the line encoder (or an encoder simulation) for one revolution of the feed roll or the measuring wheel. Range **999 999 pulses/rev.**.

4.4.3. Winder 2 (Unwinder):

The Winder 2 register card is always used for the Unwinder. Since all parameters are fully similar to the Winder 1 card, they are not described here once more.



When your application uses one of the tension control modes where the Unwinder drive is responsible to build up and keep the tension, it is important to set parameter "PGain" of "Winder 2" to 0.

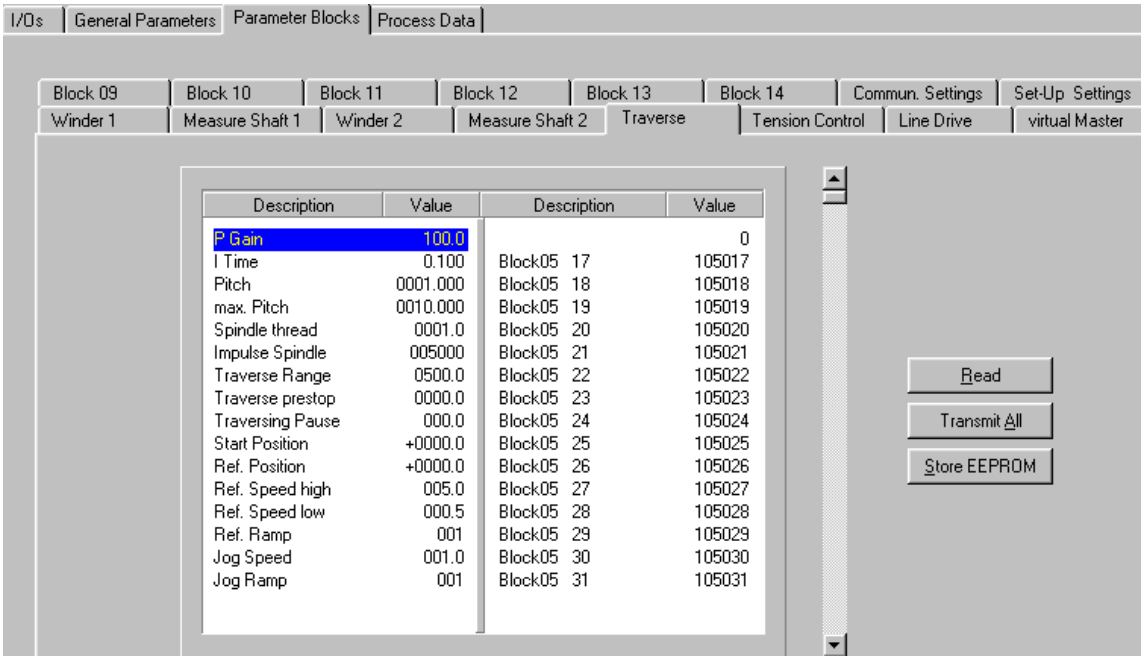
4.4.4. Measure Shaft 2:

Where two line measuring systems are applied (i.e. one before and one more after a dancer roll), this register card defines the details of the second measuring roll. All parameters are fully similar to Measure Shaft 1

4.4.5. Traverse:

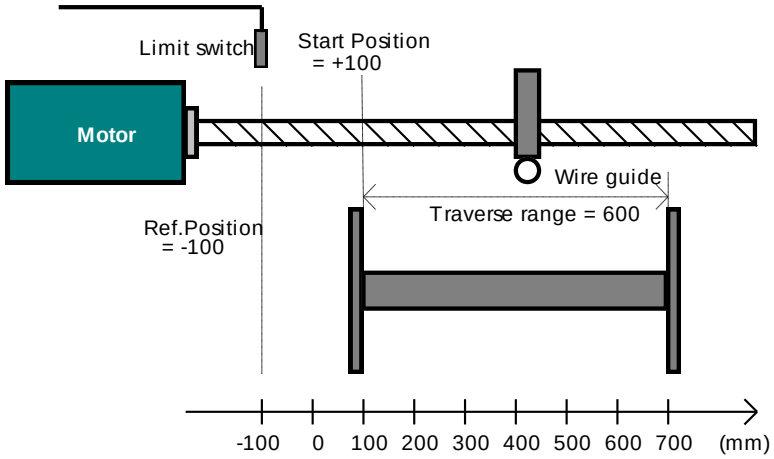
Sets the properties of the traverse drive (if available). Reversals occur by change of the polarity of the speed reference signal (+/- 10 V).

The traverse drive uses always Analog output No.4
(terminals 7 and 8 of the "Ana.Out" connector)



Text	Function
PGain	Proportional Gain of the control loop of the traverse drive. Range **0 – 999.9 %**
I-Time	Integration time to compensate for proportional errors on the traverse. With setting 0.000 all integration is switched off (proportional control only) Range **0.001 – 9.999 seconds** (extremely fast – very slow)
Pitch	traverse pitch width for one revolution of the winding roll, or cable diameter Range **0 – 999.999 mm**
max. Pitch	Maximal pitch width coming up in production. This entry is used to calculate the maximum speed of the traverse drive. Range **0 – 999.999 mm**
Spindle thread	Pitch of the screw moving the traverse support Range **0 – 999.999 mm**
Impulse spindle	Number of incremental encoder pulses for one revolution of the traverse screw. Range **999 999 impulses**

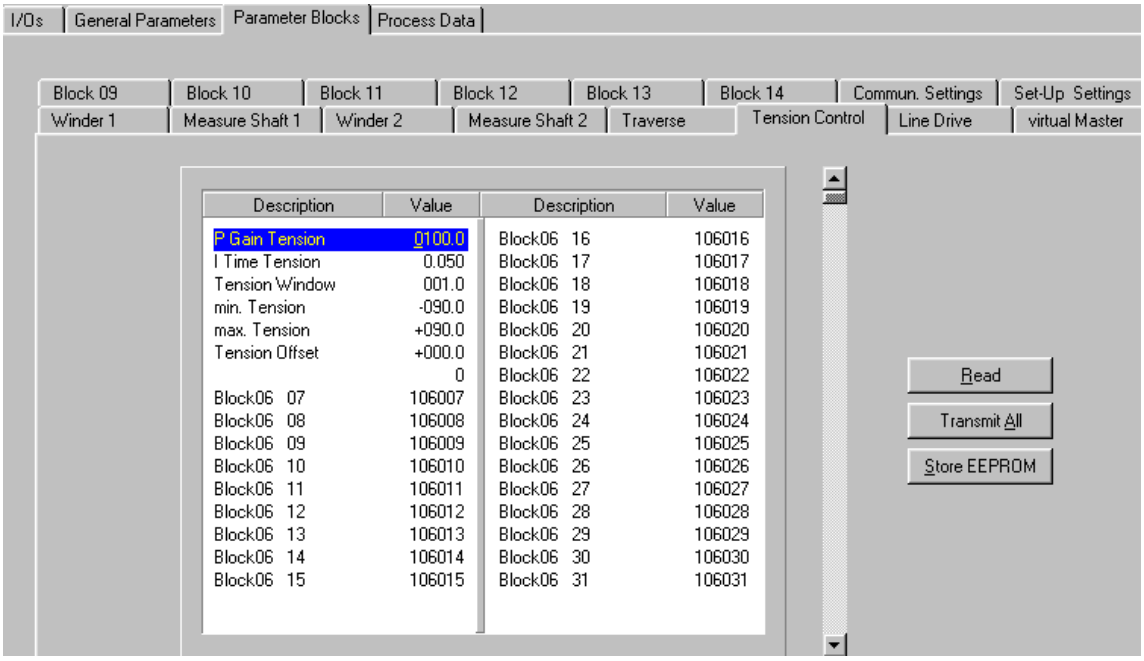
Text	Function
Traverse Range	Total traveling distance or inner spool width Range **0 – 9999.9mm**
Traverse Prestop	Pre-stop position for reversals. Example: when you set Traverse Range to 1000 mm and Traverse Prestop to 5 mm, the drive will reverse at the positions 5mm and 995 mm. Range **0 – 9999.9 mm**
Traversing Pause	Break, standstill of the traverse drive in the reversal positions for a defined angular displacement of the spool. Range **0 – 999.9°** (360° = 1 revolution)
Start position	Position, where the traveling range of the traverse starts (with respect to the reference position, see drawing) Range **+/- 9999.9 mm**
Ref. position	Position marked by a limit switch for referencing of the traverse positions (see drawing). Range **+/- 9999.9 mm**



