# Operating Manual CMGZ434

Digital microprocessor controlled tension control unit
for line drives

Version 2.22 05/04 sd

This operation manual is also available in german and french.
Please contact your local representative.

Diese Bedienungsanleitung ist auch in deutsch und französisch erhältlich.
Bitte kontaktieren Sie die Vertretung im zuständigen Land.

Ce mode d'emploi est également disponible en français et en allemand.
Veuillez contacter la représentation locale.

# 1 Safety Instructions

## 1.1 Description conditions

**a) High danger of health injury or loss of life**

**Danger**

This symbol refers to high risk for persons to get health injury or loss life. It has to be followed strictly.

**b) Risk of damage of machines**

**Caution**

This symbol refers to informations, that, if ignored, could cause heavy mecanical damage. This warning has to be followed absolutely.

**c) Notice for proper function**

**Notice**

This symbol refers to an important information about proper use. If not followed, malfunction can be the result.

## 1.2 List of safety instructions

Proper function of the 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.

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.

The tension controller can operate drives with high performance. It has no built-in emergency stop function. 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 ciruits, etc.

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.

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!

Some contacts of the 110VAC resp. 230VAC version are under 110V resp. 230V tension! Mortal danger! Disconnect power supply before open the housing!

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# 2 Definitions

**Offset:** Correction value for compensation of the zero point difference. Thanks to the offset, it is ensured that a force of 0N will generate a signal of 0V exactly.

**Gain:** Amplification factor for the measuring signal. Use of proper value will set the measuring range of the sensor exactly corresponding to the signal output range (0...10V).

**Strain gauge:** Electronic component that will change its resistance while its length has changed. Strain gauges are used in the FMS force sensors for acquisition of the feedback value.

**Single quadrant resp four-quadrant drive:** Expression refers to the speed/torque diagram used in the drive technology. A single quadrant drive can only drive in forward direction; a four-quadrant drive can both drive and brake in forward and reward direction.

# 3 System components

The FMS line drive controller consists of the following components (refer also to fig. 1):
**Force sensors**

- For mechanical/electrical conversion of the tension force
- Force measuring bearing
- *Force measuring roller, Force measuring journal or Force measuring bearing block*

**Electronic unit CMGZ434**

- For supplying of the force sensors and amplifying of the mV signal
- With integrated digital PI- or PID-controller to drive the drive unit
- Speed or torque control supported
- External line speed signal can be processed an added to the output value
- With operation panel for parametrization
- Interface RS232
- *Interface CAN-Bus*
- For mounting into insert card support block EMGZ555959 (by mounting into switch cabinet)
- *Mounted in separate housing (CMGZ434.E)*
- *Integrated power supply (by using separate housing)*
- Supports connection of an external feedback display

**Drive**

- Speed or torque controlled drive
- AC or DC motor
- many different products are suitable

*(Italic components as variant or option)*

# 4 System description

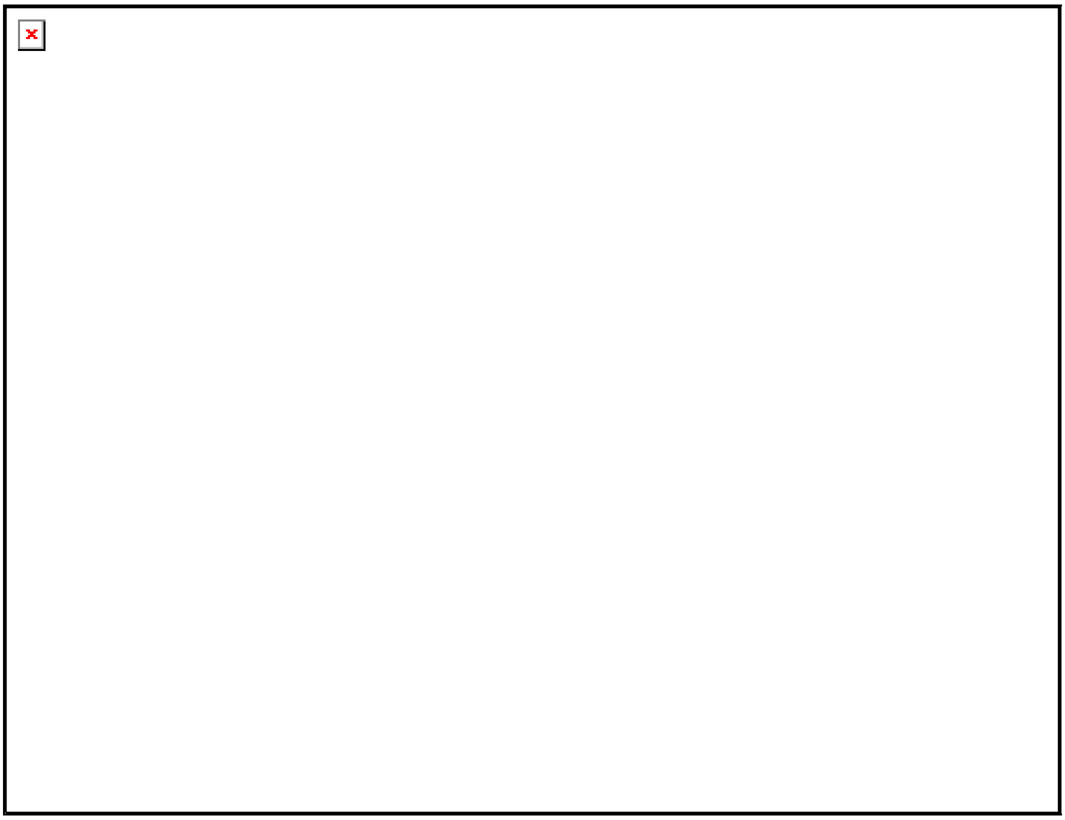

**fig. 1: Basic structure of a drive control system on a line drive application**

C434001e

## 4.1 Functional description

The force sensors measure the tension force in the material and transmit the measuring value as a mV signal to the electronic unit CMGZ434. The electronic unit amplifies the mV signal and calculates the error to the reference value. If the material tension is too low resp. too high, the drive will be driven slower resp. faster, depending on the drive being mounted before or after the force sensors (fig. 1).

## 4.2 Force sensors

The force sensors are based on the flexion beam principle. The flexion is measured by strain gauges and transmitted to the electronic unit as mV signal. Due to the wheatstone wiring of the strain gauges, the measured value is according also to the power supply. So, the force sensors are supplied from the CMGZ434 by a very accurate power supply.

## 4.3 Electronic unit CMGZ434

**Common**

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).

**Controller**
The control unit compares the reference value with the measured feedback value and transmits the error to the controller configurable as PI or PID. The controller calculates the output signal according to the difference. The output signal is provided as an analog signal (0...10V / ±10V / 0...20mA / 4...20mA).
With a tacho generator or other source, a 0...10V signal proportional to the line speed can be fed to the controller. This signal may be overlayed to the PID signal.

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

**fig. 2: Block diagram of the electronic unit CMGZ434** C434002e

## 4.4 Drive

There can be used any AC or DC four-quadrant drive selected according to the required dynamics.

# 5 Controller theory

## 5.1 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 across the rollers. Tension may change when humidity, temperature, winding or unwinding diameters vary or when the sheets are being printed, coated, glued or pressed. Tension is measured constantly and maintained at the correct value with the FMS force measuring and control system.

## 5.2 PID controller

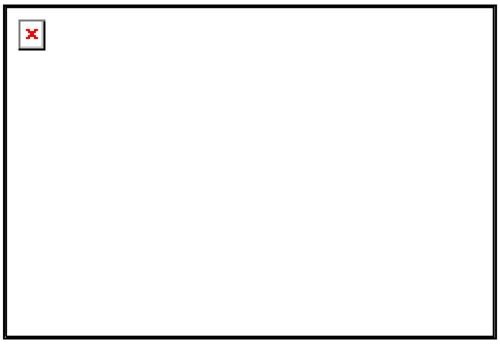

**fig 3: Step response of a PID controller**

C432003e

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.

