Operating Manual CMGZ411/421

Digital microprocessor controlled tension control unit

V2.01 05/04 sd

This operation manual is also available in German.
Please contact your local representative.

Diese Bedienungsanleitung ist auch in Deutsch erhältlich.
Bitte kontaktieren Sie die Vertretung im zuständigen Land.

1 Safety Instructions

Danger

Some contacts of the 230VAC version are under 230V tension! Mortal danger! Disconnect power supply before open the housing!

Danger

The tension controller can operate drives or brakes with high performance. It has no built-in emergency stop function. Switching off the power supply is not sufficient to prevent personal injury or mechanical damage! To provide safety of man and machine in case of malfunction, the person responsible for system design has to establish specific safety procedures such as emergency stop circuits, etc.

⚠ Caution

Bad earth connection may cause electric shock to persons, malfunction of the total system or damage of the electronic unit! It is vital to ensure that proper earth connection is done.

⚠ Caution

The processor board is mounted directly behind the operation panel. Improper handling may damage the fragile electronic equipment! Don't use rough tools as screwdrivers or pliers! Don't touch processor board! Touch earthed metal part to discharge static electricity before removing operation panel!

⚠ Caution

Proper function of the web tension controller is only guaranteed with the recommended application of the components. In case of other arrangement, heavy malfunction can be the result. Therefore, the installation instructions on the following pages must be followed strictly.

⚠ Caution

Local installation regulations are to preserve safety of electric equipment. They are not taken into consideration by this operating manual. However, they have to be followed strictly.

2 Table of contents

3 Description

3.1 Common

The CMGZ411/421 is a digital web tension controller. The electronic unit contains a microprocessor to handle all calculations and communications, the highly accurate sensor power supply and the signal amplifier for the measuring value. As operation interface it provides 4 keys, 4 LED's and a 2x16 characters display in the front of the electronic unit. All inputs are saved in an EEPROM. The electronic unit has no jumpers or trimmers to keep most accurate long-time and temperature stability. There can be connected one or two force sensors to the electronic unit.

Strain gauge amplifier: The strain gauge amplifier provides the highly accurate 4V power supply. A highly accurate, fixed difference amplifier rises the mV signal up to 10V. This signal will be fed to the A/D converter. The microprocessor then does all application-specific calculations with the digitized measuring value (such as offset, gain, low-pass filter). The tension feedback signal is available at the 0...10V analogue output.

Controller: The control unit compares the reference value with the measured feedback value and transmits the error to the controller configurable as PI, PD or PID. The controller calculates the output signal according to the difference. The output signal is provided as an analogue signal (0...10V / ±10V / 0...20mA / 4...20mA).

Interface: As standard, the electronic unit supports an RS232 interface. As an option, there is an additional board with CAN-Bus interface available.

3.2 Special functions CMGZ411

Gain switching: For applications with different wrap angles, the gain factor can be changed easily using a digital input.

Correction input: For applications with continuously varying wrap angles (i.e. at winders/unwinders directly), the CMGZ411 provides a 0..10V input for the continuous correction. The correction signal usually is obtained from a PLC or from a potmeter that is mounted at the moving section of the machine. Correction can be set to linear or cosine function.

Diameter calculation: In winder / unwinder applications, the controller is able to calculate the actual diameter. Therefore it is necessary to get line speed information from a tacho roller or from a PLC. Line speed information is given to the controller using a 10V input.

Taper function: Based on the diameter calculation, the CMGZ411 is able to reduce tension reference automatically across the increasing diameter. Three different reduction curves (square, linear, square root) are available. The tension then is reduced from given reference at center diameter to the desired reduction at the maximum winding diameter.

Note:

Only one of the features that use an analog input (Diameter, Correction input, analog reference) can be used at a time.

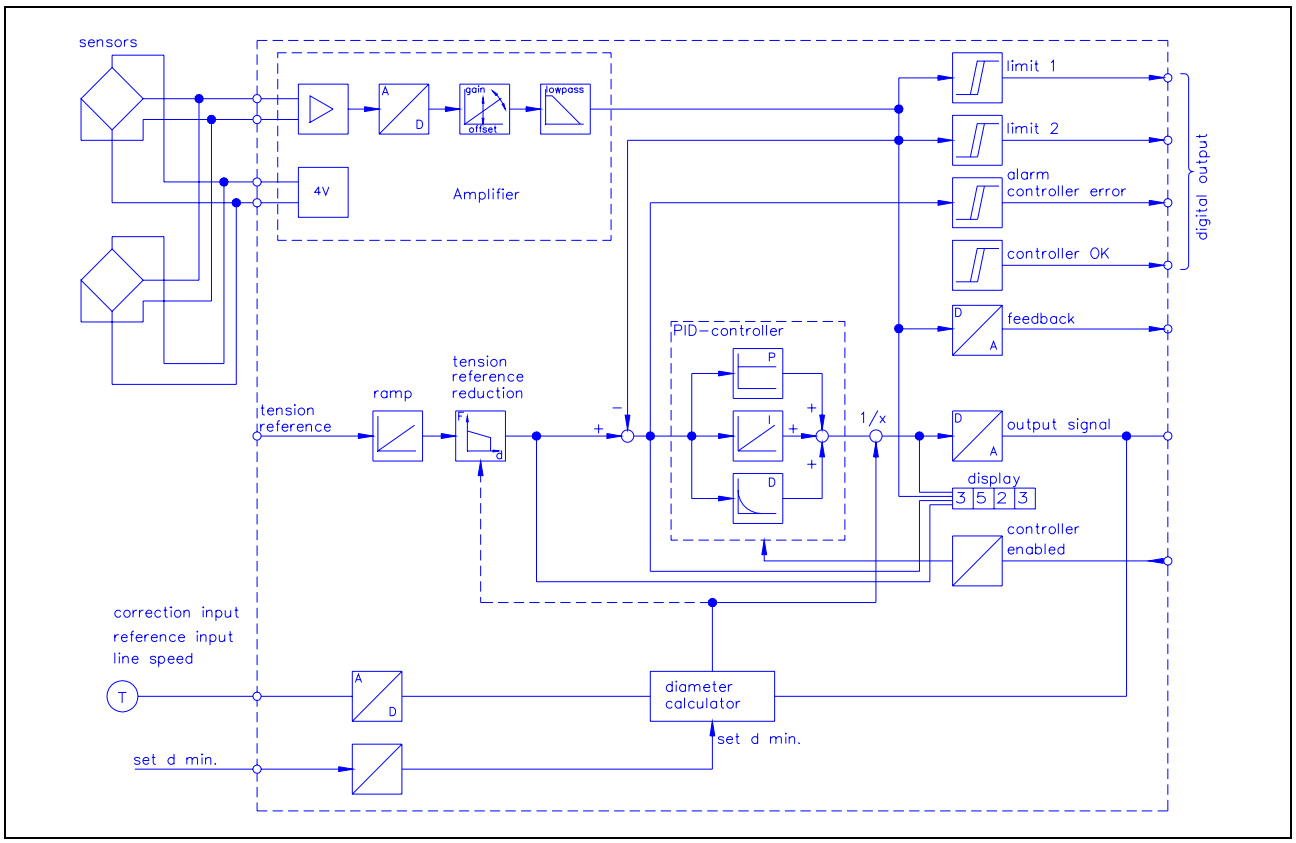
Special functions CMGZ421

Double channel measurment: The CMGZ421 calculates the tension reference values independently for the 2 bearings of a measuring roller. Analogue outputs provide the feedback signals for channel A, channel B and channel A+B. The controller uses the feedback signal A+B.

If the Difference between A and B exceeds a limit value, an error message occurs.

Gain switching: For applications with different wrap angles, the gain factor can be changed easily using a digital input.

3.3 Block Diagram CMGZ411



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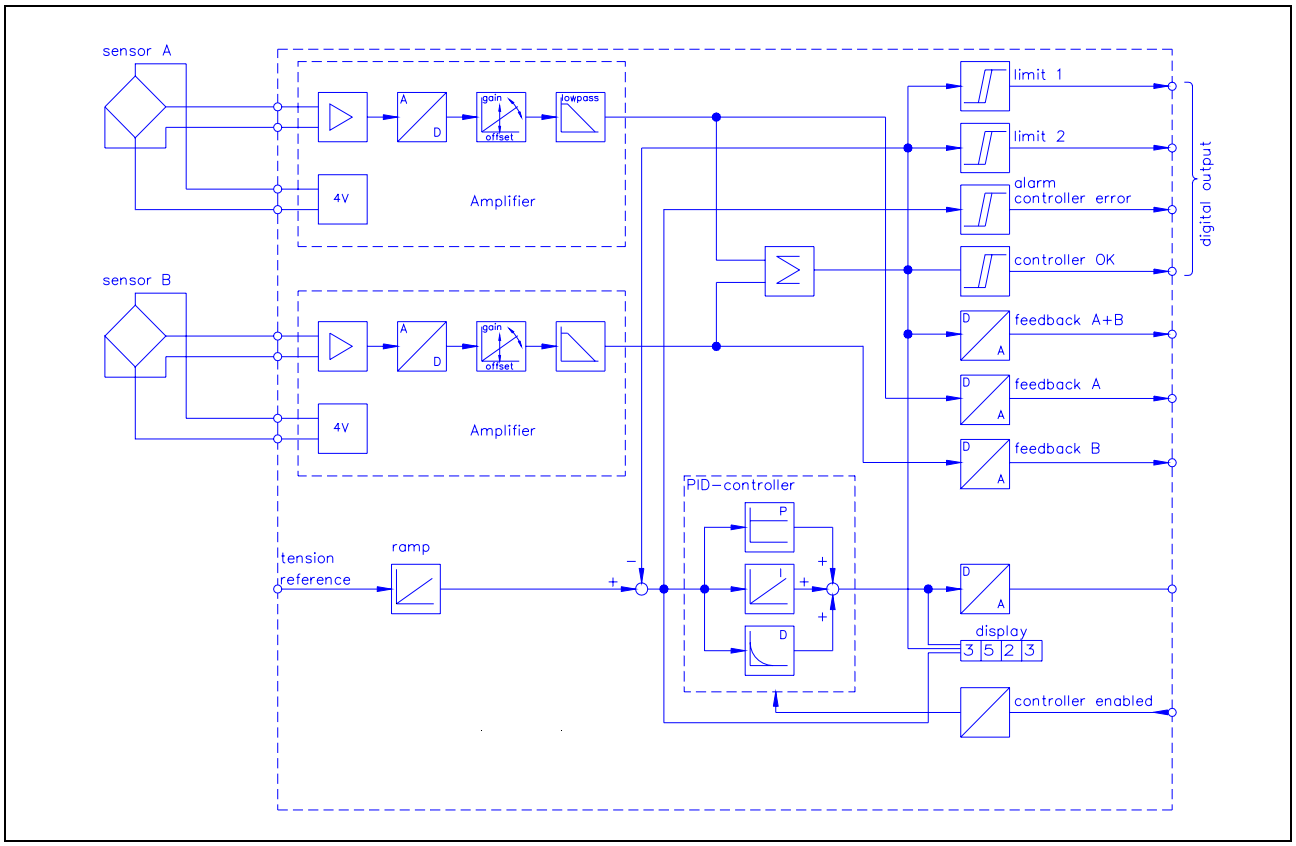
3.4 Block Diagram CMGZ421



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4 Controller theory

Web tension control loops

When manufacturing and processing foils, wires, ropes, paper and fabric sheets, it is important that the product is under constant tension when guided over the cylinders. Tension may change when humidity, temperature, winding or unwinding diameters vary or when the material is being printed, coated, glued or pressed.

Tension is measured constantly and maintained at the correct value with the FMS force measuring and control system. The system includes the following components:

- Force measuring bearings or Force measuring rollers for mechanical / electrical conversion of the force
- Amplifier providing the excitation and the amplifier for the mV signal of the sensors (integrated in CMGZ411).
- Control unit for the comparison of tension reference and feedback value and the PID controller.

The output of the tension control unit drives either an electrical brake or a pneumatic brake via an electric/pneumatic converter or an electric drive as a 1-quadrant or 4-quadrant model version. With a 4-quadrant electric drive, the tension control unit is able to hold constant tension in both rotational directions as well as at standstill. As a tension control loop prevents waste and tear of the band, this is a very economical solution for any kind of band material. The version with compact steel housing (CMGZ411.E/421.E) allows to build a control system easily.

Control Unit

The function of any control loop is to maintain the feedback value exactly at the level of the reference and to minimize the influence of any interference on the control loop.

In addition, the control loop must be stable under all operating conditions. These aims can only be achieved if the dynamic behaviour of the control loop is adapted to the machine.

P Component

A controller with only a proportional component emits an output signal that is proportional to the error. If the error equals to zero, the output signal also equals to zero. A small error only can create a small output signal which is not high enough to compensate the complete error. That means that a controller with only a proportional component will have a steady error depending on the p factor. The characteristic value for a P controller is the proportional factor X_p.

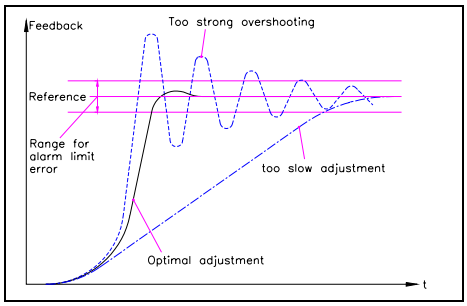


Diagram:Step response of a PID controller

I Component

A controller with an integral component integrates the error signal continuously and emits the result as an output signal. The I controller adds also very small differences between reference and feedback to the output signal and thus, the output is adjusted until the error equals to zero. This output value is maintained until a new error occurs. The integral component therefore allows zero error in steady state. The characteristic value for an I-controller is the time T_n.