Text	Function
Ref. Speed high	High speed used by the drive, while moving into the direction of the limit switch after a referencing command. Range **0 – 999.9 %**
Ref. Speed low	Low speed used by the drive, after finding the limit switch, to search for the reference position (falling edge) in reverse direction. Range **0 – 999.9 %**
Ref. Ramp	Ramp time used for acceleration and deceleration with high reference speed. Range **0 – 999 sec**.
Jog Speed	Traverse speed with operation of the Jog command. Range **0 – 999.9 %**
Jog Ramp	Ramp time for acceleration and deceleration with Jog command. Range **0 – 999 sec.**

4.4.6. Tension Control:

This register card defines the basic properties of the tension control. As a feedback, an Analog signal (voltage or current) proportional to the real tension must be applied to Analog input No. 2 (terminals 5 - 8 of the "Ana.In" connector)

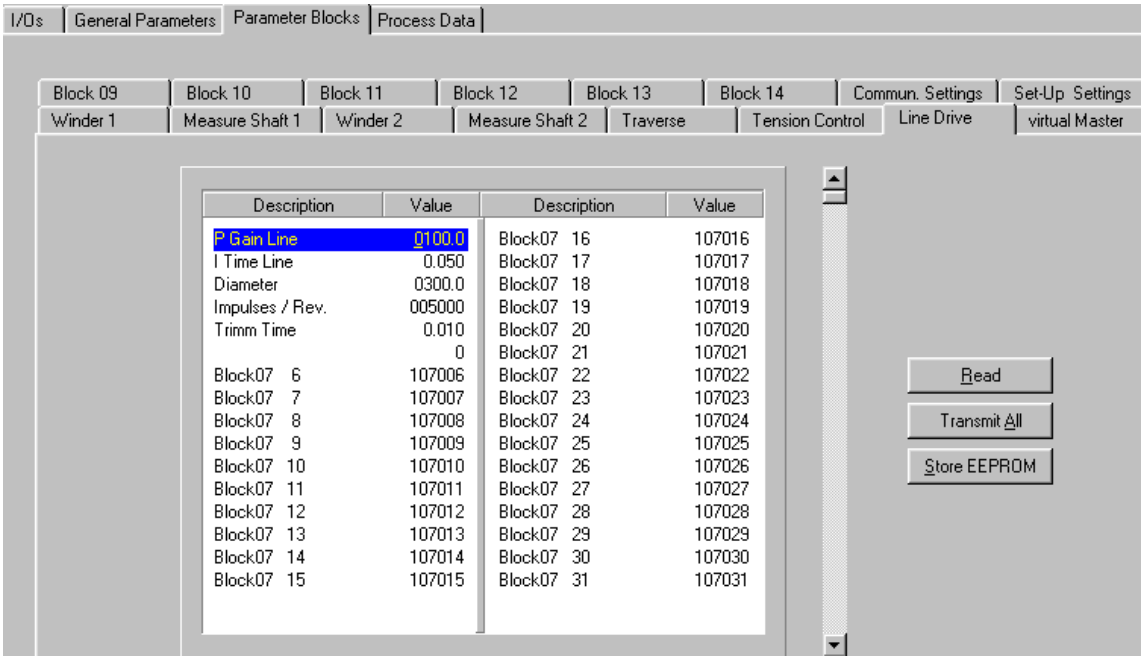


Text	Function
P Gain Tension	Proportional gain of the internal tension control loop. Range **0 – 999.9 %**
I Time Tension	Integration time to compensate for proportional errors. With setting 0.000 all integration is switched off (proportional control only) Range **0.001 – 9.999 seconds** (extremely fast – very slow)
Tension Window	Tolerance window where the real tension is allowed to swing without immediate response of the controller. Serves for stabilization of the control loop. Range **0 – 999.9 %**
min. Tension max. Tension	Presets to activate an alarm output when these levels are underpassed or exceeded. Range **+/- 100%** of the Analog feedback
Tension Offset	Defines the desired tension value in percent of the feedback signal. When, i.e., a signal of 0-20 mA is available for tensions of 0 – 5 N, setting of 50% will tune the control loop for a tension of 2.5 N. Range **+/- 100,0%**
P Gain min. Diameter	Proportional gain can also be scaled by the actual measured diameter. This parameter represents the proportional gain at the smallest diameter (ref. "Min. Diameter"). Range **0 – 999.9 %**
P Gain max. Diameter	This parameter represents the proportional gain at the largest diameter (ref. "Max. Diameter"). Range **0 – 999.9 %**

When your application uses one of the tension control modes, it is important to set parameter "PGain" of that drive to 0 which is responsible to build up and control the tension.

4.4.7. Line Drive:

This register card defines the properties of a line drive involved into the system, with applications where an infeed motor or an outfeed motor is needed.



Text	Function
P Gain Line	Proportional gain for the control loop of the line drive. Range **0 – 999.9 %**
I Time Line	Integration time to compensate for proportional errors. With setting 0.000 all integration is switched off (proportional control only) Range **0.001 – 9.999 second**s (extremely fast – very slow)
Diameter	Diameter of the feed roll. Range **0 – 9999.9 mm**
Impulses/rev.	Number of incremental encoder pulses for one revolution of the feed roll. Range **999 999 impulses**
Trim Time	Sets the differential speed that is added or subtracted to the line speed upon activation of a Trim command. Range **0.001 sec/inc. – 9.999 sec./inc.** (very fast – very slow)

When your application uses one of the tension control modes where the line drive is responsible to build up and keep the tension, it is important to set parameter "PGain" of "Line Drive" to 0.

4.4.8. Virtual Master:

Some of the applications shown later use a virtual Master instead of a physical Master, and all drives operate as Slaves.