The PID controller used in the CMGZ434 calculates an output signal that corresponds to the addition of „P“, „I“ and „D“ component. The „D“ component can be skipped alternatively. Due to the digital design, the controller has an exactly reproducible behaviour, because every parameter is known as an exact number which doesn’t drift away. Due to that, it has high long-time and temperature stability. This feature also allows to exchange an electronic unit without readjusting.

**„P“ component**

A controller with only a proportional component emits an output signal that is proportional to the error.If the error is zero, the output signal also will be 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. The characteristic value of a „P“ controller is the proportional factor $X_p$.

**„I“ component**

A controller with an integral component adds the error to the output signal continuously and emits this output signal. Due to that, the output signal will be enlarged or reduced until the error is zero. This output signal is maintained until a new error occurs. The integral component therefore allows zero error in steady state. The characteristic value of an „I“ controller is the settling time $T_n$.

**„D“ component**

A controller with a differential component has an output signal proportional to the changing speed of the error. If the error changes in a step, the output will show the characteristic peak impulse. Therefore, a „D“ controller reacts even if only a small controller error occurs. The characteristic value of a „D“ controller is the derivative action time $T_V$.

# 6 Quick installation guide

- Check all your requirements such as:
  – Charateristics of the drive (signal level, max. power, etc.)?
  – Controller output configuration (signal level)?
  – Feedback output configuration (signal level)?
  – Gain switching required?
  – Line speed input required?
  – Linking by interface etc.?
  – Emergency stop procedures?

- Draw your final wiring diagram according to wiring diagrams (ref. to „8.5 Wiring diagram variant for insert card support block“ / „8.6 Wiring diagram variant with separate housing“). Don’t forget digital input „Controller enabled“
- Install and wire all components (ref.to „8. Installation and wiring“)
- Control unit: Parametrize and calibrate measuring amplifier (ref. to „9.4 Calibrating the measuring amplifier“)
- Proceed a test run with low speed and low material tension:
  – Input reference value (ref. to „9.5 Inputting the reference value“)
  – Determine PID control parameters and set machine into operation (ref. to „9.6 Definition of control parameters“)
- If required, setup the line speed overlay (ref. to „9.9 Setup of line speed overlay“)
- If required, do additional settings (ref. to „9.10 Additional settings“)

**Notice**

It may be that the PID control parameters determined during the test run are no longer suitable for stable operation after setup of pilot control or increasing of material tension. Therefore it is useful to adjust the control parameters until the machine runs stable at the required reference values.

**Notice**

Starting and stopping of the machine takes increased requirements to any control loop. For stable operating also in these phases, you have to pay special attention to the starting resp. stopping behaviour of the whole machine. It is not enough to get stable operating during normal operating conditions.

# 7 Dimensions

## 7.1 Dimensions: Variant for insert card support block (CMGZ434)

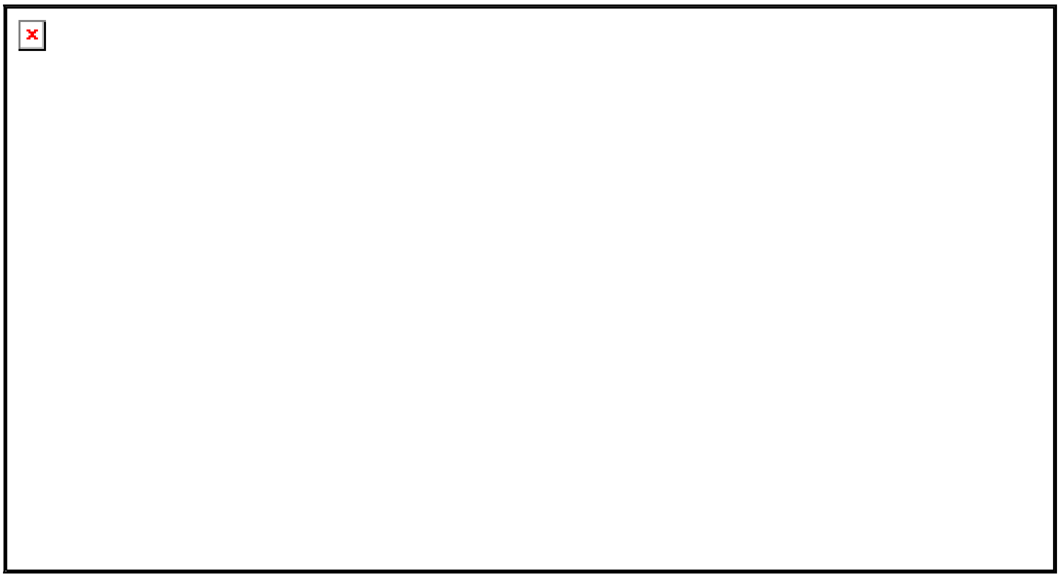

**fig. 4: Dimensions of the variant using insert card support block (series CMGZ400). The support block EMGZ555959 has to be ordered separately.** C431006us

If the electronic unit should be mounted into a 19“ rack, a multipoint plug is used instead of the support block.

## 7.2 Dimensions: Variant with separate housing (CMGZ434.E)

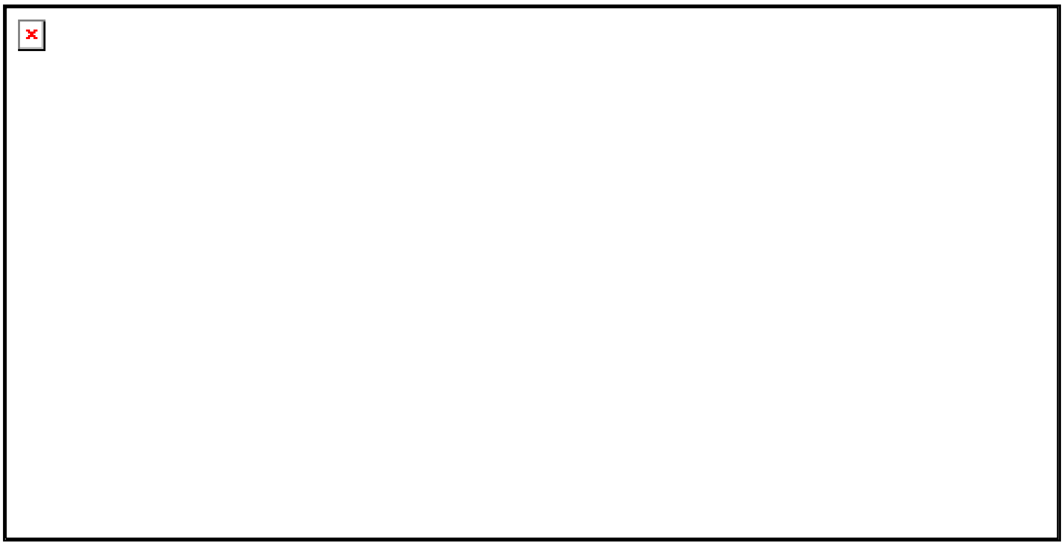

**fig. 5: Dimensions of the variant using separate housing (Option, series CMGZ400.E)** C431003e

# 8 Installation and wiring

**Caution**

Proper function of the 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.

**Danger**

The tension controller can operate drives with high performance. It has no built-in emergency stop function. 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 ciruits, etc.

## 8.1 Mounting and wiring of the electronic unit

**Variant for insert card support block (CMGZ434)**

The insert card support block can be mounted in a control cabinet. Wiring to the terminals is done according to „8.5 Wiring diagram: Variant for insert card support block“ (fig. 6). The electronic card then will be inserted into the insert block. It will be locked by a stop hook (fig. 4).