D Component

A controller with derivative component emits an output signal corresponding to the differentiated error signal. Therefore, the value of this signal is proportional to the changing speed of the error signal. If the feedback value deviates from the reference, the derivative component increases much faster than the proportional component. The controller is able to react when even a small error occures, because it reacts already to a slightly changing error signal. The characteristic value for a D controller is the time T_v.

Advantages of digital controllers compared with analog controllers

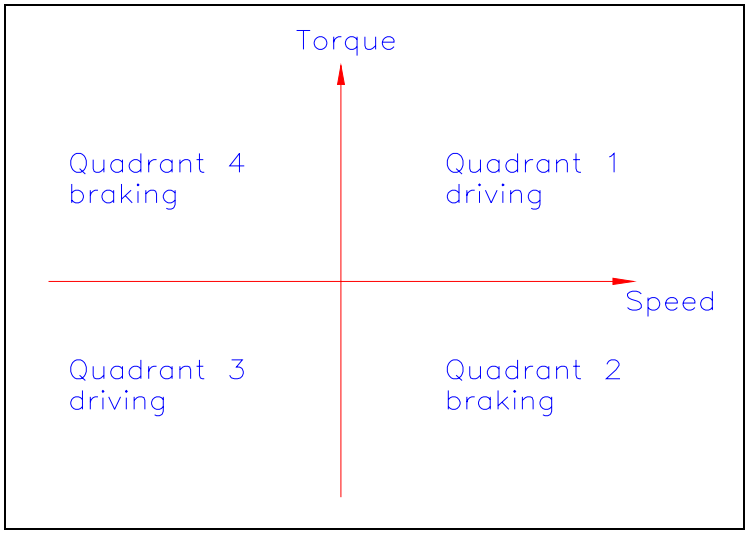
Digital controllers have exactly reproducible behaviour, because every parameter is known as an exact number. They thus have very good long-term and temperature stability. This feature also allows one to interchange two units without readjustments at the unit.

The initial adjustment usually is much easier, because numerical values are entered and no potentiometers have to be turned a few degrees.

Digital units usually have a standard interface to a PLC, personal computer or other equipment. That makes it very easy to integrate them into complex control systems. This concept simplifies initial operation and maintenance and allows easy changement of some parameters when the processed goods are changing, etc.

5 The 4 quadrants in drive technology

The four quadrants in drive technology refer to the speed/torque diagram shown. The x axis shows speed and the y axis shows torque.
The first quadrant shows positive speed and positive torque and this results in positive power, eg. drive in positive direction. In the second and fourth quadrants, the power is negative because the signs of speed and torque are different. In the third quadrant, torque and speed are negative and this results in positive power, which means driving in negative direction.
A brake can work only in the second or the fourth quadrant, because it is not able to drive by definition. A 1-quadrant drive usually works in the first quadrant, but can be installed to work in the third quadrant also. It is not possible to brake with a 1-quadrant drive. A four-quadrant drive is able to work in all 4 quadrants and able to drive and to brake in positive and negative rotational direction.



POWER = TORQUE x REVOLUTION SPEED

Application
In applications where you need only low dynamic response, it is possible to use 1-quadrant drives. If a machine not only has to accelerate fast but also has to decelerate fast, it is necessary to use a 4-quadrant drive to switch from driving to braking immediately. Only a 4-quadrant drive is able to handle both processes.
A brake would be able to help in the deceleration process, but in the acceleration phase, the brake for itself is insufficient.

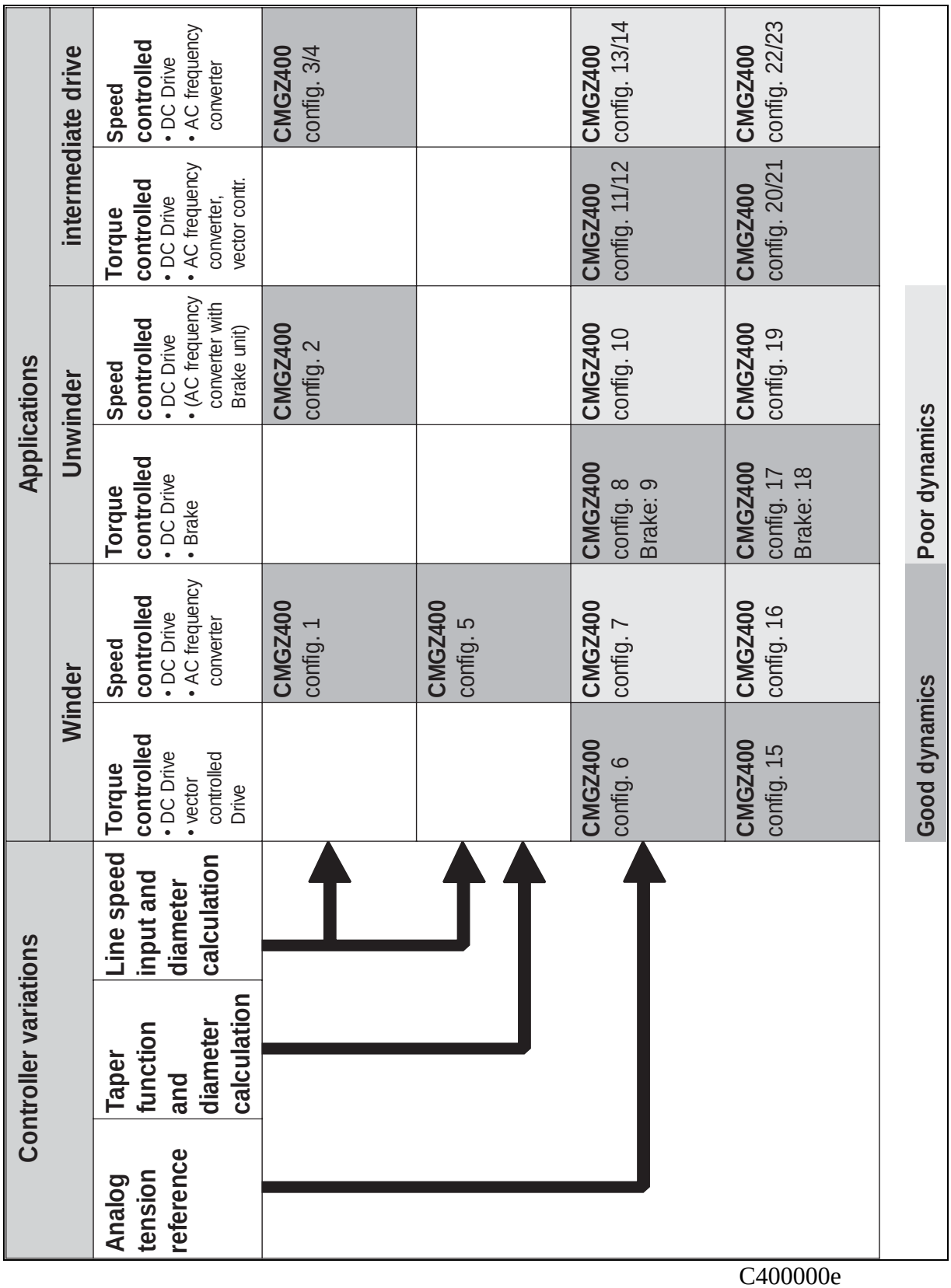
6 Quick installation guide

- Find your application on pages 8-13
- Check all your requirements such as:
  tension reduction / gain switching / analog outputs / line speed input
- draw your wiring diagram according to the wiring diagrams on pages 14-16. Do not forget the digital input „controller enabled“!
- connect your components
- Parametrize: nominal force / Machine configuration (according to your chosen number) /
  output configuration / start speed / start limit / synchronisation stop
- Put system into operation and adjust the PID controller as described on pages 20-22
- If needed, do additional adjustments (such as tension reduction, gain switching, scaling and filtering of analogue outputs, etc.)

7 Applications

7.1 Table of the application versions

With the table and the following principle images, the machine configuration is determined.



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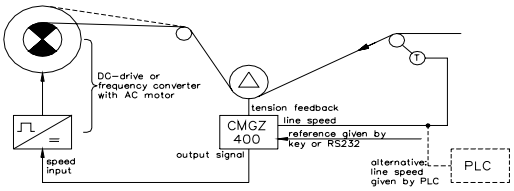
7.2 Determination of the machine configuration

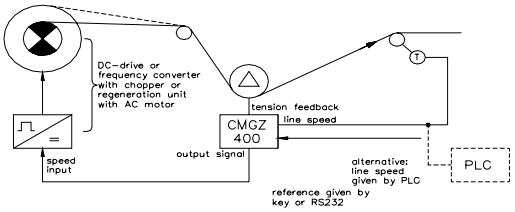
WINDER Parameter "Machine configuration" = 1/5



The line speed input is used for diameter calculation to increase the dynamic behaviour.
5 The tension reference is reduced automatically over increasing diameter by an adjustable curve.

	Controller output signal	Dynamic behaviour
1Q	0...10V 0/4...20mA } only forward operation	good dynamics during stable operation. Decceleration of the maschine is critical due to inertia of the roller.
4Q	+/–10V (0..10V 0/4..20mA only forward direction incl. braking is possible.)	high

UNWINDER Parameter "Machine configuration" = 2

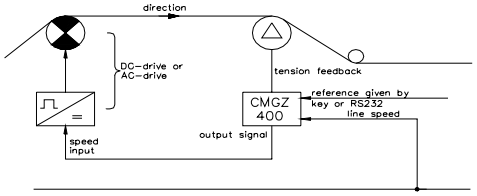


The line speed input is used for diameter calculation to increase the dynamic behaviour.

	Controller output signal	Dynamic behaviour
1Q *	0...10V 0/4...20mA } only forward operation	good dynamics during stable operation. Acceleration of the maschine is critical due to inertia of the roller.
4Q	+/–10V (0..10V 0/4..20mA only forward direction incl. braking is possible.)	high

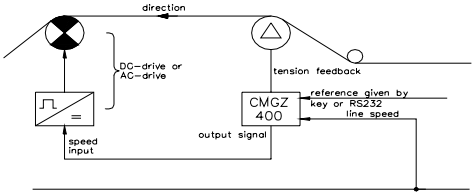
* Depending on the amount of friction of bearing and gearbox the torque has to act in forward or reverse direction.

LINE DRIVE Parameter "Machine configuration" = 3



	Controller output signal	Dynamic behaviour
1Q	0...10V 0/4...20mA } only forward operation	Depending on the sign of the torque acceleration or decceleration is critical due toinertia of the roller.
4Q	+/–10V (0..10V 0/4..20mA only forward direction incl. braking is possible.)	high

LINE DRIVE Parameter "Machine configuration" = 4



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4Q	+/–10V (0..10V 0/4..20mA only forward direction incl. braking is possible.)	high

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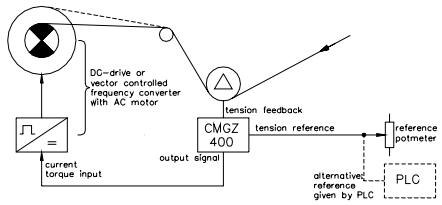
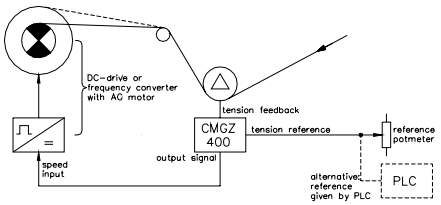
WINDER Parameter "Machine configuration" = 6



DO drives: take precautions to avoid overspeed when material is teared.

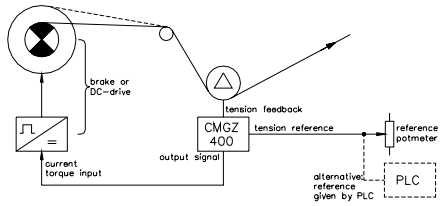
	Controller output signal	Dynamic behaviour
1Q	0..10V 0/4...20mA } only forward operation	good dynamics during stable operation. Deceleration of the maschine is critical due to inertia of the roller.
4Q	+/-10V (0..10V 0/4..20mA both directions but no braking possible.)	high

WINDER Parameter "Machine configuration" = 7



	Controller output signal	Dynamic behaviour	
1Q	0..10V 0/4...20mA } only forward operation	good dynamics during stable operation. Deceleration of the maschine is critical due to inertia of the roller.	$v * \frac{d\ max.}{d\ min.} < 20$ ramp [s]
4Q	+/-10V (0..10V 0/4..20mA only forward direction incl. braking is possible.)		

UNWINDER Parameter "Machine configuration" = 8/9

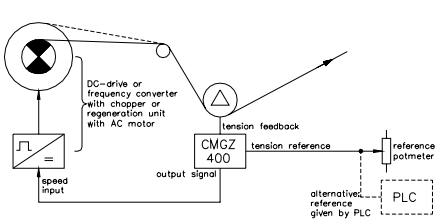


DO drives: take precautions to avoid overspeed when material is teared.

	Controller output signal	Dynamic behaviour
brake	0...10V 0/4...20mA via converter	good dynamics during stable operation. Acceleration of the maschine is critical due to inertia of the roller.
1Q *	0...10V 0/4...20mA } only forward operation	same as brake
4Q	+/-10V (0..10V 0/4..20mA both directions but no accelerating possible. *)	high

* Depending on the amount of friction of bearing and gearbox the torque has to act in forward or reverse direction.