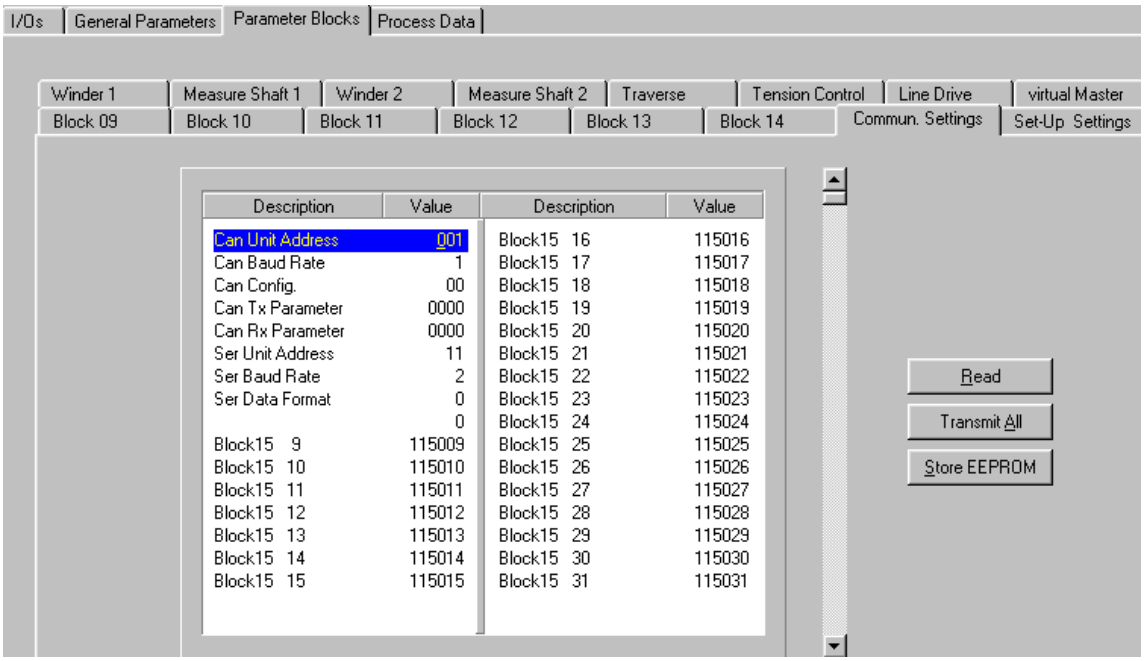
Parameters shown on this register card are for factory setting purpose only and must not be changed by the customer!

4.4.9. 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 **CI150**, which is available on our homepage or on our CD-ROM

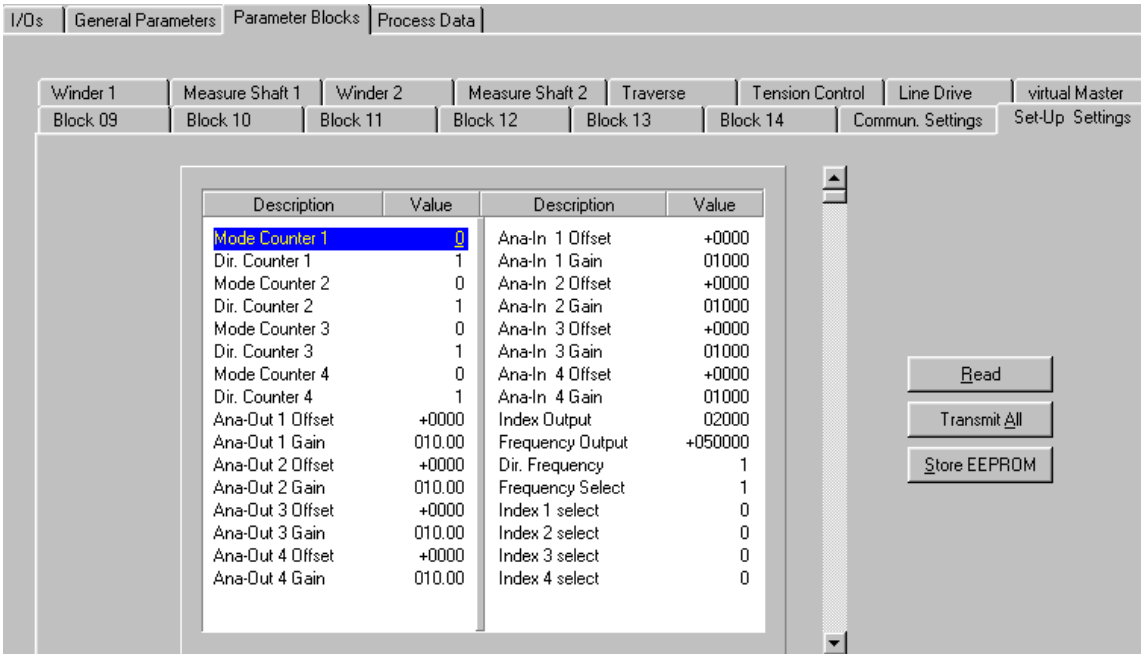
The serial link uses the following parameters:

<table>
<tr><th>Text</th><th>Description</th></tr>
<tr><td>Unit Address:</td><td>Unit address: You can use addresses between 11 and 99. However, you must not use address numbers containing a “zero” like 03, 30, 40 etc. because these are reserved for collective addressing of several units.
Factory setting: 11</td></tr>
<tr><td>Ser. Baud Rate</td><td>Serial communication speed:
0: 38400 Bit/s
1: 19200 Bit/s
2: 9600 Bit/s
3: 4800 Bit/s
4: 2400 Bit/s
Factory setting = 2</td></tr>
<tr><td>Serial Data Format:</td><td>
<table>
<tr><th>Setting</th><th>Data bits</th><th>Parity</th><th>Stop bits</th></tr>
<tr><td>0</td><td>7</td><td>even</td><td>1</td></tr>
<tr><td>1</td><td>7</td><td>even</td><td>2</td></tr>
<tr><td>2</td><td>7</td><td>odd</td><td>1</td></tr>
<tr><td>3</td><td>7</td><td>odd</td><td>2</td></tr>
<tr><td>4</td><td>7</td><td>none</td><td>1</td></tr>
<tr><td>5</td><td>7</td><td>none</td><td>2</td></tr>
<tr><td>6</td><td>8</td><td>even</td><td>1</td></tr>
<tr><td>7</td><td>8</td><td>odd</td><td>1</td></tr>
<tr><td>8</td><td>8</td><td>none</td><td>1</td></tr>
<tr><td>9</td><td>8</td><td>none</td><td>2</td></tr>
</table>
Factory setting = 0</td></tr>
</table>



4.4.10. Setup Settings:

These settings define all important properties of inputs and outputs:



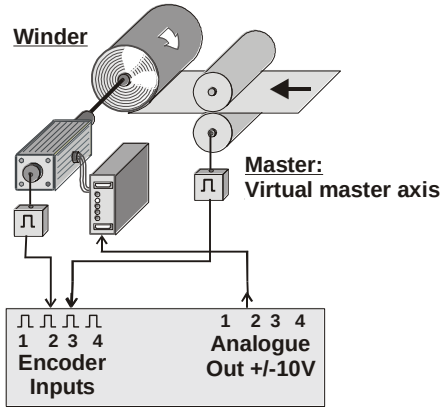
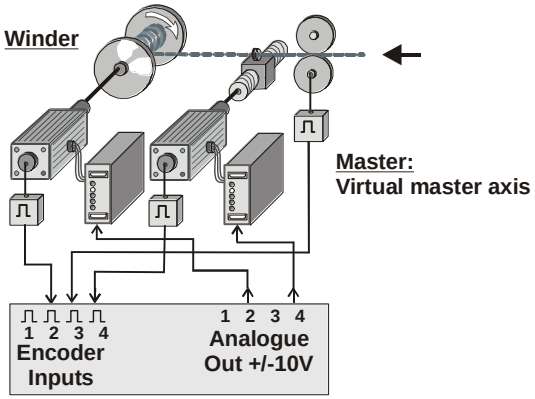
Text	Description
Mode Counter (1–4)	Determines the number of edges counted from the four incremental encoder inputs: 0 = (x1), 1 = (x2) 2 = (x4)
Dir. Counter (1–4)	Assigns a counting direction (up / down) to the corresponding encoder input, depending on the quadrature A/B phase displacement. These parameters 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 Analog output. This parameter uses a numeric range from – 2047 ... 0000 ... +2047 corresponding to --100% ... 0000 ... +100% full scale output.
Ana-Out Gain (1-4)	Sets the full scale output of the corresponding Analog output, directly in volts. 0 – 10,00 means 0 – 10 volts or 20 mA
Ana-In Offset (1-4)	Sets the zero position of the corresponding Analog input. This parameter uses a numeric range from – 2047 ... 0000 ... +2047 corresponding to --100% ... 0000 ... +100% full scale input.
Ana-In Gain (1-4)	Scales the corresponding Analog input with respect to a full scale signal (1V or 10V or 20mA, depending on input terminal used). Setting 1000 causes the controller to read 1000 when a full scale signal is applied to the input.
Index output	This and all following parameters remain unused with application of this firmware.