**Variant with separate housing (CMGZ434.E)**

The housing can be mounted in a control cabinet or directly beside the machine. All connections are led through glands to the screw terminals and connected according to „8.6 Wiring diagram: Variant with separate housing“ (fig. 7 and 8).

## 8.2 Mounting the force sensors

Mounting of the force sensors is done referring to the FMS Installation manual which is delivered together with the force sensors.
Wiring to the terminals of the electronic unit is done according to wiring diagram (fig. 6 resp. 7).

☞ **Notice**

Connecting the shield of the signal cable to the electronic unit *and* to the force sensor may cause ground circuits which may interfere the measuring signal massively. Malfunction can be the result. The shield should be connected only to the electronic unit. On the „force sensor side“, the shield should stay open.

## 8.3 Mounting the drive unit

The motor and the drive power amplifier will be mounted according to manufacturer’s specification. (If an AC drive unit is used, the energy produced in the motor while braking must be led off to a brake resistor or equivalent.)
Connection of the power amplifier to the Tension Controller’s output terminal is done according to the wiring diagram (fig. 6 resp. 7).

**Danger**

The tension controller can operate drives with high performance. It has no built-in emergency stop function. 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 ciruits, etc.

## 8.4 Mounting the tacho generator

If the control loop is operated with line speed overlay, the actual line speed has to be transmitted to the electronic unit. For this purpose the actual line speed is detected with a tacho generator and the line speed signal is fed to the analog line speed input (terminals d6 / d8 resp. 7 / 8).
The tacho generator is mounted according to manufacturer’s specification.

A other 0...10V signal proportional to the line speed may be used too (for ex. from a PLC) instead of the tacho generator

## 8.5 Wiring diagram: Variant for insert card support block (CMGZ434)

**fig. 6: Wiring diagram: Variant for insert card suppor block** C434005e

### 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.

## 8.6 Wiring diagram: Variant with separate housing (CMGZ434.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 110V resp. 230VAC version are under 110V resp. 230V tension! Mortal danger! Disconnect power supply before open the housing!

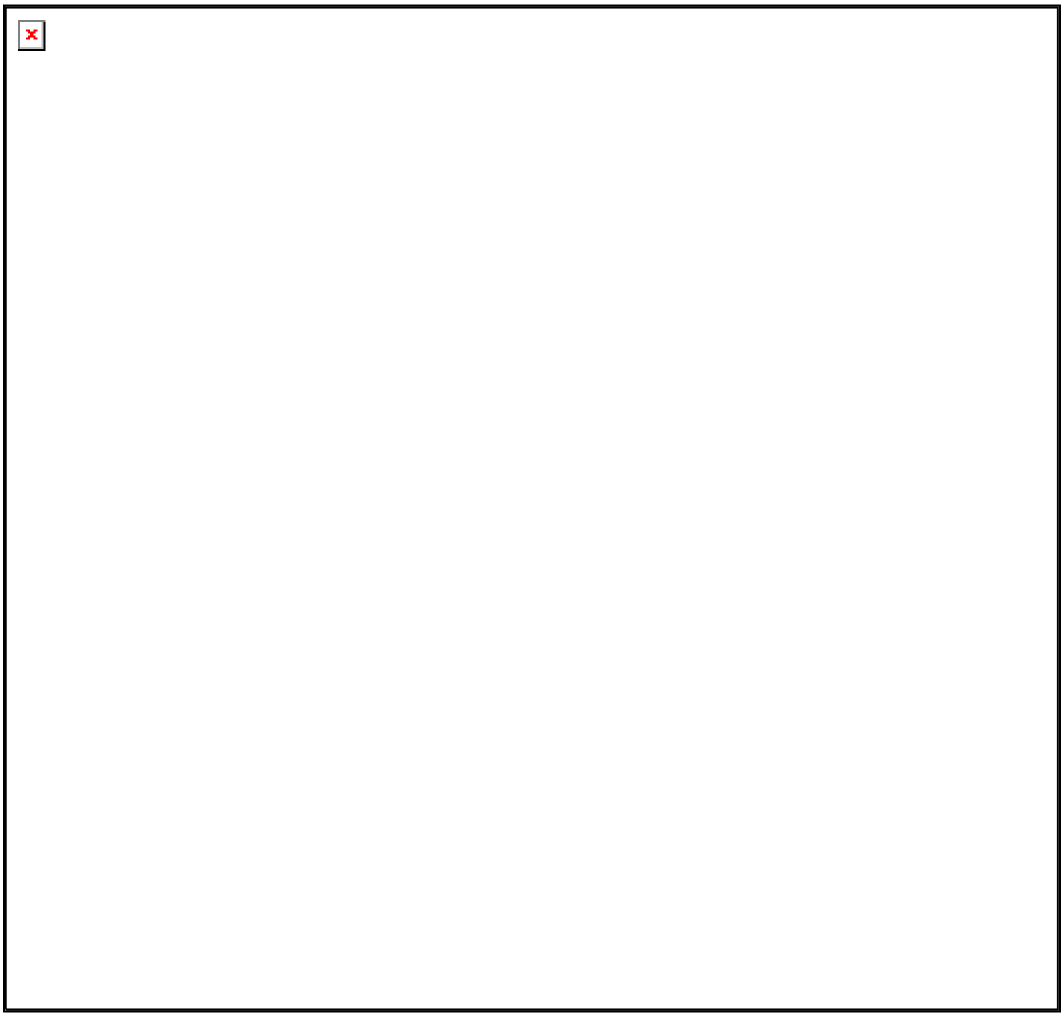

**fig. 7: Wiring diagram: Variant with separate housing** C434011e

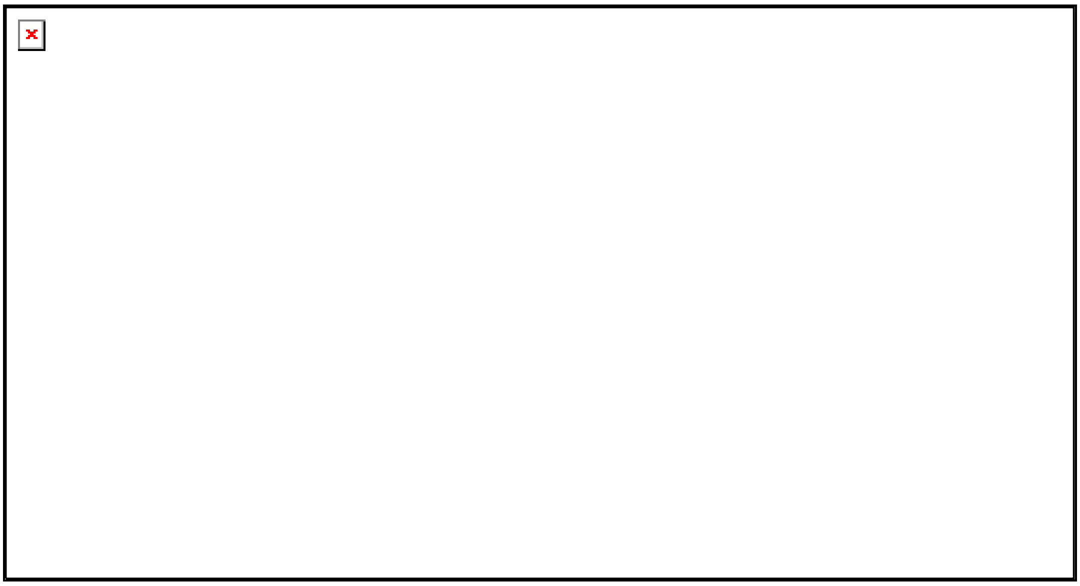

**fig. 8: Screw terminal arrangement on Terminal board** C432007e

# 9 Operation

## 9.1 View of the operating panel

**fig. 9: Operating panel: Variant for insert card support block (CMGZ434)** C434006e

**fig. 10: Operating panel: Variant with separate housing (CMGZ434.E)** C434007e

## 9.2 Schematic diagram of main operating menu

**fig. 11** C434008e

## 9.3 Checking the parameters

Before the initial setup is done, the following parameters have to be set resp. you have to check if they correspond with the effective machine conditions (ref. to „11. Parametrization“):