UNWINDER Parameter "Machine configuration" = 10



	Controller output signal	Dynamic behaviour	
1Q	0..10V 0/4...20mA } only forward operation	good dynamics during stable operation. Acceleration of the maschine is critical due to inertia of the roller.	$v * \frac{d\ max.}{d\ min.} < 20$ ramp [s]
4Q	+/-10V (0..10V 0/4..20mA only forward direction incl. braking is possible.)		

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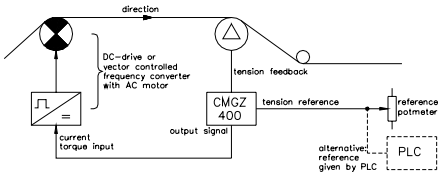
LINE DRIVE Parameter "Machine configuration" = 11



DC drives: take precautions to avoid overspeed when material is teared.

	Controller output signal	Dynamic behaviour
1Q	0...10V 0/4...20mA } only forward operation	Depending on the sign of the torque acceleration or deceleration is critical due toinertia of the roller.
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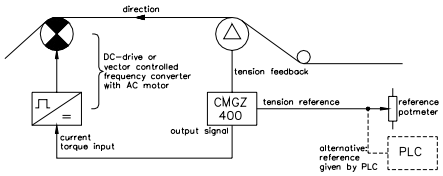
LINE DRIVE Parameter "Machine configuration" = 12



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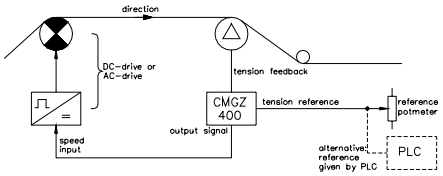
LINE DRIVE Parameter "Machine configuration" = 13



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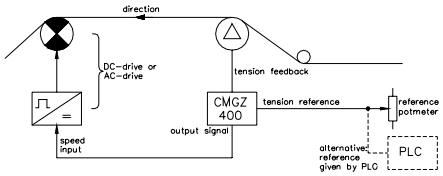
1Q	0...10V 0/4...20mA } only forward operation	Depending on the sign of the torque acceleration or deceleration is critical due toinertia of the roller.	$v * \frac{d\ max.}{d\ min.} < 20$
4Q	+/–10V (0..10V 0/4..20mA only forward direction incl. braking is possible.)		$\frac{}{ramp\ [s]}$

LINE DRIVE Parameter "Machine configuration" = 14



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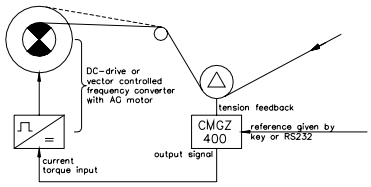
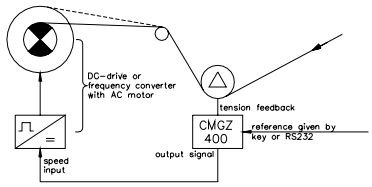
WINDER Parameter "Machine configuration" = 15



DC drives: take precautions to avoid overspeed when material is teared.

	Controller output signal	Dynamic behaviour
1Q	0..10V / 0/4...20mA } only forward operation	good dynamics during stable operation. Deceleration of the maschine is critical due to inertia of the roller.
4Q	+/-10V (0..10V 0/4..20mA both directions but no braking possible.)	high

WINDER Parameter "Machine configuration" = 16



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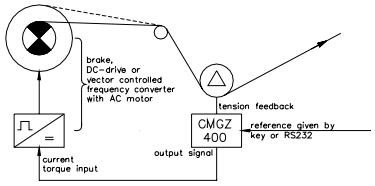
4Q	+/-10V (0..10V 0/4..20mA only forward direction incl. braking is possible.)		ramp [s]

UNWINDER Parameter "Machine configuration" = 17/18



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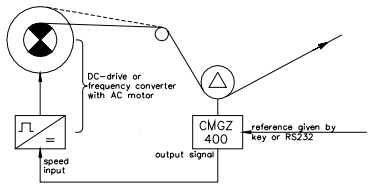
UNWINDER Parameter "Machine configuration" = 19



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4Q	+/-10V (0..10V 0/4..20mA only forward direction incl. braking is possible.)		ramp [s]

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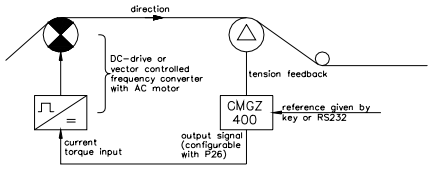
LINE DRIVE Parameter "Machine configuration" = 20



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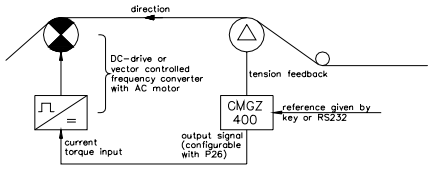
LINE DRIVE Parameter "Machine configuration" = 21



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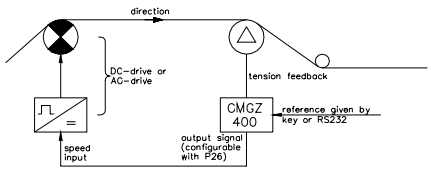
LINE DRIVE Parameter "Machine configuration" = 22



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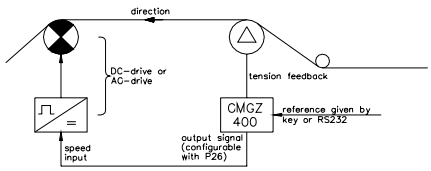
4Q	+/-10V (0..10V 0/4..20mA only forward direction incl. braking is possible.)		

LINE DRIVE Parameter "Machine configuration" = 23



DC drives: take precautions to avoid overspeed when material is teared.

	Controller output signal	Dynamic behaviour	
1Q	0...10V 0/4...20mA } only forward operation	Depending on the sign of the torque acceleration or deceleration is critical due toinertia of the roller.	$v * \frac{d\ max.}{d\ min.} < 20$ ramp [s]
4Q	+/-10V (0..10V 0/4..20mA only forward direction incl. braking is possible.)		

C400005e

8 Wiring

Wiring the controller

Firstly, the whole control system has to be wired. The terminal assignment of the controller is shown in the diagrams below.

The force sensor have to be wired using 2*2*0.75mm^2 shielded twisted-pair cable to avoid signal noise.

Special importance must be given to the earth connection. The shield of the connection cables to the sensors has to be connected at the controller side only. At the sensor side, it has to stay open to prevent ground circuits. It is also important to ground the gnd terminal of the controller only to a single point. The Ground terminals of the controller and the reference input of the drive resp. brake unit are connected!

⚠ Caution:

Bad earth connection may cause electric shock to persons, malfunction of the total system or damage of the electronic unit! It is vital to ensure that proper earth connection is done.

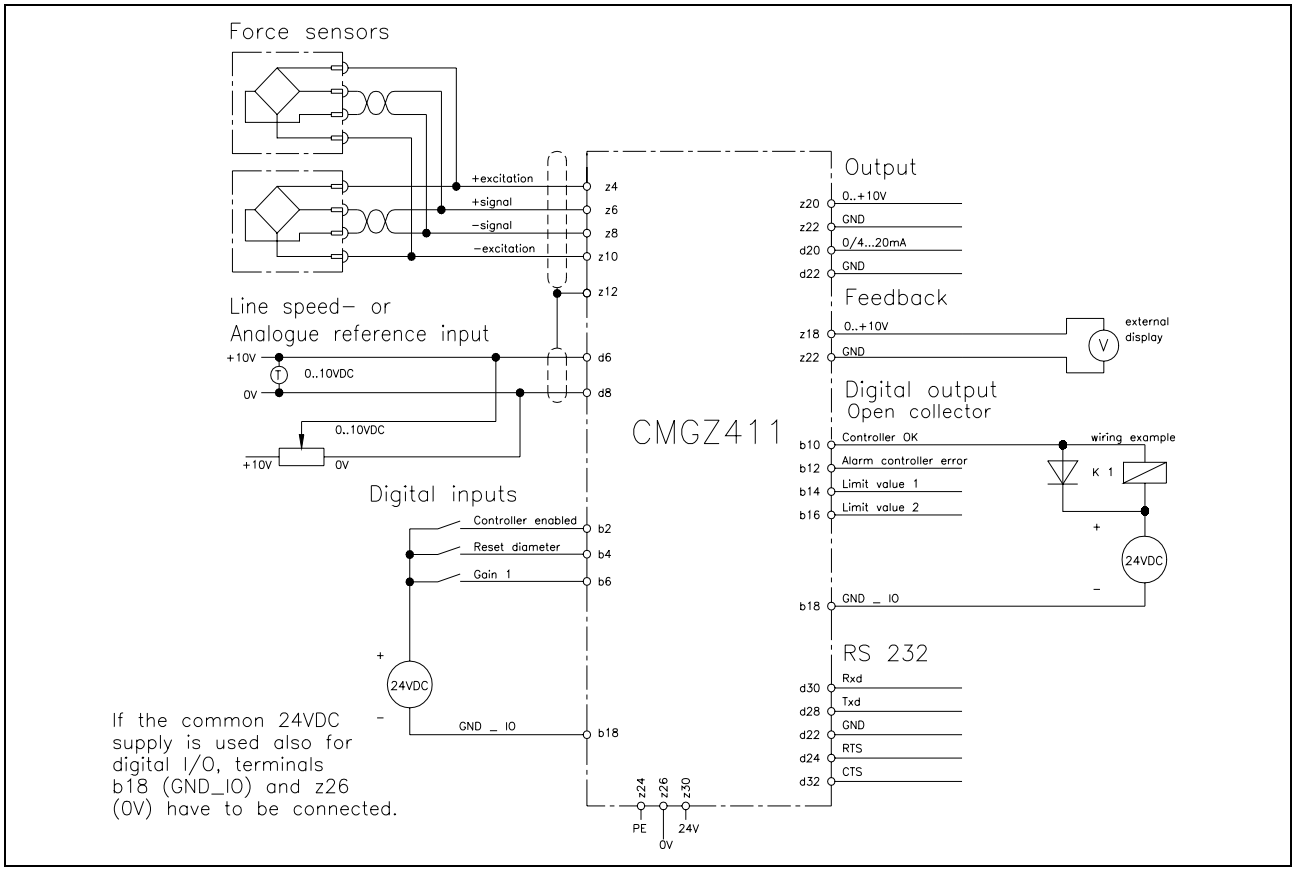
Digital inputs / outputs

The digital inputs are activated by applying an external 24VDC source.

The digital outputs (open collector, gnd is switched) refer also to this 24VDC source.

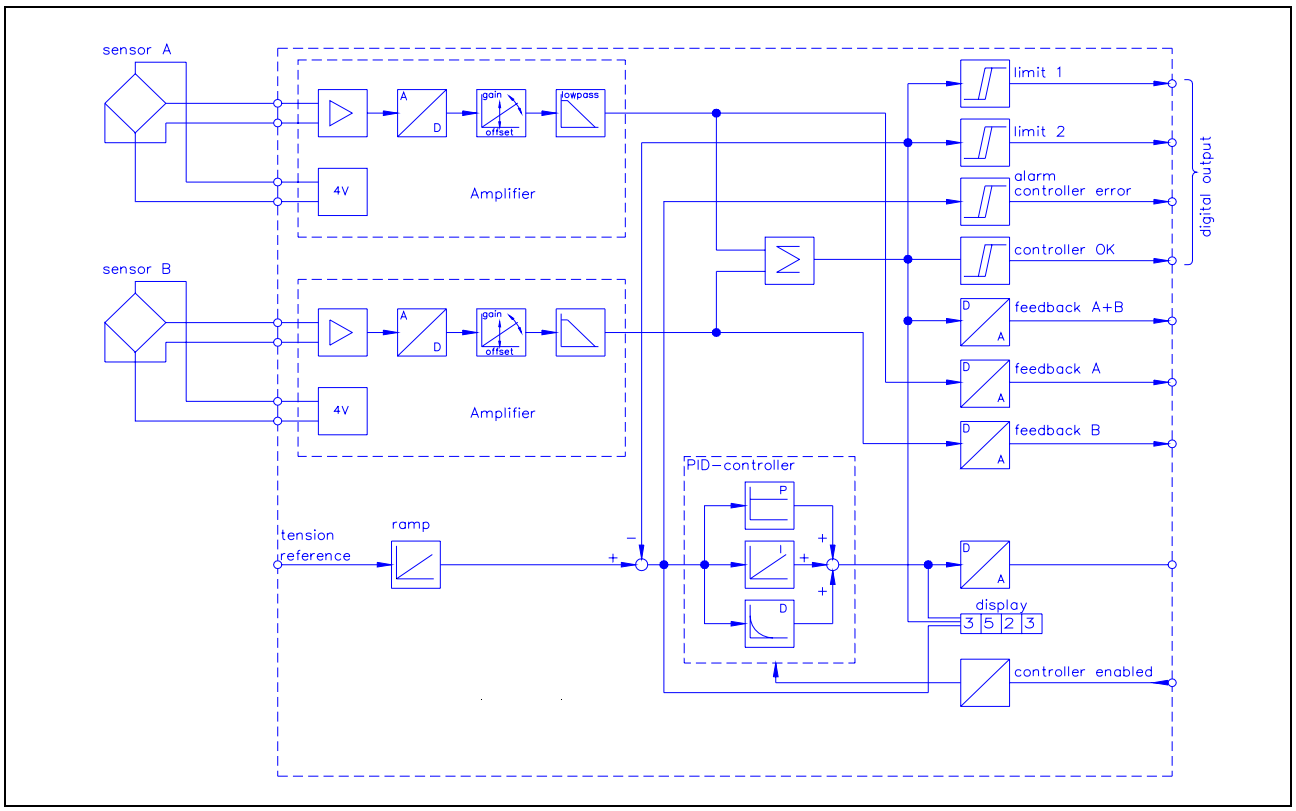
The digital inputs and outputs are galvanic insulated from the other circuitry.