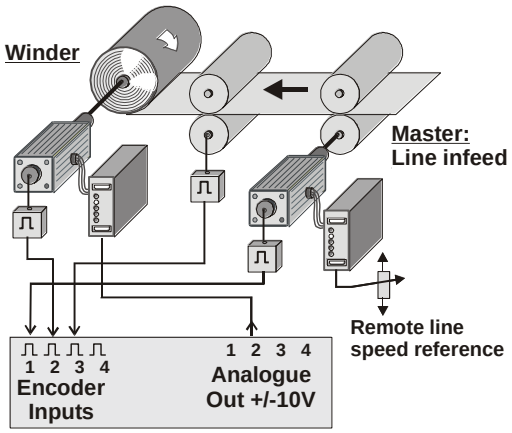
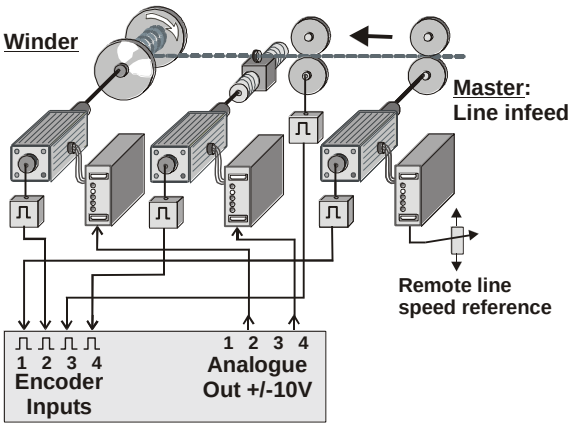
5. Possible Applications

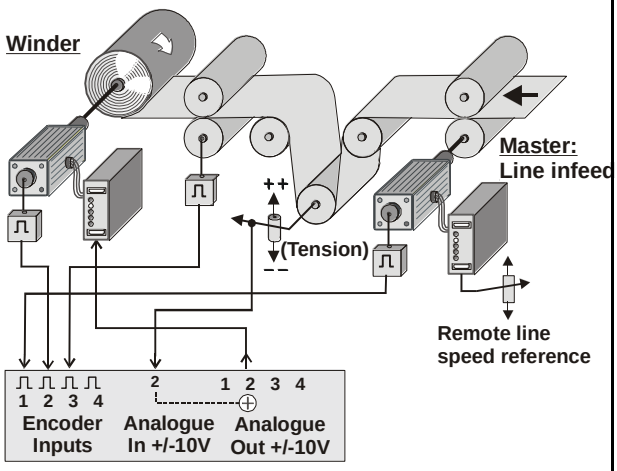
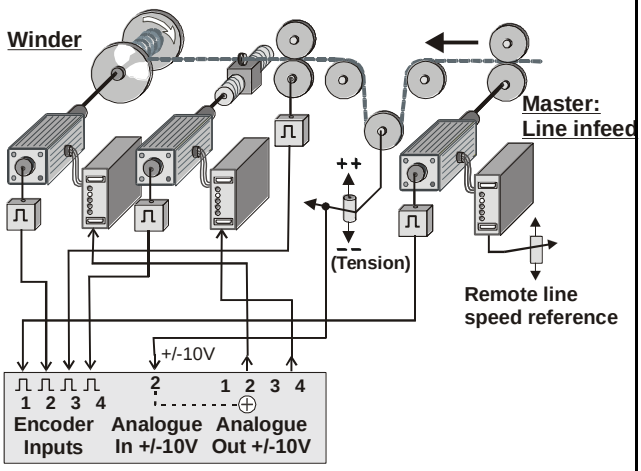
The subsequent drawings and short form indications show the possible applications. You can also see which hardware connections must be made and which register cards must be used for set up and commissioning.

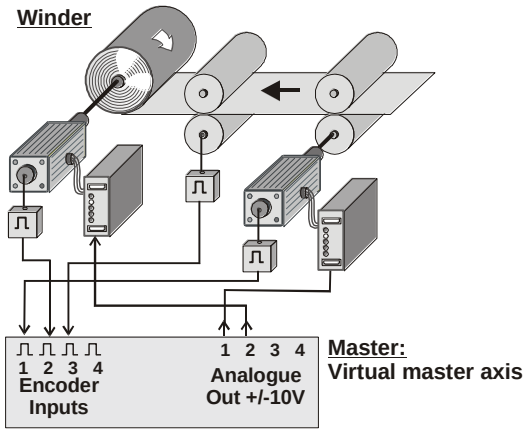
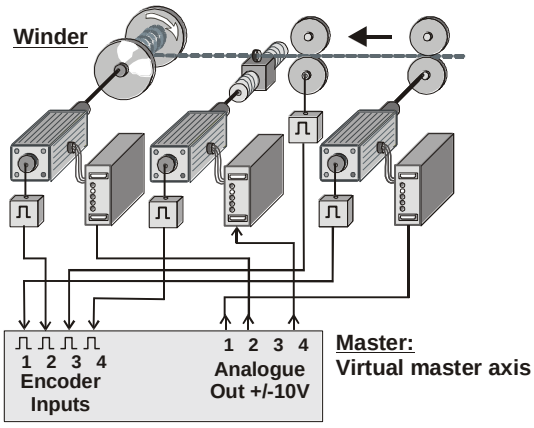
You are always free to use only parts of the functions shown in the drawings, and to omit unused components. If, i.e., you like to have a pure traverse control only, you can use Mode1 and connect only encoder 2, encoder 4 and output 4

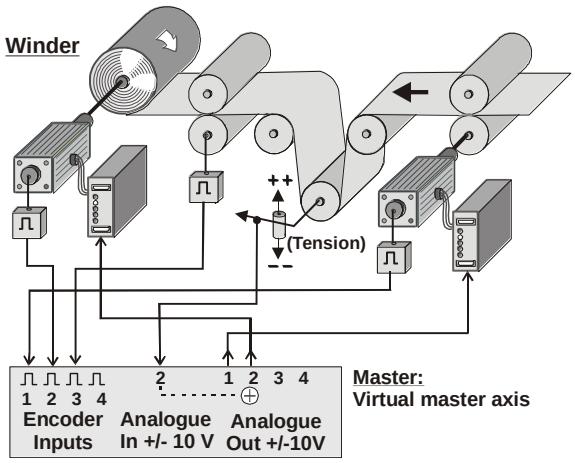
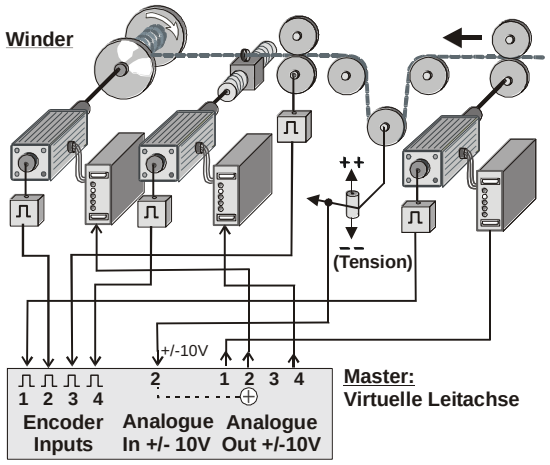
In case of any questions, please contact our technical support staff.