**Measuring amplifier parameters**

- *Nominal force*
- *Unit of force*
- *Sensitivity*
- *1 or 2 sensors*

**PID controller parameters**

- *Lowpass output* (reset to default)
- *Line speed overlay* (for the time being set to *None*)
- *PID-configuration* (for the time being set to *PI*; if PID configuration is required, refer to „9.10 Additional Settings“)
- *Output limit* (set according to the drive used)
- *Output configuration* (set according to the drive used)
- *Position line drive* (depending on machine configuration)
- *Ramp reference* (reset to default)
- *Reference* (depending on machine configuration)
- *Scale ref. input* (if reference potentiometer is used)

## 9.4 Calibrating the measuring amplifier

**Simulating Method (recommended)**
The following instructions are referring to a setup and calibration on-site. The material tension will be simulated by a weight (fig. 12).

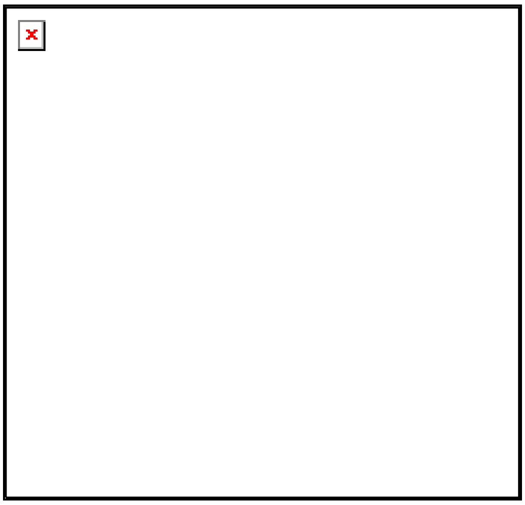

**fig. 12: Calibrating the measuring amplifier** C431011e

- Connect the first force sensor
- Check, if a positive value is displayed when loading the sensor in measuring direction. If not, exchange terminals z6 / z8 (resp. 2 / 3)
- If used, connect the second force sensor
- Check, if a positive value is displayed when loading the sensor in measuring direction. If not, exchange terminals z6 / z8 (resp. 2 / 3)
- Insert material or a rope loosely to the machine
- Adjust offset by activating the parameter function *find offset* and pressing the ↵ key for 3 seconds. The electronic unit calculates automatically the new offset value.
- Load material or rope with a defined weight (fig. 12)
- Activate parameter function *calibrate feedback.* Input the force referring to the applied weight (refer to „10. Parametrization“). The electronic unit calculates automatically the new gain value.
- Quit calibration with *Home* key.

**Mathematical method**

If the material 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.

- Offset adjustment has to be done as described under „Simulating method".
- The Gain value will be calculated by the following formula and then inputted in the parameter *gain feedback* (refer to „10. Parametrization").

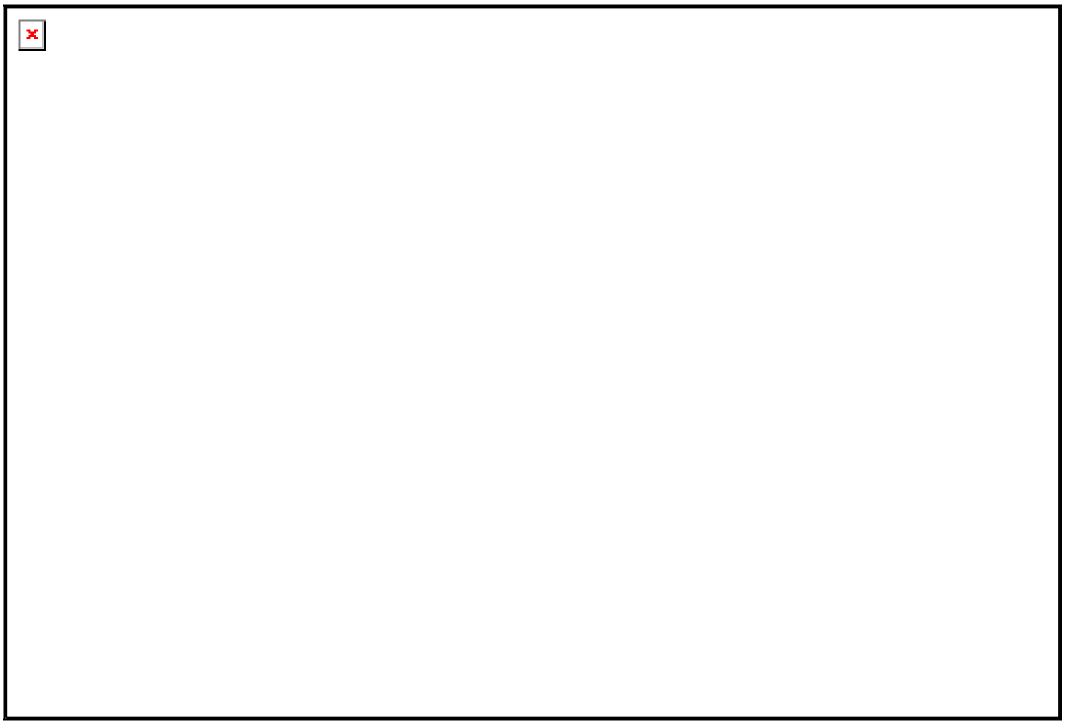

**fig. 13: Force vectors in the FMS force measuring bearing** C431012e

$$GainFeedback = \frac{1}{\sin\delta \cdot \sin(\gamma / 2) \cdot n}$$

**Definition of symbols:**

| | | | |
|---|---|---|---|
| $\alpha$ | angle between vertical and measuring web axis | $F_B$ | material tension |
| $\beta$ | angle between vertical and $F_M$ | $F_G$ | roller weight |
| $\gamma$ | wrap angle of material | $F_M$ | measuring force resulting from $F_B$ |
| $\gamma_1$ | entry angle of material | $F_{Meff}$ | effective measuring force |
| $\gamma_2$ | exit angle of material | n | number of force sensors |
| $\delta$ | Angle between measuring web axis and $F_M$ | | |

## 9.5 Inputting the reference value

The material tension reference value can be inputted by the operating panel resp. interface, or by the analog input:

**reference input by operating panel resp. interface**

- Set parameter *reference internal / external* to *internal*
- Press „REFERENCE“ key in the main operating menu for 3 seconds (refer to fig. 11). Input new reference value using the keyboard. Quit change mode and save the new reference in the EEPROM by using the ↵ key. (If change mode is quit by using „HOME“ key, the new reference is taken only into RAM and will be lost while power-off or changing a parameter.)
- Alternatively: Send reference value by interface to the electronic unit (refer to „10. Serial interface“).