8.1 Wiring diagram of the web tension controller CMGZ411



C411001e

8.2 Wiring diagram of the web tension controller CMGZ421



C421001e

8.3 Wiring diagram CMGZ411.E / CMGZ421.E

The housing of the electronic unit will be opened by unscrewing the 4 philips screws on the operation panel and swinging out the operation panel to the right side.

⚠ Caution:

The processor board is mounted directly behind the operation panel. Improper handling may damage the fragile electronic equipment! Don't use rough tools as screwdrivers or pliers! Don't touch processor board! Touch earthed metal part to discharge static electricity before removing operation panel!

Danger: Some contacts of the 230VAC version are under 230V tension! Mortal danger! Disconnect power supply before open the housing!

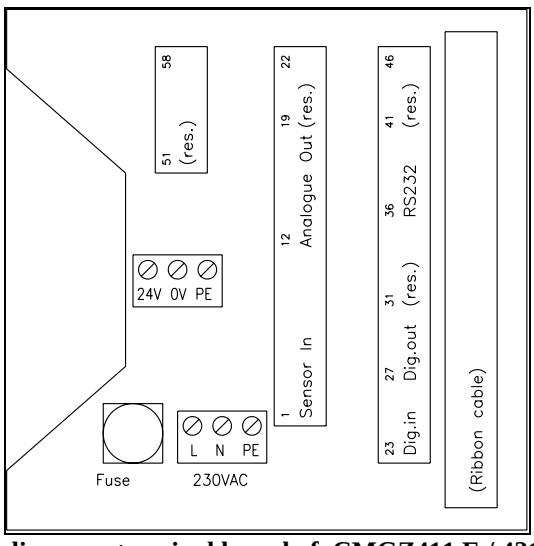


diagram: terminal board of CMGZ411.E / 421.E E411001e

Terminal assignment CMGZ411.E

Connection	Wire colour	#
Sensor 1 / channel A		
+ Excitation	yellow	1
+ Signal	brown	2
– Signal	white	3
– Excitation	green	4
Shield/earth	(metal)	5
Sensor 2 / channel A		
+ Excitation	yellow	1
+ Signal	brown	2
– Signal	white	3
– Excitation	green	4
Shield/earth	(metal)	5
Correction input		
0...10V		7
Gnd		8
Dig. I/O		
Dig.In controller enabled		23
Dig.In reset diameter		24
Dig.In gain 1		25
Dig.In 4 (reserved)		26
Dig.Out controller ok		27
Dig.Out alarm contr.err.		28
Dig.Out limit value 1		29
Dig.Out limit value 2		30
Analog Out		
Controller out (0...10V)		12
Controller out (0/4..20mA)		13
Controller out Gnd		14
Feedback (0...10V)		15
Feedback Gnd		18
RS232		
Gnd		36
RTS		37
TxD		38
RxD		39
CTS		40
Main supply [1)]		
Phase 230VAC	brown	L
Gnd 230VAC	blue	N
Protection/earth	yellow/green	PE
+24VDC		24V
Gnd 24VDC		0V
Protection/earth		PE

Terminal assignment CMGZ421.E

Connection	Wire colour	#
Sensor 1 / channel A		
+ Excitation	yellow	1
+ Signal	brown	2
– Signal	white	3
– Excitation	green	4
Shield/earth	(metal)	5
Sensor 2 / channel A		
+ Excitation	yellow	6
+ Signal	brown	7
– Signal	white	8
– Excitation	green	9
Shield/earth	(metal)	5
Dig. I/O		
Dig.In controller enabled		23
Dig.In reset diameter		24
Dig.In gain 1		25
Dig.In 4 (reserved)		26
Dig.Out controller ok		27
Dig.Out alarm contr.err.		28
Dig.Out limit value 1		29
Dig.Out limit value 2		30
Analog Out		
Controller out (0...10V)		12
Controller out (0/4..20mA)		13
Controller out Gnd		14
Feedback (0...10V) (A+B)		15
Feedback Gnd		18
Feedback (0...5V) (A)		16
Feedback (0...5V) (B)		17
Feedback Gnd		18
RS232		
Gnd		36
RTS		37
TxD		38
RxD		39
CTS		40
Main supply [1)]		
Phase 230VAC	brown	L
Gnd 230VAC	blue	N
Protection/earth	yellow/green	PE
+24VDC		24V
Gnd 24VDC		0V
Protection/earth		PE

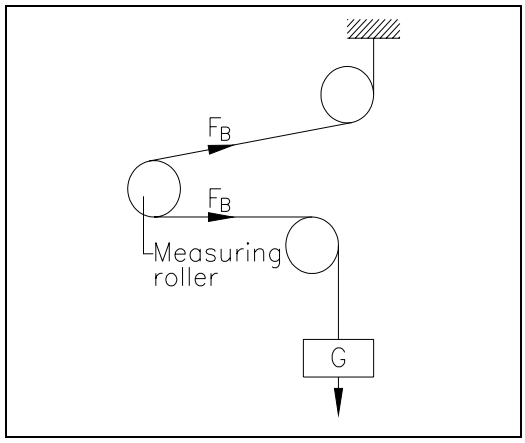
1) Main supply is to connect with the 110/230VAC terminal block or the 24VDC terminal block, depending on customer specification. The required supply voltage is printed to the nameplate on the steel housing.

9 Initial operation of measuring amplifier

9.1 Initial operation of measuring amplifier CMGZ411

Simulating method (recommended)

The following operating instructions describe operation and calibration in the machine; the web tension can be simulated by a weight.



- Connect the first sensor
- Check, if a positive value is displayed when loading the first sensor in measuring direction. If not, change terminals z6 / z8 (2 / 3 with CMGZ411.E) at the controller.
- Connect the second sensor
- Check, if a positive value is displayed when loading the first sensor in measuring direction. If not, change terminals z6 / z8 (2 / 3 with CMGZ411.E) at the controller.
- Press key "PARAMETER" for 3 seconds
- Select parameter „nominal force“ with ↑ or ↓ keys. Confirm with ↵ key , input nominal force of the sensors with ↑ ↓ ← keys and confirm with ↵ key.
- Select parameter „1 or 2 sensors“ with ↑ or ↓ keys. Press ↵ key, select number of sensors with the keys ↑ ↓ ← and confirm with ↵ key.
- Insert material or rope loosely into the machine.
- Select parameter „Find offset feedback“ with ↑ or ↓ keys. Press ↵ key for 3 seconds. The electronic calculates automatically the offset value and stores it under parameter „Value offset-feedback“.
- Load material or rope with a defined weight
- Select parameter „Calibration Feedback“ with ↑ or ↓ keys and confirm with ↵ key. Input the force referring to the applied weight with ↑ ↓ ← keys and confirm with ↵ key. The electronic calculates automatically the new gain value.
- Go back to initial screen with „HOME“ key.

Mathematical method

If the web tension cannot be simulated, calibration has to be done by calculation. This way of calibrating is less accurate because the exact angles are often unknown and the effective mounting conditions, which usually deviate from the ideal, are not taken into account.
For this purpose, the offset has to be adjusted as described above. The gain factor has to be calculated by the following formulas and then entered under Parameter „Value gain-feedback“.
There are the following cases:

CMGZ411 with 1 Force measuring bearing

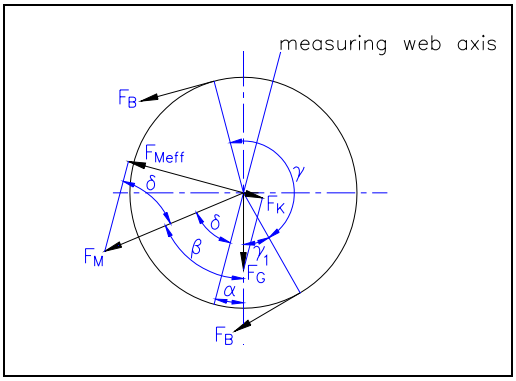
$$\text{Gain feedback} = \frac{1}{\sin\delta * \sin(\gamma/2)}$$

CMGZ411 with 2 Force measuring bearings

$$\text{Gain feedback} = \frac{0.5}{\sin\delta * \sin(\gamma/2)}$$

CMGZ411 with 1 Force measuring roller

$$\text{Gain feedback} = \frac{0.5}{\sin\delta * \sin(\gamma/2)}$$



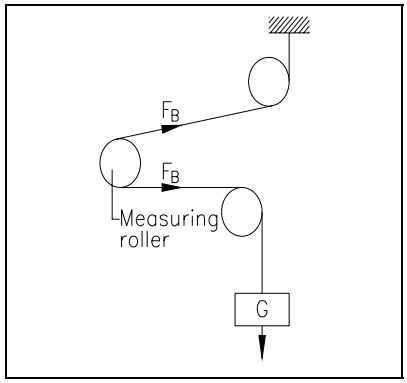
With this setup, the display will show the effective web tension value

For all formulas, γ will be the wrap angle and δ will be the angle between measuring web axis and resulting force F_M.

9.2 Initial operation of measuring amplifier CMGZ421

Simulating method (recommended)

The following operating instructions describe operation and calibration in the machine; the web tension can be simulated by a weight.



- Connect both sensors
- Check, if a positive value is displayed when loading the sensors in measuring direction. If not, change terminals z6 / z8 resp. d6 / d8 (2 / 3 resp. 7 / 8 with CMGZ421.E) at the controller.
- Press key "PARAMETER" for 3 seconds
- Select parameter „nominal force“ with ↑ or ↓ keys. Confirm with ↵ key , input nominal force of the sensors with ↑ ↓ ← keys and confirm with ↵ key.
- Insert material or rope loosely into the machine.
- Select parameter „Find offset channel A“ with ↑ or ↓ keys. Press ↵ key for 3 seconds. The electronic calculates automatically the offset value and stores it under parameter „Value offset-feedback channel A“.
- Select parameter „Find offset channel B“ with ↑ or ↓ keys. Press ↵ key for 3 seconds. The electronic calculates automatically the offset value and stores it under parameter „Value offset-feedback channel B“.
- Load material or rope with a defined weight
- Select parameter „Calibration Feedback channel A“ with ↑ or ↓ keys and confirm with ↵ key. Input the force referring to the applied weight with ↑ ↓ ← keys and confirm with ↵ key. The electronic calculates automatically the new gain value and stores it under parameter „Value gain-feedback channel A“.
- Select parameter „Calibration Feedback channel B“ with ↑ or ↓ keys and confirm with ↵ key. Input the force referring to the applied weight with ↑ ↓ ← keys and confirm with ↵ key. The electronic calculates automatically the new gain value and stores it under parameter „Value gain-feedback channel B“.
- Go back to initial screen with „HOME“ key.

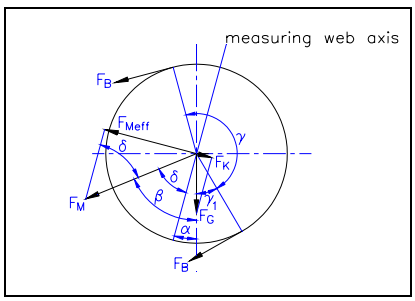
Mathematical method

If the web tension cannot be simulated, calibration has to be done by calculation. This way of calibrating is less accurate because the exact angles are often unknown and the effective mounting conditions, which usually deviate from the ideal, are not taken into account.
For this purpose, the offset has to be adjusted as described above. The gain factor has to be calculated by the following formulas and then entered under parameter „Value gain-feedback channel A“ and parameter „Value gain-feedback channel B“.
There are the following cases:

CMGZ421 with 2 Force measuring bearings

$$\text{Gain feedback ch.A} = \frac{0.5}{\sin\delta * \sin(\gamma/2)}$$

$$\text{Gain feedback ch.B} = \frac{0.5}{\sin\delta * \sin(\gamma/2)}$$



With this setup, the display will show the effective web tension value

For all formulas, γ will be the wrap angle and δ will be the angle between measuring web axis and resulting force F_M.

9.3 Correction input (CMGZ411)

The correction input (terminals d6 / d8 resp. 7 / 8) is needed to change the gain value defined. Under parameter „Correction input“, it is possible to select a linear or a cosine correction. This parameter is normally used if the wrap angle changes continuously.

Linear correction

The adjustment is made by entering a correction value (1.000 without influence) at 0V input (parameter „Linear correction at 0V“), and also at 10V input (parameter „Linear correction at 10V“).
The measured value can be influenced to higher values (>1.000) as well as to lower values(<1.000).