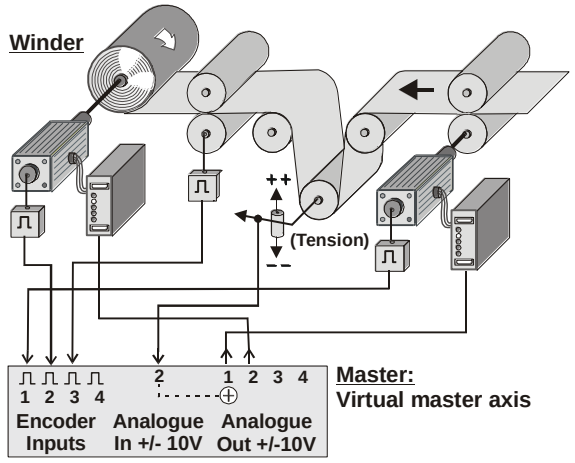
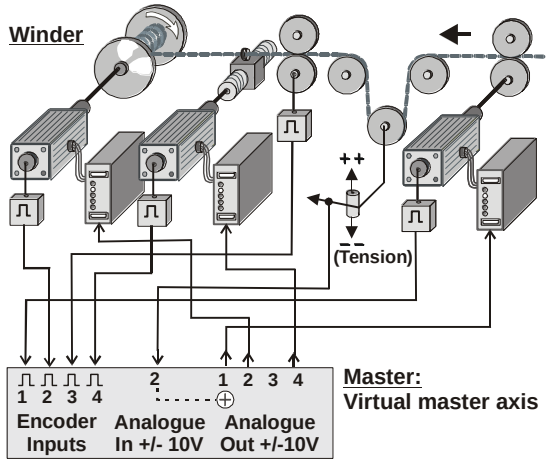
Mode 0 without Traverse		**Mode 0** with Traverse	
			
Encoder 1		Analog Out 1	
Encoder 2	Winder1	Analog Out 2	Winder1
Encoder 3	Measure Shaft 1	Analog Out 3	
Encoder 4	Traverse	Analog Out 4	Traverse

Mode 1 without Traverse		**Mode 1** with Traverse	
			
Encoder 1	Line or Measuring Wheel	Analog Out 1	
Encoder 2	Winder1	Analog Out 2	Winder1
Encoder 3	Measure Shaft 1	Analog Out 3	
Encoder 4	Traverse	Analog Out 4	Traverse

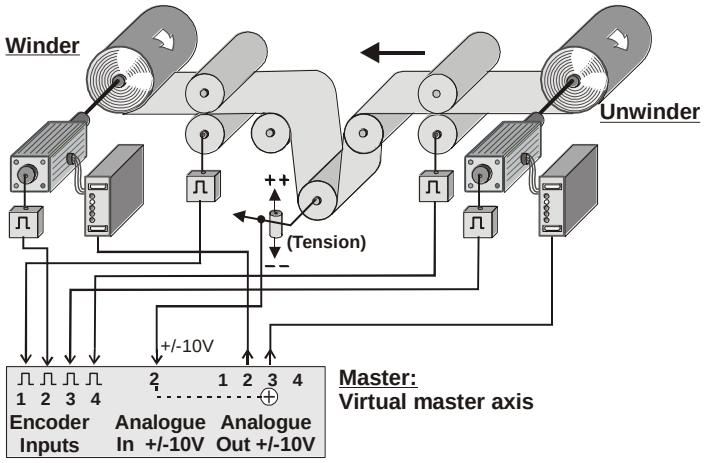
Mode 2 without Traverse		**Mode 2** with Traverse	
			
Encoder 1	Line or Measuring Wheel	Analog Out 1	
Encoder 2	Winder1	Analog Out 2	Winder1 + Tension
Encoder 3	Measure Shaft 1	Analog Out 3	
Encoder 4	Traverse	Analog Out 4	Traverse

Mode 3 without Traverse		**Mode 3** with Traverse	
			
Encoder 1	Line	Analog Out 1	Line
Encoder 2	Winder1	Analog Out 2	Winder1
Encoder 3	Measure Shaft 1	Analog Out 3	
Encoder 4	Traverse	Analog Out 4	Traverse

Mode 4 without Traverse		**Mode 4** with Traverse	
			
Encoder 1	Line	Analog Out 1	Line
Encoder 2	Winder1	Analog Out 2	Winder1 + Tension
Encoder 3	Measure Shaft 1	Analog Out 3	
Encoder 4	Traverse	Analog Out 4	Traverse

Mode 5 without Traverse		**Mode 5** with Traverse	
			
Encoder 1	Line	Analog Out 1	Line + Tension
Encoder 2	Winder1	Analog Out 2	Winder1
Encoder 3	Measure Shaft 1	Analog Out 3	
Encoder 4	Traverse	Analog Out 4	Traverse

Mode 6 (no Traverse possible)

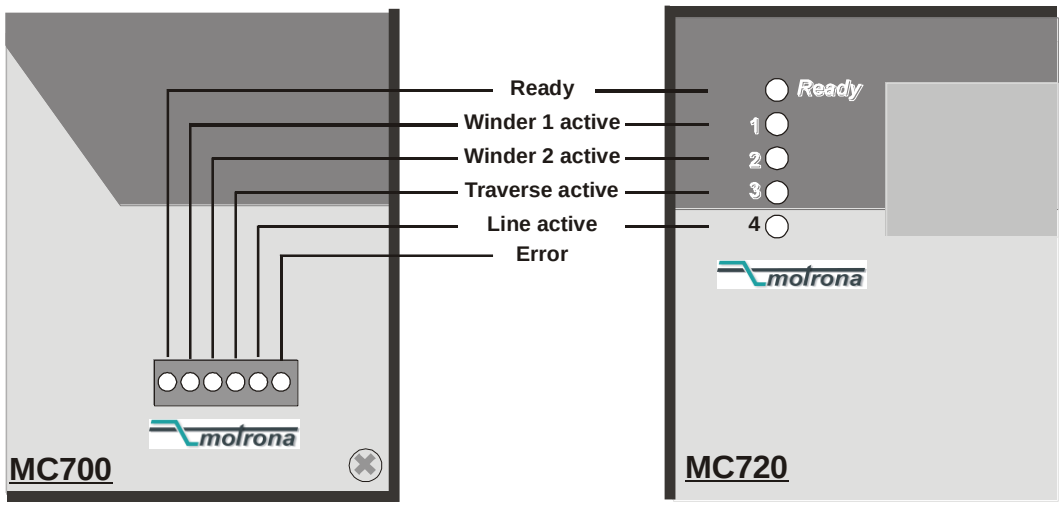


Encoder 1	Measure Shaft 1	Analog Out 1	
Encoder 2	Winder1	Analog Out 2	Winder1
Encoder 3	Winder2	Analog Out 3	Winder2 + Tension
Encoder 4	Measure Shaft 2	Analog Out 4	

Many of the applications shown previously will also work in reverse direction (i.e. "Unwinding" instead of "Rewinding").