**reference input by analog input**

- Set parameter *reference internal / external* to *external*
- Apply 0...10V source to the analog input (terminals z2 / d2 resp. 10 / 11)
- Set parameter *scale ref. input* to the needed reference value range (refer to „10. Parametrization)

## 9.6 Definition of control parameters

**Experimental determination of control parameters (recommended)**

If the behaviour of the control loop is unknown, tuning is done by means of a systematic approach (fig. 14):

- Set parameter *Derivative D* to 0s (only if PID configuration is used)
- Set parameter *Integral I* very high (100.00s)
- Set parameter *Proportional P* very small (for ex. 1.00)
- Enable controller
- If control loop is not oscillating: Increase *Proportional P*
- If control loop is oscillating: decrease *Proportional P*
- Repeat this procedure until the control loop is stable and nearly oscillating. The controller can remain enabled; the controller parameters may be changed during automatic operation.
- If the control loop is running stable with the „P“ component, the *Integral I* can be decreased until the steady error disappears.
- If the *Integral I* is too small, the control loop will become unstable again.
- (Only using PID configuration): Increase *Derivative D* carefully until the controller is nearly oscillating.
- If the *Derivative D* is too high, the control loop will become unstable again.
- If the control loop is running stable, the parameters *Proportional P*, *Integral I* and *Derivative D* should be noted for eventually re-setup.

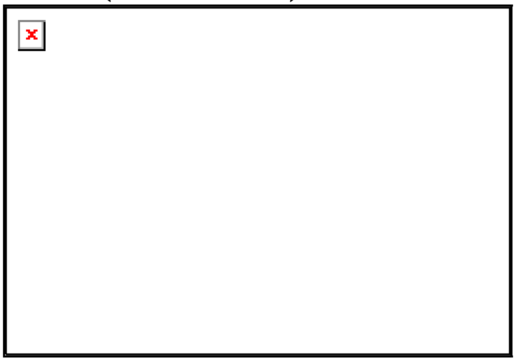

**fig. 14: Transient effect of the control system** C431013e

**Mathematic determination of control parameters**

- If the behaviour of the control loop is known, the control parameters may be calculated by the known mathematical procedures and saved in the parameters *Proportional P0...P3, Integral I0...I3* resp. *Derivative D0...D3*. (There is only the parameter set active which is chosen by the BCD inputs; refer to „9.7 Switching the controller parameters“.)
- If the control loop is oscillating, the control parameters will be fine-tuned as described under „Experimental determination of control parameters“.

**Notice**

There can be saved 4 different P-, I- and D- values (P0...P3; I0...I3; D0...D3). This allows easy and flexible adjustment of the controller to different materials. (There is only the parameter set active which is chosen by the BCD inputs; refer to „9.7 Switching the controller parameters“.) The instructions above is valid for all 4 sets of parameters. But for better understanding, the instruction is written in common form.

**Notice**

Correct setting of the control loop can be difficult. To judge the adjustment of the control parameters, an oscilloscope may be helpful to record the behaviour of the feedback value. The oscilloscope shows if the control loop operates stable, and if there is no more static error.

**Notice**

The controller must be adjusted so that the feedback reaches the reference in the shortest possible way but without overshooting. If the feedback overshoots, this is seen on the display or with an oscilloscope.

## 9.7 Switching the control parameters

There can be saved 4 different P-, I- and D- values (P0...P3; I0...I3; D0...D3). Due to that, it is possible to adjust the control loop flexibly to different material characteristics. However, switching to another set of parameters is only possible if the controller is disabled.

Switching is done by using the digital inputs „BCD cipher 0“ and „BCD cipher 1“ according to table below:

| **dig. input BCD cipher 1** | **dig. input BCD cipher 0** | **Binary code** | **BCD code** | **Parameter set** |
|---|---|---|---|---|
| open | open | 0 0 | 0 | P0 / I0 / D0 |
| open | 24VDC | 0 1 | 1 | P1 / I1 / D1 |
| 24VDC | open | 1 0 | 2 | P2 / I2 / D2 |
| 24VDC | 24VDC | 1 1 | 3 | P3 / I3 / D3 |

## 9.8 Automatic operation

**State „Controller disabled“**
After power on, the controller is disabled. Its output value is 0V, 0mA or 4mA (depending on setting of parameter *Output config.*)

**Enable controller**
The controller will be enabled by digital input „Controller enabled“ or by serial interface. The controller then begins to control the material tension and to hold it at the level of the reference value, and the digital output „Controller ok“ will be activated.

**Change of control parameters while automatic operation**
The control parameters *P0...P3 / I0...I3 / D0...D3, Influence of PI* and *PID-configuration* can be changed while the controller being enabled. Setting is done as written in „11.3 Description of the parameters“. The new values are taken for the control loop when parameter mode is quit.

**Change of reference value while automatic operation**
The reference value can be changed while automatic operation as described under „9.5 Inputting the reference value“.

**Disable controller**
To terminate controlling after stopping the machine, the controller has to be disabled. If enabling was done by interface, disabling must be done also by interface. After disabling the controller, the output value will be set to zero immediately and the digital output „Controller ok“ will be cancelled.

☞ **Notice**

If the controller is disabled while the material is running, the drive unit will stop immediately. This may cause material crack. Therefore, the controller should be disabled only if the machine is no longer running.

## 9.9 Setup of line speed overlay

If the control unit is operated with line speed overlay, a line speed signal is used to build the output value. The control unit adapts the signal referring to the diameter proportion between tacho roller and drive roller. The hereby calculated value is taken and the percentage quota of the PI resp. PID controller is overlayed. The sum will be the output value. Therefore the controller now is only responsible for the non-synchronous part. This will increase controlling stability.
The parameters for line speed overlay may be calculated. But often the referring values of the machine are unknown. Therefore the experimental setup of line speed overlay is listed below:

**Transmission of line speed signal**
To transmit the actual line speed to the electronic unit, an analog signal 0...10V (from a tacho generator or other source) is fed to the analog input (terminals d6 / d8 resp. 7 / 8; refer to „8.4 Mounting the tacho generator“)

**Parametrization of the tacho roller**

For the control unit knowing the actual line speed, the line speed signal has to be set in relation to the diameter and speed of the tacho roller:

- Set line speed signal on the master computer or on a drive already setup to a certain value, for ex. 5V. Note that value:

  $U_{Line}$ = _________________ [V]

- Set tachometer to the running drive roller and read the rotation speed.
  Note that value:

  $n_{Tacho}$ = _________________ [rpm]

- Reset line speed signal to 0, so that the drive roller will stop.
- Measure the diameter of the drive roller and input it into parameter *Tacho diameter*.
- Calculate number of rotations per volt using the following formula:

  $P_1 = \frac{n_{Tacho}}{U_{Line}}$ = _________________ [rpm/V]

- Store the $P_1$ value in parameter *Tacho voltage*.

**Parametrization of the drive roller**

For the control unit being able to drive the drive roller correctly, the output signal has to be set in relation to the diameter and speed of the drive roller:

- Drive the drive unit with a certain output value, for ex. 5V. Note that value:

  $U_{Output}$ = _________________ [V]

- Set tachometer to the running drive roller and read the rotation speed.
  Note that value:

  $n_{Drive}$ = _________________ [rpm]

- Reset the output signal to 0, so that the drive roller will stop.
- Measure the diameter of the drive roller and input it into parameter *Center diameter*.
- Calculate number of rotations per volt using the following formula:

  $P_2 = \frac{n_{Drive}}{U_{Output}}$ = _________________ [rpm/V]

- Store the $P_2$ value in parameter *Controlled drive*.

**Partition the output into pilot control signal and PI resp. PID output signal**

- Set parameter *Line speed overlay* to *Yes* (ref. to „11. Parametrization“)
- Set parameter *Influence of PI* to an appropriate value, for ex. „10%“
- Proceed for a test run. Adjust PI resp. PID control parameters and parameter *Influence of PI* until the control loop will run stable under all conditions.