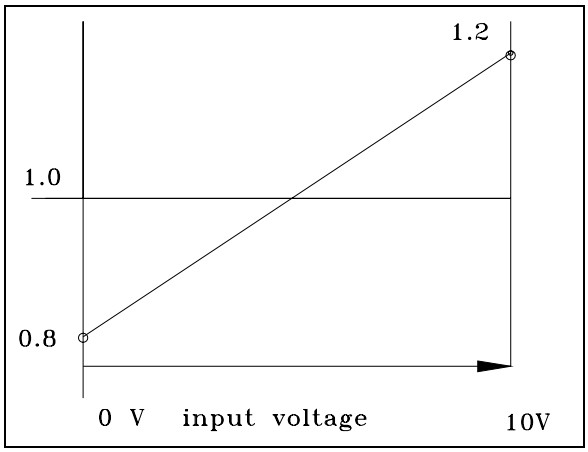


Diagram: Example of a linear correction

Cosine correction

The adjustment is made by choosing 3 positions within the used correction range. Search parameter „gain cosine at U1“ and press the ″↵″ key. Change the value in the display in this position with the keys ″↑ ↓″ until the effective value is displayed. Save the gain and voltage values with ↵ key. The display shows now „gain cosine at U2“.
Change now to the second position and press key ″↵″. Change the shown value in this position with the keys ″↑ ↓″ until the effective value is shown. Save again with ↵ key. The display shows now „gain cosine at U3“.

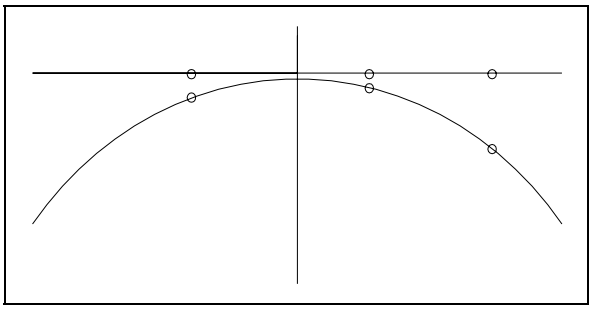


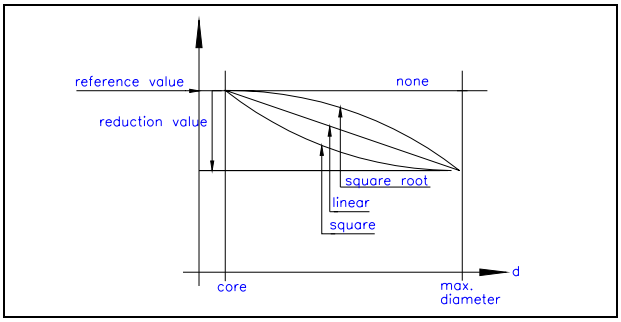
Diagram: Example of a cosine correction

Change now to the third position and press key ″↵″. Change the shown value in this position with the keys ″↑ ↓″ until the effective value is shown. Save again with ↵ key.
The correction voltage can be given also by a potentiometer.

10 Initial operation of PID controller

10.1 Parametrization of the PID controller

- Set the parameters „Machine configuration“ and „Output configuration“ as needed



Reference value given by potentiometer (analogically)

- Connect potentiometer or other source as shown in the wiring diagram
- Set parameter „scale poti reference“ referring to the needed nominal force at 10V

Winder/Unwinder with 10V input for line speed

- Input rotations per volt of the tacho generator to parameter „Line speed tacho“
- Input diameter of the tacho roller to parameter „Tacho diameter“
- Input rotations per volt of the controlled drive to parameter „Winder drive“
- Input minimum roller diameter to parameter „Center diameter“
- Input maximum roller diameter to parameter „Max. diameter“

Tension reduction

If a reference tension reduction is needed, all settings have to be made as described under „Winder/Unwinder“. In addition, the parameter „tension reduction“ stores the needed configuration, and the parameter „reduction value“ stores the reduction factor.

Controller with line drive

- Input the percentage quota of the PID controller which is added to the line speed to parameter „Line speed overlay“.

10.2 Determination of PID control parameters

Mathematic determination of control parameters

To calculate the parameters for the controller, the well-known equations of Bode, Ziegler-Nichols or others can be used. The values calculated by the appropriate formulas can be entered under the parameters PID-configuration, Proportional component P, Integral component I, Derivative component D. After that, the controller is fine-tuned under operating conditions.

Experimental determination of control parameters (recommended)

In the case of a control loop with unknown behaviour, tuning is done by means of a systematic approach.

- Set parameter „PID-Configuration“ to PI
- Set Parameter “Integral component I″ very high
- Set Parameter ″Proportional component″ small
- enable controller
- If loop is instable: Decrease Parameter „Proportional component P“
- If loop is stable: Increase Parameter „Proportional component P“
- Repeat this procedure until the loop is stable, but is just not oscillating. This setting allows the loop to be stable, but as long as there is no I component, there will be a steady error.
- If the loop is stable with only P component, decrease the I component until the steady error disappears. If the I component is too small, the loop will once again become instable.

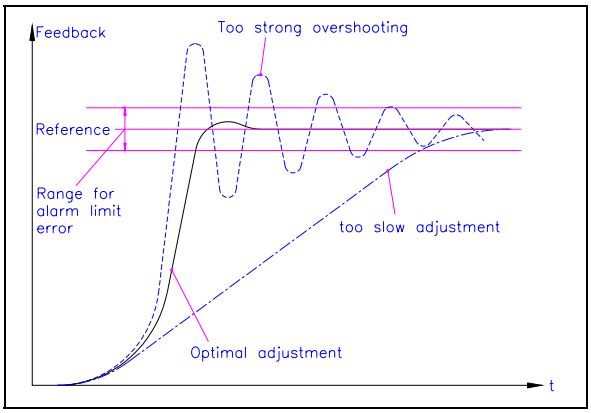


diagram: The controller has to be set in a way that the feedback value will reach the reference value as fast as possible.

- If the reaction of the control loop is not fast enough, Parameter „PID configuration“ can be set to PID to add a derivative control component. The adjustment of the derivative component D starts with small values. Increase as long as the loop remains stable.

If the reference value can’t be reached, there is a static error (eg. no or too small I component). In a steady state with no static error, the reference can be reached and also maintained.
To judge the adjustment of the control loop, an oscilloscope can be very helpful. The oscilloscope not only shows whether the control loop operates in a stable manner, but also whether there is a static error.

10.3 Enable controller

After switching the CMGZ411/421 on, the controller is locked. The output signal is zero if a drive is used, regardless of tension reference and feedback. If a brake is used, the output signal will be the start torque defined in parameter „start speed“.
By using the digital input "controller enabled" or the corresponding serial interface command, the controller starts to work.

Control loop with a drive

The behaviour of the controller after it is enabled is determined by the parameters ″Start speed″ and ″Start limit″. These two parameters ensure an easy starting phase: If there is slack material in the machine and the controller controls a drive, it would accelerate suddenly to achieve the reference tension. As soon as the material is stretched, the drive can not decelerate fast enough, and the material can be stretched excessively so that tearing results. To avoid this, the controller starts with only a small output signal given by parameter ″Start speed″ until a certain tension value (given by parameter ″Start limit“) is reached. After that, the controller switches very smoothly (without the output signal jumping from one value to another) to tension control mode, and the digital output „Controller ok“ is activated.
With configuring the parameter ″Start limit“ to 0, this behaviour can be suppressed and the controller begins to operate immediately. Although this is possible, it is advisable to use a value greater than zero, because this starting procedure takes only fractions of a second if there is no slack material.

If a 1-Q drive is used as an unwinder, the starting procedure is inactive, as the drive is only able to turn in the unwinding direction.
If a 1-Q drive is used as a winder, a speed value (start speed) and the corresponding tension force (start limit) can be given as provided.
If a 4-Q drive is used, the complete starting procedure can be followed. The values must be set depending on the machine and the material that is used.

Control loop with a brake

Using a brake, the controller starts to work immediately after enabling the controller. That means the output value is made depending of the control error (reference - feedback), and the digital output „Controller ok“ is activated.

If the Controller is used with a brake, the slow starting process must be controlled by another drive in the machine, because the brake is not able to drive the material. Parameter ″Start speed″ is adjusted so that the brake is able to hold a certain torque but not too high. (Caution! Frictional grip of brake after standstill). Parameter ″Start limit″ is not used because the controller starts to work immediately after enabling the controller.

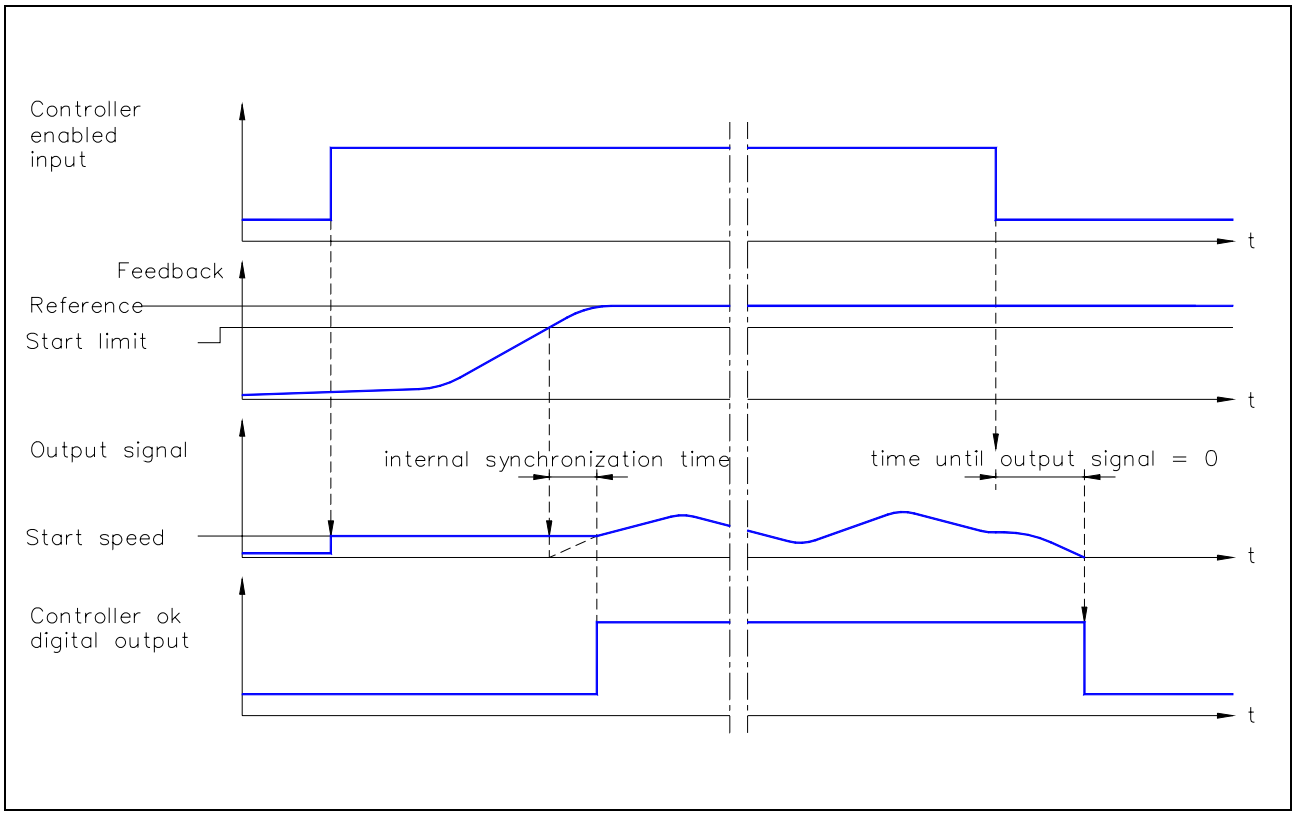
10.4 Controller lock

To stop control operating, reset the digital input „controller enabled“ or activate the corresponding serial interface command, depending on how you started the controller.
If no brake is used and the parameter ″Synchronisation-stop″ is set to „yes“, the controller don’t stops immediately but continues to control until the output signal is zero. Then, the dig. output „Controller ok“ will be reset. If parameter ″Synchronisation-stop″ is set to „no“, the output value will be zero immediately.
If a brake is used, the output value will be reduced to the start torque (start speed). If the start torque is reached, the dig. output „Controller ok“ will be reset.

10.5 Setting of tension reference

By pressing the key "REFERENCE" for 3 seconds, the actual tension tension reference is shown in the display. By pressing the arrow keys, the tension reference can be changed. The value shown in the display is taken for the control loop continuously. But the tension reference can be given also by interface or by analogue input.

10.6 Time flow of the signals using a control loop with drive



C400006e

11 Serial interface (RS232)

The serial interface is operated for example by a personal computer as a kind of „question and answer“ game: The PC sends a question resp. a command; the electronic unit will send an answer back. If the answer is missing, the electronic unit or the connection cable may fail.