However, to ensure that your Unwinding application will really function fine, we strongly recommend to agree application details with our technical support!

6. Function of the LED Indicators

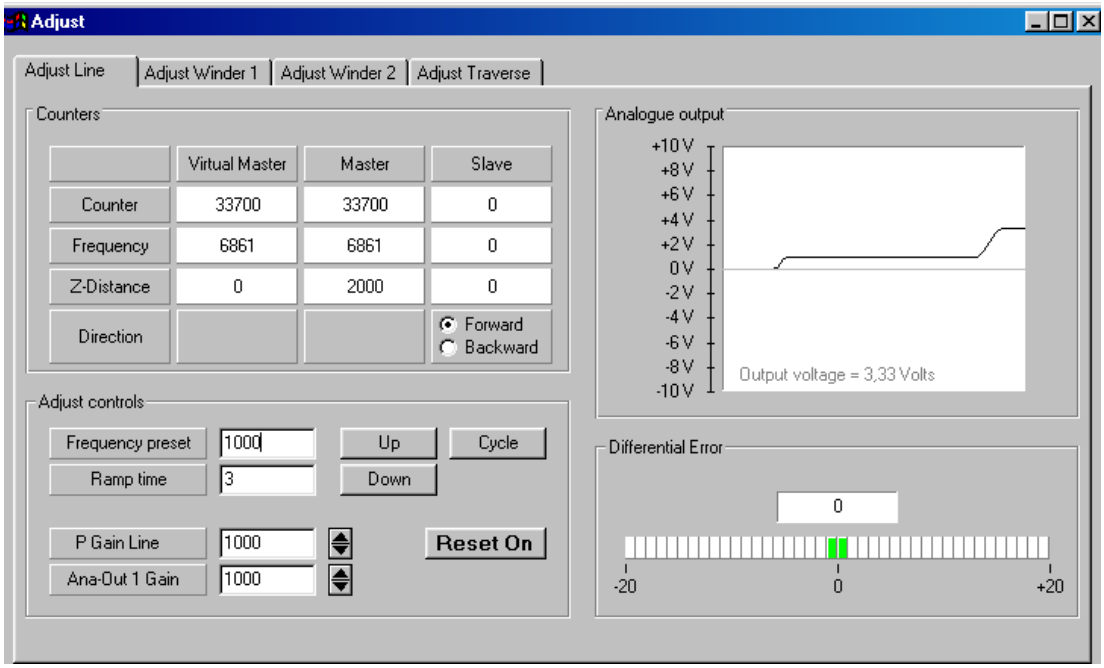


7. Steps for Commissioning

For setup and commissioning of all drives, the „Adjust“ menu is available under „Tools“ in the main menu of the screen.

The essential steps are to assign the proper direction of rotation to every encoder, to scale the Analog outputs with respect to the speed reference inputs of the drives and to tune the proportional gains for all control loops.

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 “Int.Time” to 000)



The Adjust Menu provides a choice between the drives „Line“, Winder1“, „Winder2“ and „Traverse“. You must only adjust the drives which are physically used with your application. The Adjust Program uses the virtual master axis and treats all drives as Slaves during the tuning process, independent of the later configuration and application. Only the drive which actually is selected will move, and all other drives remain in standstill.

Please proceed as follows: *see next page*

7.1. Presets

Set the desired testing speed to the window marked "Frequency Preset". The drives will move with this speed and setting is directly in meters/min with one decimal position. We recommend using a slow speed like 10 – 20 % of the maximum speed for tuning.

Example: Setting of 200 will use a speed of 20.0 meters/min for the tuning procedure.

- Set also a ramp time to the corresponding window. This ramp will be used for acceleration and deceleration during the adjusting procedure.
- Both windows, "P Gain" and "Ana-Out Gain" should read 1000 at this time.

Click to „Up" and the selected drive will start to move. In the column "Slave" you can see a counter and a frequency meter from the encoder feedback, and also the distance of marker pulses where applicable.

7.2. Direction of Rotation

- It is a must that the "Counter" in the "Slave" column counts upwards (increments) with a positive sign.
  Where you find it counts down or to negative, please click to the other direction box (Forward or Reverse) to force upwards count.
- When we count up, click to the "Down" key to stop the drive again. The definition of direction of rotation has been stored now to the unit.

7.3. Tuning the Analog 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 color bar and the differential counter in the field "Differential Error". There are the following two options:

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

b) The bar graph moves to the left and the counter counts down (-): The Analog output is too high. Please decrease the setting of "Ana-Out Gain" by overtyping the figures or by scrolling with the DOWN key.

"Ana-Out Gain" is set correctly when the bar graph remains in it's green/yellow center position and the differential counter swings around zero (i.e. +/-8)

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, the setting therefore should be as high as possible. However, depending on dynamics and inertia of the whole system, too high gain values can produce stability problems.

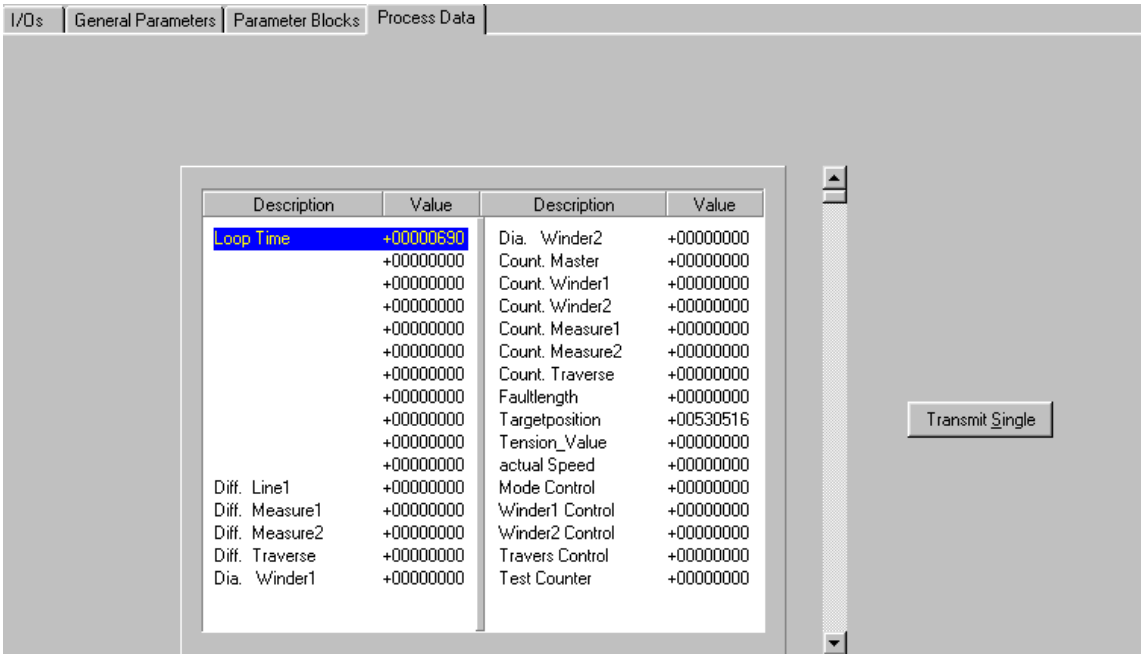
Please try to increase the setting from 1000 to 1500, 2000 etc. As soon as you find unsteady operation, noise or oscillation, you must reduce the setting again correspondingly.