## 9.10 Additional settings

**PI or PID configuration**

The Tension Controller can be operated as PI or as PID controller. FMS recommends operating as PI controller because this setup is much easier to handle, and the controller dynamics are sufficient for most applications (refer also to „5. Controller theory“):

| Characteristics of PI controller | Characteristics of PID controller |
|---|---|
| + Easier to adjust than a PID controller<br>+ Quite good behaviour<br>+ Is very suitable where great inertia moments make the D component ineffective | + Behaviour is more dynamically than that of a PI controller (PID controller are used where the dynamics of a PI controller is not enough)<br>– The D component causes greater tendency to instable behaviour than using a PI controller! |

The parameter *PID-configuration* is set to *PI* or *PID*, depending on required operation mode.

**Setting of the lowpass filters**

The control unit provides 3 lowpass filters independently adjustable from each other. They are used to prevent noise which is added to the signals. Signal variations which are faster than the cut-off frequency are then suppressed. The lower the cut-off frequency, the more sluggish the output signal will be.

The lowpass filters are configured by setting its cut-off frequency to an appropriate value. The cut-off frequency is set in the parameter *Lowpass output*, *Lowpass instrument* resp. *Lowpass display* (ref. to „11. Parametrisation“).

**Notice**

If the cut-off frequency is set to a value too low, the output signal will become sluggish. It may be that the feedback value is no longer suitable for control loop applications. You have to pay attention that the cut-off frequency is set to a suitable value.

**Setting of the limit switches**

The control unit provides 2 limit switches which can be tapped at the digital outputs (terminals b14 and b16 resp. 29 and 30). The limit switches are actuated when the feedback value exceeds resp. undershoots (depending on parameter *Limit 1 min / max* resp. *Limit 2 min / max*) the force values stored in parameters *Limit value 1* resp. *Limit value 2*.

Tapping of the limit switches is done according to wiring diagram (fig. 6 or 7).

**Scaling of the feedback output (instrument output)**

With default setting, the feedback output gives the maximum signal (10V) when the nominal force of the sensors is reached. The output signal level can be customized with the parameter *Scale instrument*.

# 10 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.

## 10.1 Wiring diagram: RS232 interface

**fig. 15: Wiring diagram RS232 interface** C431009e

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.

## 10.2 Command list

| command | answer | purpose |
|---|---|---|
| DIFF<CR> | DIFY<CR> / DIFN<CR> | read alarm control error |
| DIFR<CR> | DIFRXXXX.X<CR> | actual control error in % |
| ERR?<CR> | XX<CR> | read actual erros<br>Pos.1...2 : Err1...Err2<br>Value of Pos. = 0 : No Err;<br>Value of Pos. = 1 : Err active |
| FREI<CR> | PACC<CR> / FAIL<CR> | enable controller |
| IDNT<CR> | CMGZ434 V2.01 03/99<br>< Typ > <Version> <S > | 10 characters type, fix<br>10 characters version, fix<br>4 characters serial number, fix |
| INRS<CR> | PACC<CR> / FAIL<CR> | initialize interface (for ex. after loading of new interface parameters) |
| LAKT<CR> | XXXX.X<CR> | read actual line speed |
| LOCK<CR> | PACC<CR> / FAIL<CR> | disable conbtroller |
| REMR<CR> | PACC<CR> / FAIL<CR> | turn off remote mode (enabling of the keys on the operating panel) |
| REMS<CR> | PACC<CR> / FAIL<CR> | turn on remote mode (disabling of the keys on the operating panel) |
| SOLLXXXXXXX<CR> | PACC<CR> / FAIL<CR> | write new tension reference value into RAM (The new reference will be lost while power-off or changing a parameter.) |
| SRMP<CR> | XXXXXX<CR> | read actual tension reference value |
| STEL<CR> | XXXX.X<CR> | read actual output value |
| SWRTXXXXXXX<CR> | PACC<CR> / FAIL<CR> | write new tension reference value into EEPROM |
| STAR<CR> | XXXXXXXXXXXXXXXXXX<CR> | general status information<br>1-6 : feedback<br>7-11 : output value<br>12-16: reference after ramp<br>17 : error evaluation<br>18 : control error |
| VALS<CR> | XXXXXX<CR> | read feedback value |

## 10.3 Read parameter

| command | answer | purpose |
|---|---|---|
| RP01<CR> | XXXXX<CR> | offset feedback |
| RP02<CR> | X.XXX<CR> | gain feedback |
| RP03<CR> | XXXX<CR> | sensor, nominal force |
| RP04<CR> | X<CR> | sensor, force unit |
| RP05<CR> | X.X<CR> | sensor, sensitivity |
| RP06<CR> | X<CR> | number of sensors |
| RP07<CR> | XXX.X<CR> | lowpass, feedback |
| RP08<CR> | XX.X<CR> | lowpass, instrument |
| RP09<CR> | XX.X<CR> | lowpass, display |
| RP10<CR> | XX.XX<CR> | scale of instrument |
| RP11<CR> | X<CR> | limit 1 min / max |
| RP12<CR> | XXXXX<CR> | limit value 1 |
| RP13<CR> | X<CR> | limit 2 min / max |
| RP14<CR> | XXXXX<CR> | limit value 2 |

| | | |
|---|---|---|
| RP15<CR> | X<CR> | display language |
| RP16<CR> | X<CR> | line speed overlay |
| RP17<CR> | XXX.X<CR> | influence of PID |
| RP18<CR> | X<CR> | PID-configuration |
| RP19<CR> | XXX.XX<CR> | proportional P0 |
| RP20<CR> | XXX.XX<CR> | integral I0 |
| RP21<CR> | XX.XXX<CR> | derivative D0 |
| RP22<CR> | XXX.XX<CR> | proportional P1 |
| RP23<CR> | XXX.XX<CR> | integral I1 |
| RP24<CR> | XX.XXX<CR> | derivative D1 |
| RP25<CR> | XXX.XX<CR> | proportional P2 |
| RP26<CR> | XXX.XX<CR> | integral I2 |
| RP27<CR> | XX.XXX<CR> | derivative D2 |
| RP28<CR> | XXX.XX<CR> | proportional P3 |
| RP29<CR> | XXX.XX<CR> | integral I3 |
| RP30<CR> | XX.XXX<CR> | derivative D3 |
| RP31<CR> | XXX.X<CR> | alarm limit error |
| RP32<CR> | XXX.X<CR> | output limit |
| RP33<CR> | X<CR> | output config. |
| RP34<CR> | X<CR> | pos. line drive |
| RP35<CR> | XX.X<CR> | ramp reference |
| RP36<CR> | X<CR> | reference internal / external |
| RP37<CR> | XXXX<CR> | scale of reference |
| RP38<CR> | XXXX<CR> | tacho voltage |
| RP39<CR> | XXXX<CR> | controlled drive |
| RP40<CR> | XXXX<CR> | tacho diameter |
| RP41<CR> | XXXX<CR> | center diameter |
| RP42<CR> | XXX<CR> | identifier |
| RP43<CR> | X<CR> | baud rate interface |
| RP44<CR> | X<CR> | data bit interface |
| RP45<CR> | X<CR> | stop bit interface |
| RP46<CR> | X<CR> | parity bit interface |

All parameter numbers refer to the parameter list.