11.1 Wiring diagram of the RS232 interface

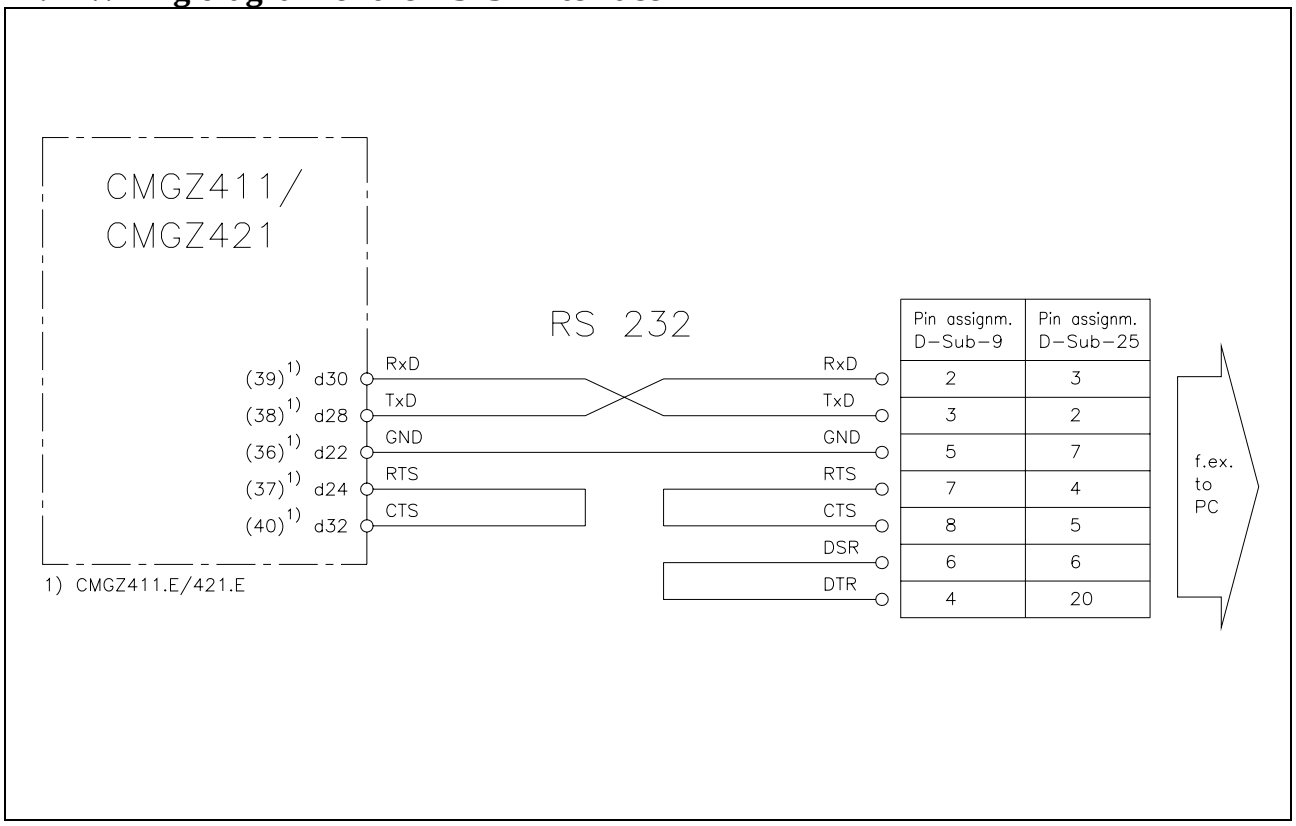


Diagram: Wiring of the RS232 interface C400007e

Reliable connection using maximum baudrate (9600) is guaranteed up to wire length of 10m. If the baudrate is reduced and/or good conditions prevail, considerably greater distances can be bridged in some cases. Connection to a PC etc. is done with a 9- or 25-pole Sub-D connector.

11.2 Command list

Command	Answer from controller	Purpose
IDNT<CR>	'CMGZ 411 V 1.00 0895' < Typ > <Version> . . <S >	10 characters type, fixed 10 characters version, fixed 4 characters serial number, fixed
DAKT<CR>	XXXXX<CR>	read actual diameter (CMGZ411)
DIFF<CR>	DIFY<CR> / DIFN<CR>	alarm controller error
DIFR<CR>	DIFRXXXX.X<CR>	alarm controller error in %
ERR?<CR>	XXXXXX<CR>	ask for eventual errors 1st digit: 1: Err1, 0: no Err1 2nd digit: 1: Err2, 0: no Err2 3rd " " 3 " " 3 etc.
FREI<CR>	PACC<CR> / FAIL<CR>	enable controller
INRS<CR>	PACC<CR> / FAIL<CR>	interface initialization (for ex. after loading new parameters)

LOCK<CR>	PACC<CR> / FAIL<CR>	disable controller, lock
REMR<CR>	PACC<CR> / FAIL<CR>	turn off remote mode
REMS<CR>	PACC<CR> / FAIL<CR>	turn on remote mode
SOLLXXXXX<CR>	PACC<CR> / FAIL<CR>	write new tension reference into RAM
SRMP<CR>	XXXXX<CR>	read actual tension reference
STEL<CR>	XXX.X<CR>	read actual output signal
SWRTXXXXX<CR>	PACC<CR> / FAIL<CR>	write new tension reference into EEPROM
STAR<CR>	XXXXXXXXXXXXXXXXXX<CR>	general status information 1-6 : feedback 7-11 : output 12-16: reference after ramp 17 : error evaluation 18 : controller error
VALA<CR>	XXXXXX<CR>	feedback channel A (CMGZ 421)
VALB<CR>	XXXXXX<CR>	feedback channel B (CMGZ 421)
VALS<CR>	XXXXXX<CR>	feedback A+B

11.3 Write parameters

Command	Answer	Purpose
WP01XXXXX<CR>	PACC<CR> / FAIL<CR>	offset feedback channel A
WP02X.XXX<CR>	PACC<CR> / FAIL<CR>	gain feedback channel A
WP03XXXXX<CR>	PACC<CR> / FAIL<CR>	offset feedback channel B (CMGZ 421)
WP04X.XXX<CR>	PACC<CR> / FAIL<CR>	gain feedback channel B (CMGZ 421)
WP05X.XXX<CR>	PACC<CR> / FAIL<CR>	value gain 1 -> channel A
WP06X.XXX<CR>	PACC<CR> / FAIL<CR>	value gain 1 -> channel B (CMGZ 421)
WP07XXXX<CR>	PACC<CR> / FAIL<CR>	nominal force
WP08X<CR>	PACC<CR> / FAIL<CR>	unit force
WP09X.X<CR>	PACC<CR> / FAIL<CR>	sensitivity
WP10X<CR>	PACC<CR> / FAIL<CR>	1 or 2 sensors
WP11XXX.X<CR>	PACC<CR> / FAIL<CR>	filter feedback
WP12XX.X<CR>	PACC<CR> / FAIL<CR>	filter instrument A+B
WP13XX.X<CR>	PACC<CR> / FAIL<CR>	filter instrument A (CMGZ 421)
WP14XX.X<CR>	PACC<CR> / FAIL<CR>	filter instrument B (CMGZ 421)
WP15XX.X<CR>	PACC<CR> / FAIL<CR>	filter display
WP16XX.XX<CR>	PACC<CR> / FAIL<CR>	scal. instrument A+B
WP17XX.XX<CR>	PACC<CR> / FAIL<CR>	scal. instrument A (CMGZ 421)
WP18XX.XX<CR>	PACC<CR> / FAIL<CR>	scal. instrument B (CMGZ 421)
WP19X<CR>	PACC<CR> / FAIL<CR>	limit 1 min / max
WP20XXXXX<CR>	PACC<CR> / FAIL<CR>	limit value 1
WP21X<CR>	PACC<CR> / FAIL<CR>	limit 2 min / max
WP22XXXXX<CR>	PACC<CR> / FAIL<CR>	limit value 2
WP23X<CR>	PACC<CR> / FAIL<CR>	language
WP24XX.X<CR>	PACC<CR> / FAIL<CR>	ramp reference
WP25X<CR>	PACC<CR> / FAIL<CR>	PID-configuration
WP26XX.XX<CR>	PACC<CR> / FAIL<CR>	Proportional component P
WP27XXX.XX<CR>	PACC<CR> / FAIL<CR>	Integral component I
WP28XX.XXX<CR>	PACC<CR> / FAIL<CR>	Derivative component D
WP29XXX.X<CR>	PACC<CR> / FAIL<CR>	alarm controller error

WP30XX<CR>	PACC<CR> / FAIL<CR>	machine configuration
WP31X<CR>	PACC<CR> / FAIL<CR>	output configuration
WP32XX.XX<CR>	PACC<CR> / FAIL<CR>	start speed
WP33XXX.X<CR>	PACC<CR> / FAIL<CR>	start limit
WP34X<CR>	PACC<CR> / FAIL<CR>	synchronisation-stop
WP35XXX.X<CR>	PACC<CR> / FAIL<CR>	line speed overlay (CMGZ411)
WP36XXXX<CR>	PACC<CR> / FAIL<CR>	Line speed tacho (CMGZ411)
WP37XXXX<CR>	PACC<CR> / FAIL<CR>	winder drive (CMGZ411)
WP38XXXX<CR>	PACC<CR> / FAIL<CR>	tacho diameter (CMGZ411)
WP39XXXX<CR>	PACC<CR> / FAIL<CR>	center diameter (CMGZ411)
WP40XXXXX<CR>		PACC<CR> / FAIL<CR> max. diameter (CMGZ411)
WP41X<CR>	PACC<CR> / FAIL<CR>	tension reduction (CMGZ 411)
WP42X.XXX<CR>	PACC<CR> / FAIL<CR>	reduction value (CMGZ 411)
WP43XXXXX<CR>	PACC<CR> / FAIL<CR>	scal. poti reference (CMGZ411)
WP44X<CR>	PACC<CR> / FAIL<CR>	correction input (CMGZ 411)
WP45XX.XXX<CR>		PACC<CR> / FAIL<CR> linear correction at 0VDC (CMGZ 411)
WP46XX.XXX<CR>		PACC<CR> / FAIL<CR> linear correction at 10 VDC (CMGZ 411)
WP47X.XXX<CR>	PACC<CR> / FAIL<CR>	gain cosine at U1 (CMGZ 411)
WP48X.XXX<CR>	PACC<CR> / FAIL<CR>	gain cosine at U2 (CMGZ 411)
WP49X.XXX<CR>	PACC<CR> / FAIL<CR>	gain cosine at U3 (CMGZ 411)
WP50XXX<CR>	PACC<CR> / FAIL<CR>	identifier
WP51XXXX<CR>	PACC<CR> / FAIL<CR>	Baud rate interface
WP52X<CR>	PACC<CR> / FAIL<CR>	Data bit interface
WP53X<CR>	PACC<CR> / FAIL<CR>	Stop bit interface
WP54X<CR>	PACC<CR> / FAIL<CR>	Parity interface

11.4 Read parameters

Command	Answer	Purpose
RP01<CR>	XXXXX<CR>	offset feedback channel A
RP02<CR>	X.XXX<CR>	gain feedback channel A
RP03<CR>	XXXXX<CR>	offset feedback channel B (CMGZ 421)
RP04<CR>	X.XXX<CR>	gain feedback channel B (CMGZ 421)
RP05<CR>	X.XXX<CR>	value gain 1 -> channel A (CMGZ 421)
RP06<CR>	X.XXX<CR>	value gain 1 -> channel B (CMGZ 421)
RP07<CR>	XXXX<CR>	nominal force
RP08<CR>	X<CR>	unit force
RP09<CR>	X.X<CR>	sensitivity
RP10<CR>	X<CR>	1 or 2 sensors
RP11<CR>	XXX.X<CR>	filter feedback
RP12<CR>	XX.X<CR>	filter instrument A+B
RP13<CR>	XX.X<CR>	filter instrument A (CMGZ 421)
RP14<CR>	XX.X<CR>	filter instrument B (CMGZ 421)
RP15<CR>	XX.X<CR>	filter display
RP16<CR>	XX.XX<CR>	scal. instrument A+B
RP17<CR>	XX.XX<CR>	scal. instrument A (CMGZ 421)
RP18<CR>	XX.XX<CR>	scal. instrument B (CMGZ 421)
RP19<CR>	X<CR>	limit 1 min / max
RP20<CR>	XXXXX<CR>	limit value 1
RP21<CR>	X<CR>	limit 2 min / max
RP22<CR>	XXXXX<CR>	limit value 2
RP23<CR>	X<CR>	language
RP24<CR>	XX.X<CR>	ramp reference
RP25<CR>	X<CR>	PID-configuration

RP26<CR>	XX.XX<CR>	Proportional component P
RP27<CR>	XXX.XX<CR>	Integral component I
RP28<CR>	XX.XXX<CR>	Derivative component D
RP29<CR>	XXX.X<CR>	alarm controller error
RP30<CR>	XX<CR>	machine configuration
RP31<CR>	X<CR>	output configuration
RP32<CR>	XX.XX<CR>	start speed
RP33<CR>	XXX.X<CR>	start limit
RP34<CR>	X<CR>	synchronisations-stop
RP35<CR>	XXX.X<CR>	line speed overlay (CMGZ411)
RP36<CR>	XXXX<CR>	Line speed tacho (CMGZ411)
RP37<CR>	XXXX<CR>	winder drive (CMGZ411)
RP38<CR>	XXXX<CR>	tacho diameter (CMGZ411)
RP39<CR>	XXXX<CR>	center diameter (CMGZ411)
RP40<CR>	XXXXX<CR>	max. diameter (CMGZ411)
RP41<CR>	X<CR>	tension reduction (CMGZ 411)
RP42<CR>	X.XXX<CR>	reduction value (CMGZ 411)
RP43<CR>	XXXXX<CR>	scal. poti reference (CMGZ411)
RP44<CR>	X<CR>	correction input (CMGZ 411)
RP45<CR>	XX.XXX<CR>	linear correction at 0 VDC (CMGZ 411)
RP46<CR>	XX.XXX<CR>	lineare correction at 10 VDC (CMGZ 411)
RP47<CR>	X.XXX<CR>	gain cosine at U1 (CMGZ 411)
RP48<CR>	X.XXX<CR>	gain cosine at U2 (CMGZ 411)
RP49<CR>	X.XXX<CR>	gain cosine at U3 (CMGZ 411)
RP50<CR>	XXX<CR>	identifier
RP51<CR>	XXXX<CR>	Baud rate interface
RP52<CR>	X<CR>	Data bit interface
RP53<CR>	X<CR>	Stop bit interface
RP54<CR>	X<CR>	Parity interface

All parameter numbers refer to the parameter list. Depending on the value value being ok or not, the control unit’s reply to a write parameter command is PACC<CR> (value accepted) or FAIL<CR> (value not accepted). With PACC, the parameter is written to the EEPROM.