We also recommend to use the automatic “Cycle” function for observations about stability. When clicking to this key, the drive will continuously ramp up and down while you can observe the color bar and the differential counter.

Once you have done these steps for all drives connected to the controller, your machine is basically ready for operation.

8. 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 (00 – 31) are updated continuously.



9. Hints for Type MC720 with Integrated Operator Terminal

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

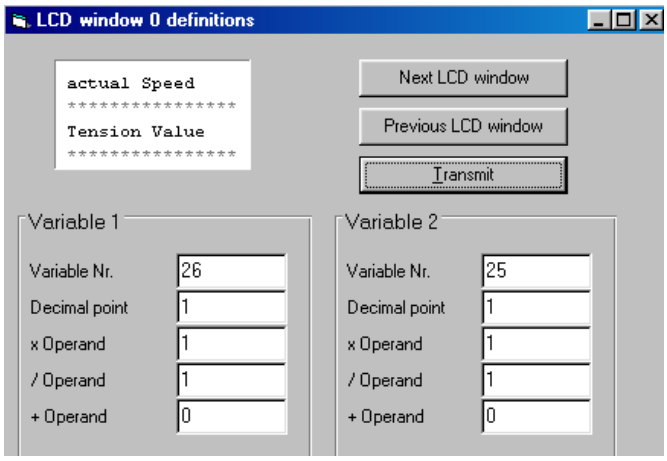
9.1. Setting of parameters and registers

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 7 of this manual, all keypad and LCD operations should be self-explaining.

9.2. Display of actual process values

During normal production, you can use the LCD for display of interesting actual values like roll diameters, line speed etc. 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 head line menu.



- There are totally 4 LCD windows accessible (0 – 3) and the actual window number appears in the blue head line. To change from one window to another, use the keys "Next LCD window" or "Previous LCD window".

- Each window allows to display two actual values with two text comments. The line with asterisk ******* 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)
- **Variable Nr:** 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 of section 8.
- **Decimal point:** Defines the position where a decimal point should appear on the LCD display (0=no decimal point)
- **xOperand, /Operand, +Operand:** 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

The keypad of MC 720 controllers allows to modify parameter settings with the machine in standstill only!

For any changes "on the fly" while the machine is running, you must use serial communication (by PC, PLC or remote operator terminal), or change the settings via Fieldbus (CANBUS, PROFIBUS).

10. Parameter Tables

Parameter table “General Settings”

Text	Units	Format	Ser. Code	Minimum	Maximum	Default
"Winder Mode "	-	xx	! 0000	00	15	0
"Traverse on/off"	-	x	! 0001	0	1	0
"Speed digi/anal "	-	x	! 0002	0	1	0
" max. Linespeed"	m/min	xxx.x	! 0003	0.1	999.9	300.0
"actual Linespeed"	m/min	xxx.x	! 0004	0.0	999.9	1000
"Ramp Time to max"	sec.	xxx	! 0005	1	999	3
"Ramp Time E-Stop"	sec.	xxx	! 0006	0	999	1

Parameter table “Winder1”

Text	Units	Format	Ser. Code	Minimum	Maximum	Default
"P Gain "	%	xxx.x	! 0100	0.0	999.9	100.0
"I Time "	sec.	x.xxx	! 0101	0.000	9.999	0.100
“Winding Length”	m	xxxx.xx	! 0102	0.00	9999.99	100.00
"Start Diameter "	mm	xxxx.x	! 0103	0.1	9999.9	300.0
"min. Diameter "	mm	xxxx.x	! 0104	0.1	9999.9	2000.0
"max. Diameter "	mm	xxxx.x	! 0105	0.1	9999.9	1500.0
"max. Dia. Change"	mm	xxxx.x	! 0106	0.0	9999.9	0.0
"Impulses / Rev. "	Impulse	xxxxxx	! 0107	1	999999	5000
"Jog Speed "	%	xxx.x	! 0108	0.1	100.0	1.0
"Jog Ramp "	sec.	xxx	! 0109	0.1	999	1

Parameter table “Measure Shaft 1”

Text	Units	Format	Ser. Code	Minimum	Maximum	Default
"Diameter "	mm	xxxx.x	! 0120	0.1	9999.9	300.0
"Impulses / Rev. "	Impulse	xxxxxx	! 0121	1	999999	5000

Parameter table “Winder2”

Text	Units	Format	Ser. Code	Minimum	Maximum	Default
"P Gain "	%	xxx.x	! 0140	0.0	999.9	100.0
"I Time "	sec.	x.xxx	! 0141	0.000	9.999	0.100
"Winding Length "	m	xxxx.xx	! 0142	0.00	9999.99	100.00
"Start Diameter "	mm	xxxx.x	! 0143	0.1	9999.9	300.0
"Start Diameter "	mm	xxxx.x	! 0144	0.1	9999.9	200.0
"max. Diameter "	mm	xxxx.x	! 0145	0.1	9999.9	1500.0
"max. Dia. Change,	mm	xxxx.x	! 0146	0.0	9999.9	0.0
"Impulses / Rev. "	Impulse	xxxxxx	! 0147	1	999999	5000
"Jog Speed "	%	xxx.x	! 0148	0.1	100.0	1.0
"Jog Ramp "	sec.	xxx	! 0149	1	999	1

Parameter table “Measure Shaft 2”

Text	Units	Format	Ser. Code	Minimum	Maximum	Default
"Diameter "	mm	xxxx.x	! 0160	0.1	9999.9	300.0
"Impulses / Rev. "	Impulse	xxxxxx	! 0161	1	999999	5000

Parameter table “Traverse”

Text	Units	Format	Ser. Code	Minimum	Maximum	Default
"P Gain "	%	xxx.x	! 0180	0.0	999.9	100.0
"I Time "	sec.	x.xxx	! 0181	0.000	9.999	0.100
"Pitch "	mm	xxxx.x	! 0182	0.1	9999.9	1.0
"max. Pitch "	mm	xxxx.x	! 0183	0.1	9999.9	10.0
"Spindle thread "	mm	xxxx.x	! 0184	0.1	9999.9	10
"Impulse Spindle "	Impulse	xxxxxx	! 0185	1	999999	5000
"Traverse Range "	mm	xxxx.x	! 0186	0.1	9999.9	500.0
"Traverse prestop"	mm	xxxx.x	! 0187	0.0	9999.9	0.0
"Traversing Pause"	Grad	xxx.x	! 0188	0.0	999.9	0.0
"Start Position "	mm	+/-xxxxx.x	! 0189	-9999.9	9999.9	0.0
"Ref. Position "	mm	+/-xxxxx.x	! 018A	-9999.9	9999.9	0.0
"Ref. Speed high "	%	xxx.x	! 018B	0.1	100.0	5.0
"Ref. Speed low "	sec.	xxx.x	! 018C	0.1	100.0	0.5
"Ref. Ramp "	%	xxx	! 018D	1	999	1
"Jog Speed "	sec.	xxx.x	! 018E	0.1	100.0	1.0
“Jog Ramp "		xxx	! 018F	1	999	1

Parameter table “Tension Control”

Text	Units	Format	Ser. Code	Minimum	Maximum	Default
"P Gain Tension "	%	xxxx.x	! 01A0	0.0	9999.9	100.0
"I Time Tension "	sec.	x.xxx	! 01A1	0.000	9.999	0.050
"Tension Window "	%	xxx.x	! 01A2	0.0	9.999	1.0
"min. Tension "	%	+/-xxx.x	! 01A3	-999.9	+999.9	-90.0
"max. Tension "	%	+/-xxx.x	! 01A4	-999.9	+999.9	90.0
"Tension Offset "	%	+/-xxx.x	! 01A5	-999.9	+999.9	0.0