## 10.4 Write parameter

| command | answer | purpose |
|---|---|---|
| WP01XXXXX<CR> | PACC<CR> / FAIL<CR> | offset feedback |
| WP02X.XXX<CR> | PACC<CR> / FAIL<CR> | gain feedback |
| WP03XXXX<CR> | PACC<CR> / FAIL<CR> | sensor, nominal force |
| WP04X<CR> | PACC<CR> / FAIL<CR> | sensor, force unit |
| WP05X.X<CR> | PACC<CR> / FAIL<CR> | sensor, sensitivity |
| WP06X<CR> | PACC<CR> / FAIL<CR> | number of sensors |
| WP07XXX.X<CR> | PACC<CR> / FAIL<CR> | lowpass, feedback |
| WP08XX.X<CR> | PACC<CR> / FAIL<CR> | lowpass, instrument |
| WP09XX.X<CR> | PACC<CR> / FAIL<CR> | lowpass, display |
| WP10XX.XX<CR> | PACC<CR> / FAIL<CR> | scale of instrument |
| WP11X<CR> | PACC<CR> / FAIL<CR> | limit 1 min / max |
| WP12XXXXX<CR> | PACC<CR> / FAIL<CR> | limit value 1 |
| WP13X<CR> | PACC<CR> / FAIL<CR> | limit 2 min / max |
| WP14XXXXX<CR> | PACC<CR> / FAIL<CR> | limit value 2 |
| WP15X<CR> | PACC<CR> / FAIL<CR> | display language |
| WP16X<CR> | PACC<CR> / FAIL<CR> | line speed overlay |
| WP17XXX.X<CR> | PACC<CR> / FAIL<CR> | influence of PID |

| | | |
|---|---|---|
| WP18X<CR> | PACC<CR> / FAIL<CR> | PID-configuration |
| WP19XXX.XX<CR> | PACC<CR> / FAIL<CR> | proportional P0 |
| WP20XXX.XX<CR> | PACC<CR> / FAIL<CR> | integral I0 |
| WP21XX.XXX<CR> | PACC<CR> / FAIL<CR> | derivative D0 |
| WP22XXX.XX<CR> | PACC<CR> / FAIL<CR> | proportional P1 |
| WP23XXX.XX<CR> | PACC<CR> / FAIL<CR> | integral I1 |
| WP24XX.XXX<CR> | PACC<CR> / FAIL<CR> | derivative D1 |
| WP25XXX.XX<CR> | PACC<CR> / FAIL<CR> | proportional P2 |
| WP26XXX.XX<CR> | PACC<CR> / FAIL<CR> | integral I2 |
| WP27XX.XXX<CR> | PACC<CR> / FAIL<CR> | derivative D2 |
| WP28XXX.XX<CR> | PACC<CR> / FAIL<CR> | proportional P3 |
| WP29XXX.XX<CR> | PACC<CR> / FAIL<CR> | integral I3 |
| WP30XX.XXX<CR> | PACC<CR> / FAIL<CR> | derivative D3 |
| WP31XXX.X<CR> | PACC<CR> / FAIL<CR> | alarm limit error |
| WP32XXX.X<CR> | PACC<CR> / FAIL<CR> | output limit |
| WP33X<CR> | PACC<CR> / FAIL<CR> | output config. |
| WP34X<CR> | PACC<CR> / FAIL<CR> | pos. line drive |
| WP35XX.X<CR> | PACC<CR> / FAIL<CR> | ramp reference |
| WP36X<CR> | PACC<CR> / FAIL<CR> | reference internal / external |
| WP37XXXX<CR> | PACC<CR> / FAIL<CR> | scale of reference |
| WP38XXXX<CR> | PACC<CR> / FAIL<CR> | tacho voltage |
| WP39XXXX<CR> | PACC<CR> / FAIL<CR> | controlled drive |
| WP40XXXX<CR> | PACC<CR> / FAIL<CR> | tacho diameter |
| WP41XXXX<CR> | PACC<CR> / FAIL<CR> | center diameter |
| WP42XXX<CR> | PACC<CR> / FAIL<CR> | Identifier |
| WP43X<CR> | PACC<CR> / FAIL<CR> | baud rate interface |
| WP44X<CR> | PACC<CR> / FAIL<CR> | data bit interface |
| WP45X<CR> | PACC<CR> / FAIL<CR> | stop bit interface |
| WP46X<CR> | PACC<CR> / FAIL<CR> | parity bit interface |

All parameter numbers refer to the parameter list. Depending on the value being ok or not, the electronic unit replys PACC<CR> (value accepted) or FAIL<CR> (value not accepted).

# 11 Parametrization

## 11.1 Parameter list

| Parameter | Unit | Default | Min | Max | Actual |
|---|---|---|---|---|---|
| Find offset | (Parameter function) | | | | |
| Calibration feedback | (Parameter function) | | | | ________ |
| Offset feedback | [Digit] | 0 | -4000 | 4000 | ________ |
| Gain feedback | [-] | 1.000 | 0.100 | 9.000 | ________ |
| Nominal force | [N,kN] | 1000 | 1 | 9999 | ________ |
| Unit of 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 | Min, Max | Max | | | ________ |
| Limit value 1 | [N,kN] | 0 | -9999 | 9999 | ________ |
| Limit 2 min / max | Min, Max | Min | | | ________ |
| Limit value 2 | [N,kN] | 0 | -9999 | 9999 | ________ |
| Language | English, German, French, Italian | | | | ________ |
| Line speed overlay | No, Yes | No | | | ________ |
| Influence of PI [1) ] | [%] | 100.0 | 0.1 | 100.0 | ________ |
| PID-configuration [1)] | PI, PID | PI | | | ________ |
| Proportional P0 [1)] | [-] | 1.00 | 0.01 | 100.00 | ________ |
| Integral I0 [1)] | [s] | 1.00 | 0.01 | 100.00 | ________ |
| Derivative D0 [1)] | [s] | 0.010 | 0.001 | 10.000 | ________ |
| Proportional P1 [1)] | [-] | 1.00 | 0.01 | 100.00 | ________ |
| Integral I1 [1)] | [s] | 1.00 | 0.01 | 100.00 | ________ |
| Derivative D1 [1)] | [s] | 0.010 | 0.001 | 10.000 | ________ |
| Proportional P2 [1)] | [-] | 1.00 | 0.01 | 100.00 | ________ |
| Integral I2 [1)] | [s] | 1.00 | 0.01 | 100.00 | ________ |
| Derivative D2 [1)] | [s] | 0.010 | 0.001 | 10.000 | ________ |
| Proportional P3 [1)] | [-] | 1.00 | 0.01 | 100.00 | ________ |
| Integral I3 [1)] | [s] | 1.00 | 0.01 | 100.00 | ________ |
| Derivative D3 [1)] | [s] | 0.010 | 0.001 | 10.000 | ________ |
| Alarm limit error | [%] | 10.0 | 0.1 | 100.0 | ________ |
| Output limit | [%] | 100.0 | 10.0 | 100.0 | ________ |
| Output configuration | ±10V, 0...10V, 0...20mA, 4...20mA | | | | ________ |
| Position of line drive | After sensor, Before sensor | | | | ________ |

[1)] These parameters may be changed also while the controller is enabled. Setting is done as written under „11.3 Description of the parameters“. The new values are taken for the control loop when parameter mode is quit.

| | | | | | |
|---|---|---|---|---|---|
| Ramp reference | [s] | 1.0 | 0.1 | 20.0 | ________ |
| Reference | Internal, External | Internal | | | ________ |
| Scale ref. input | [N,kN] | 10 | 0 | 9999 | ________ |
| Tacho voltage | [rpm/V] | 100 | 1 | 1000 | ________ |
| Controlled drive | [rpm/V] | 300 | 10 | 1000 | ________ |
| Tacho diameter | [mm] | 100 | 10 | 1000 | ________ |
| Center diameter | [mm] | 100 | 10 | 5000 | ________ |
| Identifier | [-] | 0 | 0 | 127 | ________ |
| Baud Rate RS232 | 300, 600, 1200, 2400, 4800, 9600 | | | | ________ |
| 7 or 8 data bit | [-] | 8 | 7 | 8 | ________ |
| 1 or 2 stop bit | [-] | 1 | 1 | 2 | ________ |
| Parity bit RS232 | None, Odd, Even | | | | ________ |

## 11.2 Schematic diagram of parametrization

**fig. 16** C434010e

## 11.3 Description of the parameters

The parameter changing mode will be activated by pressing the ↵ key for 3 seconds. Generally, the parameters are settable using the keys as follows:

| | |
|---|---|
| ↵ | choose |
| ↑ ↓ | switch the selections or increase / decrease numeric values |
| ← | change the decimal (while inputting a numeric value) |
| ↵ | enter |

### Find offset

**Use:** The actual force value will be saved by pressing the ↵ key for 3 seconds. This is used to compensate the weigth of the material and the roller. The determined value will be shown for 2 seconds and then stored under parameter *Offset feedback.*

### Calibration feedback

**Use:** In this parameter, using the ↑ ↓ keys you can input the force value referring to the calibration load you applied to the sensor (force feedback value). The processor then calculates the actual gain value and stores it under parameter *Gain feedback.*
Notice: The input can be aborted with the ← key. In this case the previously saved value remains.