12 Parametrization

12.1 Parameter list CMGZ411

PARAMETER	Unit	Default	MIN	MAX	Actual
Find offset feedback					
Calibration feedback					
Calibration gain 1 feedback					
Calibration gain cosine at U1					
Calibration gain cosine at U2					
Calibration gain cosine at U3					
Value offset-feedback	[Dig]	0	-4000	4000	_____
Value gain-feedback	[-]	1.000	0.100	9.000	_____
Value gain 1 feedback	[-]	1.000	0.100	9.000	_____
Nominal force	[N,KN]	1000	1	9999	_____
Unit force	[N,KN]	N	N	KN	_____
Sensitivity	[mV/V]	1.8	0.1	3.0	_____
1 or 2 sensors	[-]	1	1	2	_____
Lowpass-output	[Hz]	50.0	0.1	200.0	_____
Lowpass-instrument	[Hz]	1.0	0.1	10.0	_____
Lowpass display	[Hz]	1.0	0.1	10.0	_____
Scale-instrument	[-]	1.00	0.01	10.00	_____
Limit 1 min/max	[-]	0	0	1	_____
Limit value 1	[N,KN]	0	-9999	9999	_____
Limit 2 min/max	[-]	1	0	1	_____
Limit value 2	[N,KN]	0	-9999	9999	_____
Language	D German, E English, F French, I Italian				_____
Ramp reference	[s]	1.0	0.1	100.0	_____
PID-configuration	PID, PI, PD				_____
Proportional component P	[-]	1.00	0.01	50.00	_____
Integral component I	[s]	1.00	0.01	100.00	_____
Derivative component D	[s]	0.010	0.001	10.000	_____
Alarm limit error	[%]	10.0	0.1	100.0	_____
Maschine-configuration	[-]	1	1	23	_____
Output-configuration	0..10V, 0..20mA, 4..20mA, +/-10V				_____
Start speed	[% output.]	0.00	0.00	50.00	_____
Start limit	[% reference]	90.0	0.0	100.0	_____
Synchronisation-stop	No, Yes				_____
Line speed overlay	[%]	0.0	0.0	100.0	_____
Line speed tacho	[rpm/V]	300	1	1000	_____
Winder drive	[rpm/V]	300	1	1000	_____
Tacho diameter	[mm]	100	10	1000	_____
Center diameter	[mm]	100	10	5000	_____
Max. diameter	[mm]	1000	10	10000	_____
Tensionreduction	No, Linear, Square, Root				_____
Reduction value	[-]	0.000	0.000	1.000	_____
Scale poti reference	[N,KN]	0	0	9999	_____
Correction input	No, Linear, Cosine				_____
Linear correction at 0V	[-]	1.000	-9.999	9.999	_____
Linear correction at 10V	[-]	1.000	-9.999	9.999	_____
Gain cosine at U1	[-]	1.000	0.001	9.999	_____
Gain cosine at U2	[-]	1.000	0.001	9.999	_____
Gain cosine at U3	[-]	1.000	0.001	9.999	_____
Identifier	[-]	0	0	127	_____
Baud rate	[1/s]	9600	300	9600	_____
Data bit	[-]	8	7	8	_____
Stop bit	[-]	1	1	2	_____
Parity bit	none, odd, even				_____

12.2 Parameter list CMGZ421

PARAMETER	Unit	Default	MIN	MAX	Actual
Find offset channelA					
Calibration feedback channel A					
Find offset channel B					
Calibration feedback channel B					
Calibration gain 1 channel A					
Calibration gain 1 channel B					
Value off.-feed. chan. A	[Dig]	0	-4000	4000	_____
Value gain-feed. chan. A	[-]	1.000	0.100	9.000	_____
Value off.-feed. chan. B	[Dig]	0	-4000	4000	_____
Value gain-feed. chan. B	[-]	1.000	0.100	9.000	_____
Value gain 1 chan. A	[-]	1.000	0.100	9.000	_____
Value gain 2 chan. B	[-]	1.000	0.100	9.000	_____
Nominal force	[N,KN]	1000	1	9999	_____
Unit force	[N,KN]	N	N	KN	_____
Sensitivity	[mV/V]	1.8	0.1	3.0	_____
Lowpass-output	[Hz]	50.0	0.1	200.0	_____
Lowpass-inst. A+B	[Hz]	1.0	0.1	10.0	_____
Lowpass-inst. A	[Hz]	1.0	0.1	10.0	_____
Lowpass-inst. B	[Hz]	1.0	0.1	10.0	_____
Lowpass display	[Hz]	1.0	0.1	10.0	_____
Scale-instrument A+B	[-]	0.50	0.01	10.00	_____
Scale-instrument A	[-]	1.00	0.01	10.00	_____
Scale-instrument B	[-]	1.00	0.01	10.00	_____
Limit 1 min/max	[-]	0	0	1	_____
Limit value 1	[N,KN]	0	-9999	9999	_____
Limit 2 min/max	[-]	1	0	1	_____
Limit value 2	[N,KN]	0	-9999	9999	_____
Language	D German, E English, F French, I Italian				_____
Ramp reference	[s]	1.0	0.1	100.0	_____
PID-configuration	PID, PI, PD				_____
Proportional component P	[-]	1.00	0.01	50.00	_____
Integral component I	[s]	1.00	0.01	100.00	_____
Derivative component D	[s]	0.010	0.001	10.000	_____
Alarm limit error	[%]	10.0	0.1	100.0	_____
Maschine-configuration	[-]	1	1	23	_____
Output-configuration	0..10V, 0..20mA, 4..20mA, -/+10V				_____
Start speed	[% output]	0.00	0.00	50.00	_____
Start limit	[% reference]	90.0	0.0	100.0	_____
Synchronisation-stop	No,Yes				_____
Identifier	[-]	0	0	127	_____
Baud rate	[1/s]	9600	300	9600	_____
Data bit	[-]	8	7	8	_____
Stop bit	[-]	1	1	2	_____
Parity bit	none, odd even				_____

12.3 Description of the parameters

Find offset feedback CMGZ411

Purpose: By pressing the enter key for 3 seconds, the actually measured value is stored as an offset value. This function is used to compensate the weight of the roller and of the material.

Calibration feedback CMGZ411

Purpose: This parameter allows to adjust the display value to a value which is corresponding to the loaded weight (= web tension).The microprocessor calculates a new gain factor in the background while the display shows the feedback. The gain factor is changed by the up and down keys and stored with ↵ key. The gain factor adjusted can be seen under Parameter „Value gain feedback“.

Calibration gain 1 feedback CMGZ411

Purpose: This parameter allows to adjust the display value to a value which is corresponding to the loaded weight (= web tension).The microprocessor calculates a new gain factor in the background while the display shows the feedback. The gain factor is changed by the up and down keys and stored with ↵ key. The gain factor adjusted can be seen under Parameter „Value gain feedback“. Gain switching is activated by digital input 3 (terminal b6).

Calibration gain cosine at U1 CMGZ411

Purpose: This parameter allows to adjust the display value to a value which is corresponding to the loaded weight (= web tension) when cosine correction is active.The microprocessor calculates a gain factor in the background which will result a changed display value. The gain factor is changed by the up and down keys. If the effective value is shown, the gain factor and the referring input voltage are stored with ↵ key. Proceed with „Calibration gain cosine at U2“

Calibration gain cosine at U2 CMGZ411

Purpose: If the voltage U2 is applied to the correction input (terminals d6 / d8), this parameter allows to adjust the display value to a value which is corresponding to the loaded weight (= web tension) when cosine correction is active.The microprocessor calculates a gain factor in the background which will result a changed display value. The gain factor is changed by the up and down keys. If the effective value is shown, the gain factor and the referring input voltage are stored with ↵ key. Proceed with „Calibration gain cosine at U3“

Calibration gain cosine at U3 CMGZ411

Purpose: If the voltage U3 is applied to the correction input (terminals d6 / d8), this parameter allows to adjust the display value to a value which is corresponding to the loaded weight (= web tension) when cosine correction is active.The microprocessor calculates a gain factor in the background which will result a changed display value. The gain factor is changed by the up and down keys. If the effective value is shown, the gain factor and the referring input voltage are stored with ↵ key.

Value offset-feedback

Purpose: This parameter allows to show the offset value in digits stored under „Find offset value“. It is not needed to note this value, due to offset adjustment can be done easily at any time by using parameter „Find offset value“.

Range:	-4000	to	+4000	**Default:**	0
Increment:	1				

Value gain-feedback

Purpose: This parameter allows to show the gain factor set under „Calibration feedback“ or to enter a gain factor calculated by the formula (refer to „initial operation“).

Range:	0.100	to	9.000	**Default:**	1.000
Increment:	0.001				

Value gain 1 feedback

Purpose: This parameter allows to show the gain factor set under „Calibration gain 1 feedback“ or to enter a gain factor calculated by the formula (refer to „initial operation“).

Range:	0.100	to	9.000	**Default:**	1.000
Increment:	0.001				

Nominal force of sensors

Purpose: To get a display value according to the actual force in the machine, it is necessary to enter the nominal force of the sensors here.

Range:	1	to	9999	**Default:**	1000
Increment:	1			**Unit:**	[N, kN]

Unit force

Purpose: This parameter stores the sensor’s force unit.

Range:	N	to	KN	**Default:**	N

Sensitivity

Purpose: To get accurate force values in the display, the controller has to know the sensitivity of the force sensor. FMS has 1.8mV/V as standard.

Range:	0.1	to	3.0	**Default:**	1.8
Increment:	0.1			**Unit:**	[mV/V]

1 or 2 sensors CMGZ411

Purpose: To get accurate force values in the display, the controller has to know if a roller is supported by one or two force sensors.

Range:	1	to	2	**Default:**	1
Increment:	1			**Unit:**	[1]

Lowpass-output

Purpose: The control unit provides a low-pass filter for the tension feedback to suppress noise caused by unbalanced rollers or interference. The signal conditioned with this Filter is used for the control loop.With this parameter, the cutoff frequency is set in Hz. It must be ensured that the feedback cutoff frequency is not lower than needed for the controller dynamics.

Range:	0.1	to	200.0	**Default:**	50.0
Increment:	0.1			**Unit:**	[Hz]

Lowpass-instrument

Purpose: The control unit provides a low-pass filter for the tension feedback to suppress noise caused by unbalanced rollers or interference. The signal conditioned with this filter drives a 0-10V analog output signal. With this parameter, the cutoff frequency is set in Hz.

Range:	0.1	to	10.0	**Default:**	1.0
Increment:	0.1			**Unit:**	[Hz]

Lowpass-display

Purpose: The control unit provides a low-pass filter for the display to get stable values in the display. This cutoff frequency is independent of the feedback lowpass.

Range:	0.1	to	10.0	**Default:**	1.0
Increment:	0.1			**Unit:**	[Hz]

Scaling instrument

Purpose: With a setting of 1.00, the analogue output (0...10V) provides the nominal voltage at nominal tension force. By decreasing the scale parameter, the nominal voltage is decreased; if the scale parameter is increased, nominal voltage is also increased.

Range:	0.01	to	10.00	**Default:**	1.00
Increment:	0.01			**Unit:**	[-]

Limit value 1 min./max.

Purpose: The limit value 1 can be configured as min or max contact. This means, the digital output is activated when the value stored under parameter „limit value 1“ is passed over resp. under, depending on the setting in this parameter.

Range:	min	to	max	**Default:**	max
Increment:				**Unit:**	[-]

Limit value 1

Purpose: Actual threshold of limit value 1. The limit value is stored in the same units as the force feedback is shown in the display.

Range:	-9999	to	+9999	**Default:**	0
Increment:	1			**Unit:**	[N/kN]

Limit value 2 Min./Max.

Purpose: The limit value 2 can be configured as min or max contact. This means, the digital output is activated when the value stored under parameter „limit value 2“ is passed over resp. under, depending on the setting in this parameter.

Range:	min	to	max	**Default:**	max
Increment:				**Unit:**	[-]

Limit value2

Purpose: Actual threshold of limit value 2. The limit value is stored in the same units as the force feedback is shown in the display.

Range:	-9999	to	+9999	**Default:**	0
Increment:	1			**Unit:**	[N/kN]

Language

Purpose: With this parameter, the language in the display can be chosen.

Range: German (G), English (E), French (F), Italien (I)

Ramp reference

Purpose: To optimize the controller regarding to disturbance characteristics, changes of the reference value must not be too fast. Therefore, the tension reference is led internally over a ramp. Its rate of rise is adjusted with this parameter. The value stored in this parameter is the time it takes to let the reference value rise.

Range:	0.1	to	20.0	**Default:**	1.0
Increment:	0.1			**Unit:**	[s]

PID configuration

Purpose: This parameter mainly influences the behaviour of the controller.

Range: PID, PI, PD

Proportional component P

Purpose: This value is responsible for the reaction of the proportional component. It is stored independently of integral or derivative component.

Range:	0.01	to	50.00	**Default:**	1.00
Increment:	0.01			**Unit:**	[-]

Integral component I

Purpose: The time stored here is responsible for the integral component. It is stored independently of proportional or derivative component.