Parameter table “Line Drive”

Text	Units	Format	Ser. Code	Minimum	Maximum	Default
"P Gain Line "	%	xxxx.x	! 01C0	0.0	9999.9	100.0
"I Time Line "	sec.	x.xxx	! 01C1	0.000	9.999	0.050
"Diameter "	mm	xxxx.x	! 01C2	0.1	9999.9	300.0
"Impulses / Rev. "	Impulse	xxxxxx	! 01C3	1	999999	5000

Parameter table “Communication Settings”

Text	Units	Format	Ser. Code	Minimum	Maximum	Default
"Can Unit Address"	-	xxx	! 02C0	1	127	1
"Can Baud Rate "	-	x	! 02C1	0	7	1
"Can Config. "	-	xx	! 02C2	0	99	0
"Can Tx Parameter"	-	xxxx	! 02C3	0	4095	0
"Can Tx Parameter"	-	xxxx	! 02C4	0	4095	0
"Ser Unit Address"	-	xx	! 02C5	11	99	11
"Ser Baud Rate "	-	x	! 02C6	0	4	2
"Ser data Format "	-	x	! 02C7	0	9	0

Table “Status Words”

Status name	Ser. Code
extern Commands	!0B00
serial Commands	!0B01
Bus Commands	!0B02
all Commands	!0B03
Output set	!0B04
Error Status	!0B05

Parameter table “Setup Settings”

Text	Units	Format	Ser. Code	Minimum	Maximum	Default
"Mode Counter 1"	-	x	! 02E0	0	2	0
"Dir. Counter 1"	-	x	! 02E1	0	1	1
"Mode Counter 2"	-	x	! 02E2	0	2	0
"Dir. Counter 2"	-	x	! 02E3	0	1	1
"Mode Counter 3"	-	x	! 02E4	0	2	0
"Dir. Counter 3"	-	x	! 02E5	0	1	1
"Mode Counter 4"	-	x	! 02E6	0	2	0
"Dir. Counter 4"	-	x	! 02E7	0	1	1
"Ana-Out 1 Offset"	Inkrement	+/-xxxx	! 02E8	-9999	9999	0
"Ana-Out 1 Gain "	V	xxx.xx	! 02E9	0.00	999.99	10.00
"Ana-Out 2 Offset"	Inkrement	+/-xxxx	! 02EA	-9999	9999	0
"Ana-Out 2 Gain "	V	xxx.xx	! 02EB	0.00	999.99	10.00
"Ana-Out 3 Offset"	Inkrement	+/-xxxx	! 02EC	-9999	9999	0
"Ana-Out 3 Gain "	V	xxx.xx	! 02ED	0.00	999.99	10.00
"Ana-Out 4 Offset"	Inkrement	+/-xxxx	! 02EE	-9999	9999	0
"Ana-Out 4 Gain "	V	xxx.xx	! 02EF	0.00	999.99	10.00

Text	Units	Format	Ser. Code	Minimum	Maximum	Default
"Ana-In 1 Offset"	Inkrement	+/-xxxx	! 02F0	-9999	9999	0
"Ana-In 1 Gain "	V	xxxxx	! 02F1	0	999.99	10.00
"Ana-In 2 Offset"	Inkrement	+/-xxxx	! 02F2	-9999	9999	0
"Ana-In 2 Gain "	V	xxxxx	! 02F3	0	999.99	10.00
"Ana-In 3 Offset"	Inkrement	+/-xxxx	! 02F4	-9999	9999	0
"Ana-In 3 Gain "	V	xxxxx	! 02F5	0	999.99	10.00
"Ana-In 4 Offset"	Inkrement	+/-xxxx	! 02F6	-9999	9999	0
"Ana-In 4 Gain "	V	xxxxx	! 02F7	0	999.99	10.00
"Index Output "	Impulse	xxxxx	! 02F8	2	65500	2000
"Frequency Output"	HZ	+/-xxxxxx	! 02F9	-500000	500000	50000
"Dir. Frequency "	-	x	! 02FA	0	1	1
"Frequency Select"	-	x	! 02FB	0	1	1
"Index 1 select "	-	x	! 02FC	0	2	0
"Index 2 select "	-	x	! 02FD	0	2	0
"Index 3 select "	-	x	! 02FE	0	2	0
"Index 4 select "	-	x	! 02FF	0	2	0

Table “Commands”

Command name	Ser. Code	Control Word	Input	Description
Start	!0900	00000001	X6 / 1	
Restart	!0901	00000002	X6 / 2	
Stop	!0902	00000004	X6 / 3	
Stop on Fault	!0903	00000008	X6 / 4	
Ref for Travers	!0904	00000010	X6 / 5	
Ref rev Travers	!0905	00000020	X6 / 6	
Ref Prox Travers	!0906	00000040	X6 / 7	
go Start Travers	!0907	00000080	X6 / 8	
Jog for Travers	!0908	00000100	X6 / 9	
Jog rev Traverse	!0909	00000200	X6 / 10	
Jog for Winder1	!090A	00000400	X6 / 11	
Jog rev Winder1	!090B	00000800	X6 / 12	
Jog for Winder2	!090C	00001000	X6 / 13	
Jog rev Winder2	!090D	00002000	X6 / 14	
Trim++ Line	!090E	00004000	X6 / 15	
Trim-- Line	!090F	00008000	X6 / 16	
Reset Tension				
Emergency Stop				
Store to EEProm				
Adjust Program				
Test Program				

Table “Outputs”

Output name	Ser. Code	Control Word	Output	Description
Ready	!0A00	00000001	X7 / 1	
Stop	!0A01	00000002	X7 / 2	
Stop on Fault	!0A02	00000004	X7 / 3	
in progress	!0A03	00000008	X7 / 4	
Datum done Traverse	!0A04	00000010	X7 / 5	
Startpos. ok. Traverse	!0A05	00000020	X7 / 6	
Length > Fault	!0A06	00000040	X7 / 7	
Error	!0A07	00000080	X7 / 8	

Table “Error Status”

Error name	Control Word	Description
DP RAM Error	00000001	
CAN controller	00000002	
Tension on max.	00000004	
Tension on min.	00000008	
P max. Winder1	00000010	
P max Winder2	00000020	
P max Traverse	00000040	
P max. Line	00000080	
min. Dia Winder1	00000100	
max. Dia Winder1	00000200	
min. Dia Winder2	00000400	
max. Dia Winder2	00000800	

Table “Variables”

Variable name	Ser. Code	Description
Loop Time	!0800	
	!0801	
	!0802	
	!0803	
	!0804	
	!0805	
	!0806	
	!0807	
	!0808	
	!0809	
	!080A	
Diff Line1	!080B	
Diff Measure1	!080C	

Variable name	Ser. Code	Description
Diff Measure2	!080D	
Diff Traverse	!080E	
Dia Winder1	!080F	
Dia Winder2	!0810	
Count Master	!0811	
Count Winder1	!0812	
Count Winder2	!0813	
Count Measure1	!0814	
Count Measure2	!0815	
Count Traverse	!0816	
Fault Length	!0817	
Target Position	!0818	
Tension value	!0819	
Actual speed	!081A	
Mode control	!081B	
Winder1 control	!081C	
Winder2 control	!081D	
Traverse control	!081E	
Test counter	!081F	