Range:	0.01	to	100.00	**Default:**	1.00
Increment:	0.01			**Unit:**	[s]

Derivative component D

Purpose: The time entered under this parameter is responsible for the derivative component. It is stored independently of proportional or integral component.The derivative component is only active if the respective configuration of the controller is chosen under Parameter „PID configuration“.

Range:	0.001	to	10.000	**Default:**	0.010
Increment:	0.001			**Unit:**	[s]

Alarm controller error

Purpose: If the control error is higher than the value stored in this parameter, this is indicated by a digital output and the answer to the referring interface command.
The value means the percentage quota of the nominal force of the sensors.

Range:	0.1	to	100.0	**Default:**	10.0
Increment:	0.1			**Unit:**	[%]

Machine configuration

Purpose: The machine configuration depends on the arrangement as winder/unwinder, intermediat drive or brake to get correct feedback signal for all of these conditions.
The selection is easy with the illustrations in chapter 7.

Range:	1	to	23	**Default:**	1
Increment:	1			**Unit:**	[-]

Output configuration

Purpose: This parameter allows to select a appropriate output signal depending on the application.

Range: 0...10V, ±10V, 0.0.20mA, 4..20mA

Start speed

Purpose: If there is slack material in the machine when the controller is enabled, the drive would take up the slack very fast. If tension is reached, the drive cannot decelerate fast enough, so that material cracking can be the result. To avoid this, the controller drives with a low speed given with this parameter until a certain tension (Parameter Start limit) is reached.
If a brake is controlled, the controller starts from the torque stored here and reduces after disabling again to this torque.

Range:	0.00	to	50.00	**Default:**	0.00
Increment:	0.01			**Unit:**	[% max. output signal]

Start limit

Purpose: If there is slack material in the machine when the controller is enabled, the drive would take up the slack very fast. If tension is reached, the drive cannot decelerate fast enough, so that material cracking can be the result. To avoid this, the controller drives with a low speed until the force stored here is reached.
Controlling a brake, this parameter is not used.

Range:	0.0	to	100.0	**Default:**	90.0
Increment:	0.1			**Unit:**	[% reference]

Synchronisation-stop

Purpose: If the synchronisation stop is not active, the output value will be 0V immediately if the controller is disabled. If the synchronisation-stop is active, the controller will control until output has reached 0V.

Range:	No, Yes			**Default:**	No

Line speed overlay CMGZ411

Purpose: This parameter gives the percentage quota of the controller output which will be overlayed to the line speed. Common value is 10%.

Range:	0.0	to	100.0	**Default:**	00.0
Increment:	0.1			**Unit:**	[%]

Line speed tacho CMGZ411

Purpose: Stores the revolutions per minute that will rise a 1V signal at the line speed tacho.

Range:	1	to	1000	**Default:**	300
Increment:	1			**Unit:**	[rpm/V]

Winder drive CMGZ411

Purpose: Stores the revolutions per minute that the drive will have when a 1V signal is applied to his input terminal.

Range:	1	to	1000	**Default:**	300
Increment:	1			**Unit:**	[rpm/V]

Tacho diameter CMGZ411

Purpose: This parameter stores the diameter of the roller with the line speed tacho.

Range:	10	to	1000	**Default:**	100
Increment:	1			**Unit:**	[mm]

Center diameter CMGZ411

Purpose: Stores the minimum bobbin diameter. Used to calculate the actual bobbin diameter.

Range:	10	to	5000	**Default:**	100
Increment:	1			**Unit:**	[mm]

Max. diameter CMGZ411

Purpose: Stores the maximum bobbin diameter. Used to calculate the actual bobbin diameter.

Range:	10	to	10000	**Default:**	1000
Increment:	10			**Unit:**	[-]

Tension reduction CMGZ411

Purpose: The CMGZ411 provides facilities to reduce tension across the changing bobbin diameter. Under this parameter, the reduction is selected as linear, square or square root function.

Range:	none, linear, quadratic, root			**Default:**	root

Reduction value CMGZ411

Purpose: Stores the correction factor used at maximum bobbin diameter. For tension reduction, refer to chapter „Parametrization of the PID controller“

Range:	0.000	to	1.000	**Default:**	0.000
Increment:	0.001			**Unit:**	[N/kN]

Scal. potmeter reference CMGZ411

Purpose: Stores the tension value that will correspond to a signal of 10V at the analogue input (terminals d6 / d8).

Range:	0	to	9999	**Default:**	0
Increment:	1			**Unit:**	[N/kN]

Correction input CMGZ411

Purpose: This parameter is uesd, if the wrap angle is changing continuously. It is possible to choose between a linear or a cosine correction. Refer to chapter „correction input“

Range:	none, linear, cosine			**Default:**	none

Linear correction at 0V CMGZ411

Purpose: This parameter stores the factor that is used when 0V is applied to the correction input (terminals d6 / d8). The feedback value can be changed up (>1.000) and down (<1.000). Only active if parameter „correction input“ is „linear“.

Range:	-9.999	to	9.999	**Default:**	1.000
Increment:	0.001			**Unit:**	[-]

Linear correction at 10V CMGZ411

Purpose: This parameter stores the factor that is used when 10V is applied to the correction input (terminals d6 / d8). The feedback value can be changed up (>1.000) and down (<1.000). Only active if parameter „correction input“ is „linear“.

Range:	-9.999	to	9.999	**Default:**	1.000
Increment:	0.001			**Unit:**	[-]

Gain cosine at U1, U2, U3 CMGZ411

Purpose: Stores the value calculated with parameter „Gain cosine at U1 / U“ / U3“.

Range:	0.001	to	9.999	**Default:**	1.000
Increment:	0.001			**Unit:**	[-]

Identifier

Purpose: This parameter identifies the CAN-BUS-Interface. Reserved for future use.

Baud rate

Purpose: Configuration of the transmission rate of the RS-232 interface. 300, 600, 1200, 2400, 4800, 9600 baud.

Range:	300	to	9600	**Default:**	9600

Data bit

Purpose: Configuration of the RS-232 interface.

Range:	7	to	8	**Default:**	8

Stop bit

Purpose: Configuration of the RS-232 interface.

Range:	1	to	2	**Default:**	1

Parity bit

Purpose: Configuration of the RS-232 interface.

Range:	none, odd, even	**Default:**	none

Find offset feedback channel A resp. channel B CMGZ421

Purpose: By pressing the enter key for 3 seconds, the actually measured value is stored as an offset value. This function is used to compensate the weight of the roller and of the material.

Calibration gain feedback channel A resp. channel B CMGZ421

Purpose: This parameter allows to adjust the display value to a value which is corresponding to the loaded weight (= web tension).The microprocessor calculates a new gain factor in the background while the display shows the feedback. The gain factor is changed by the up and down keys and stored with ↵ key. The gain factor adjusted can be seen under Parameter „Value gain feedb. channel A“ resp. „Value gain feedb. channel B“.

Calibration gain 1 channel A resp. channel B CMGZ421

Purpose: This parameter allows to adjust the display value to a value which is corresponding to the loaded weight (= web tension).The microprocessor calculates a new gain factor in the background while the display shows the feedback. The gain factor is changed by the up and down keys and stored with ↵ key. The gain factor adjusted can be seen under Parameter „Value gain 1 channel A“ resp. „Value gain 1 channel B“. Gain switching is activated by digital input 3 (terminal b6).

Lowpass-instrument A+B CMGZ421

Purpose: The control unit provides a low-pass filter for the tension feedback to suppress noise caused by unbalanced rollers or interference. The signal conditioned with this filter is used for the control loop. With this parameter, the cutoff frequency in Hz is set. It must be ensured that the feedback cutoff frequency is not lower than needed for the controller dynamics.

Range:	0.1	to	10.0	**Default:**	1.0
Increment:	0.1			**Unit:**	[Hz]

Lowpass-instrument A CMGZ421

Purpose: The control unit provides a low-pass filter for the tension feedback to suppress noise caused by unbalanced rollers or interference. The signal conditioned with this filter drives a 0-5V analogue output signal. With this parameter, the cutoff frequency in Hz is set.

Range:	0.1	to	50.0	**Default:**	1.0
Increment:	0.1			**Unit:**	[Hz]

Lowpass-instrument B CMGZ421

Purpose: The control unit provides a low-pass filter for the tension feedback to suppress noise caused by unbalanced rollers or interference. The signal conditioned with this filter drives a 0-5V analogue output signal. With this parameter, the cutoff frequency in Hz is set.

Range:	0.1	to	10.0	**Default:**	1.0
Increment:	0.1			**Unit:**	[Hz]

Scaling instrument A+B CMGZ421

Purpose: With a setting of 1.00, the analogue output (0...10V) provides the nominal voltage at nominal tension force. By decreasing the scale parameter, the nominal voltage is decreased; if the scale parameter is increased, nominal voltage is also increased.

Range:	0.01	to	10.00	**Default:**	1.00
Increment:	0.01			**Unit:**	[-]

Scaling instrument A CMGZ421

Purpose: With a setting of 1.00, the analogue output (0...5V) provides the nominal voltage at nominal tension force. By decreasing the scale parameter, the nominal voltage is decreased; if the scale parameter is increased, nominal voltage is also increased.

Range:	0.01	to	10.00	**Default:**	1.00
Increment:	0.01			**Unit:**	[-]

Scaling instrument B CMGZ421

Purpose: With a setting of 1.00, the analogue output (0...5V) provides the nominal voltage at nominal tension force. By decreasing the scale parameter, the nominal voltage is decreased; if the scale parameter is increased, nominal voltage is also increased.

Range:	0.01	to	10.00	**Default:**	1.00
Increment:	0.01			**Unit:**	[-]

13 Trouble shooting

13.1 Trouble shooting CMGZ411

Error	Cause	Corrective action
Err1	A/D-converter gets signals < -9.7mV	Channel A is wrongly connected (change pins z6 / z8 resp. 2 / 3)
Err2	A/D-converter gets signals > 9.7mV	Channel A is wrongly connected (supply and signal changed) Short circuit in sensor connector or sensor cable Sensor overloaded Sensor with too high sensitivity
Err5	Analog output (A+B) is at min. (-10V, 0/4mA)	Check parameter „config. output 1“ and the offset value
Err6	Analog output value is „output 1 > Max.“(A+B) at min. (+10V, 20mA)	Check parameter „config. output 1“ and the offset value

13.2 Trouble shooting CMGZ421

Error	Cause	Corrective action
Err1	A/D-converter channel A gets signals < -9.7mV	Channel A is wrongly connected (change pins z6 / z8 resp. 2 / 3)
Err2	A/D-converter channel A gets signals > 9.7mV	Channel A is wrongly connected (supply and signal changed) Short circuit in sensor connector or sensor cable Sensor overloaded Sensor with too high sensitivity
Err3	A/D-converter channel B gets signals < -9.7mV	Channel B is wrongly connected (change pins d6 / d8 resp. 7 / 8) values < -9.7mV
Err4	A/D-converter channel B gets signals > 9.7mV	Channel B is wrongly connected (supply and signal changed) Short circuit in sensor connector or sensor cable Sensor overloaded Sensor with too high sensitivity

14 Technical Data

	CMGZ411	**CMGZ421**
Connection of sensors	1 or 2 parallel force sensors of 350Ω	2 x 1 force sensor of 350Ω
Excitation voltage	4VDC	4VDC
Input signal voltage	9.9mV	9.9mV
Resolution A/D-converter	±4096 Digit	±4096 Digit
Measuring error	<0.05% FS	<0.05% FS
Cycle time	4ms	4ms
Display	LCD 2x16 characters	LCD 2x16 characters
Analogue output 12 bit 0...10V	Web tension feedback	Web tension feedback A+B
Analogue output 12 bit ±10V, 0...10V, 0/4...20mA	Output signal	Output signal
Analogue output 8 bit 0...5V Ri=500Ω	--	Channel A feedback
Analogue output 8 bit 0...5V Ri=500Ω	--	Channel B feedback
Tension reference	with integrated keys, external 0...10V, RS232, RS485 or CAN-Bus	with integrated keys, external 0...10V, RS232, RS485 or CAN-Bus
Analogue input 0...10V for gain corrections (wrap angles etc.)	Option	--
Configurations:		
Winder	DC-drives, FC-AC-drives with selectable web tension reduction across diameter	DC-drives, FC-AC-drives with selectable web tension reduction across diameter
Unwinder	Brake, DC-drives on torque or speed control	Brake, DC-drives on torque or speed control
Line drive	FC-AC-drives, DC-drives, with or without line speed overlay	FC-AC-drives, DC-drives, with or without line speed overlay
Dig. output 1 (open collector galv. insul.)	Controller ok	Controller ok
Dig. output 2 (open collector galv. insul.)	Controller error	Controller error
Dig. output 3 (open collector galv. insul.)	Minimum / Maximum limit	Minimum / Maximum limit
Dig. output 4 (open collector galv. insul.)	Minimum / Maximum limit	Minimum / Maximum limit
Dig. input 1 (24VDC galv. insul.)	Controller enabled	Controller enabled
Dig. input 2 (24VDC galv. insul.)	Reset Diameter	
RS232	standard	standard
RS485	standard	standard
RS485 galv. insul.	Option	Option
CAN-Bus	Option	Option
Supply voltage	18...36VDC / 0.15A, galv. insul.	18...36VDC / 0.15A, galv. insul.
Connector	DIN 41612 Type F b+d+z	DIN 41612 Type F b+d+z
Temperature range	0...50°C	0...50°C
Weight	0.22kg	0.22kg

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