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

### Offset feedback

**Use:** This parameter stores the value determined with *Find offset* in [Digit]. It is not necessary to note this parameter, because a new offset adjustment is done very easy; also when changing the whole electronic unit.
The offset can also be inputted by using the ↑ ↓ ← keys.

| | | | | | |
|---|---|---|---|---|---|
| **Range:** | -4000 | to | 4000 | **Default:** | 0 |
| **Increment:** | 1 | | | **Unit:** | [Digit] |

### Gain feedback

**Use:** This parameter stores the value determined with *Calibration feedback*, resp. you can input a value calculated using the formulas described under „8.3 Calibrating the measuring amplifier“, if the material tension cannot be simulated.

| | | | | | |
|---|---|---|---|---|---|
| **Range:** | 0.100 | to | 9.000 | **Default:** | 1.000 |
| **Increment:** | 0.001 | | | **Unit:** | [-] |

## Nominal force of sensor

| | | | | | |
|---|---|---|---|---|---|
| **Use:** | To get the correct force value,, the electronic unit has to know the nominal force of the sensors. | | | | |
| **Range:** | 1 | to | 9999 | **Default:** | 1000 |
| **Increment:** | 1 | | | **Unit:** | [N,kN] |

## Unit of force

| | | | | | |
|---|---|---|---|---|---|
| **Use:** | This parameter stores the force unit of the sensor. | | | | |
| **Range:** | N, kN | | | **Default:** | N |

## Sensitivity of sensor

| | | | | | |
|---|---|---|---|---|---|
| **Use:** | To get the correct force value,, the electronic unit has to know the sensitivity of the force sensors, that means how much signal the sensor will answer by nominal force. Standard for FMS force sensors is 1.8mV/V. | | | | |
| **Range:** | 0.1 | to | 3.0 | **Default:** | 1.8 |
| **Increment:** | 0.1 | | | **Unit:** | [mV/V] |

## 1 or 2 sensors

| | | | | | |
|---|---|---|---|---|---|
| **Use:** | To get the correct force value, the electronic unit has to know if the measuring roller is beared by one or two force sensors. | | | | |
| **Range:** | 1 | to | 2 | **Default:** | 1 |
| **Increment:** | 1 | | | **Unit:** | [-] |

## Lowpass output

| | | | | | |
|---|---|---|---|---|---|
| **Use:** | The electronic unit provides a lowpass filter to prevent noise which is added to the feedback signal, caused by unbalanced rollers or interference. This parameter stores the limit frequency. The filtered feedback value will be fed to the PI controller.<br>The lowpass output filter is independent of the other filters.<br>**Notice:** The lower the cut-off frequency, the more sluggish the output signal will be. If the limit frequency is set too low, the control dynamics may be reduced dramatically! | | | | |
| **Range:** | 0.1 | to | 200.0 | **Default:** | 50.0 |
| **Increment:** | 0.1 | | | **Unit:** | [Hz] |

## Lowpass instrument

| | | | | | |
|---|---|---|---|---|---|
| **Use:** | The electronic unit provides a lowpass filter to prevent noise which is added to the analog output of the instrument (terminals z18 / z22 resp. 15 / 18). This parameter stores the limit frequency. The lower the cut-off frequency, the more sluggish the output signal will be. Due to this filter, the display on the instrument will be much more stable in the case of high fluctuations of the force value.<br>The lowpass instrument filter is independent of the other filters. | | | | |
| **Range:** | 0.1 | to | 10.0 | **Default:** | 1.0 |
| **Increment:** | 0.1 | | | **Unit:** | [Hz] |

## Lowpass display

| | | | | | |
|---|---|---|---|---|---|
| **Use:** | The electronic unit provides a lowpass filter to prevent noise which is added to the integrated display. This parameter stores the limit frequency. The lower the cut-off frequency, the more sluggish the output signal will be. Due to this filter, the value shown in the integrated display will be much more stable in the case of high fluctuations of the force value.<br>The lowpass display filter is independent of the other filters. | | | | |
| **Range:** | 0.1 | to | 10.0 | **Default:** | 1.0 |
| **Increment:** | 0.1 | | | **Unit:** | [Hz] |

## Scale instrument

| | | | | | |
|---|---|---|---|---|---|
| **Use:** | The analog output for the external instrument (0...10V) provides the nominal voltage when reaching the nominal force value. Using a setting of 1.00, the nominal voltage will be 10V. The nominal voltage is decreased when decreasing the setting value; it is increased when increasing the setting value. | | | | |
| **Range:** | 0.01 | to | 10.00 | **Default:** | 1.00 |
| **Increment:** | 0.01 | | | **Unit:** | [-] |

## Limit 1 min / max

| | | | | | |
|---|---|---|---|---|---|
| **Use:** | The digital output „Limit value 1“ can be set as a min- or a max limit switch. That means, that the digital output will be activated when passing over resp. passing under the value set under parameter *Limit value 1*. | | | | |
| **Range:** | Min, Max | | | **Default:** | Max |

## Limit value 1

| | | | | | |
|---|---|---|---|---|---|
| **Use:** | The digital output „Limit value 1“ will be activated if the threshold value stored in this parameter is passed over resp. under (according to setting in parameter *Limit 1 min / max*). | | | | |
| **Range:** | -9999 | to | 9999 | **Default:** | 0 |
| **Increment:** | 1 | | | **Unit:** | [N,kN] |

## Limit 2 min / max

| | | | | | |
|---|---|---|---|---|---|
| **Use:** | The digital output „Limit value 2“ can be set as a min- or a max limit switch. That means, that the digital output will be activated when passing over resp. passing under the value set under parameter *Limit value 2*. | | | | |
| **Range:** | Min, Max | | | **Default:** | Min |

## Limit value 2

| | | | | | |
|---|---|---|---|---|---|
| **Use:** | The digital output „Limit value 2“ will be activated if the threshold value stored in this parameter is passed over resp. under (according to setting in parameter *Limit 2 min / max*). | | | | |
| **Range:** | -9999 | to | 9999 | **Default:** | 0 |
| **Increment:** | 1 | | | **Unit:** | [N,kN] |

## Language

| | |
|---|---|
| **Use:** | With this parameter, the language in the display can be chosen. |
| **Range:** | English, German, French, Italian |

## Line speed overlay

| | | | | | |
|---|---|---|---|---|---|
| **Use:** | If this parameter is set to *Yes*, the actual line speed signal is overlayed to the PID controller output. This will increase controller dynamics significantly. Refer to „9.9 Setup of line speed overlay“ | | | | |
| **Range:** | No, Yes | | | **Default:** | No |

## Influence of PI

| | | | | | |
|---|---|---|---|---|---|
| **Use:** | If pilot control is activated, this parameter defines the percentage participation of the PI resp. PID controller which will be added to the pilot control signal.<br>„10%“ means 10% of the maximum output signal.<br>If parameter *Output limit* is set to less than 100% the influence value stored here should be adjusted accordingly.<br>If pilot control is not activated, the effective influence of PI resp. PID is 100%, independent of this parameter. | | | | |
| **Range:** | 0.1 | to | 100 | **Default:** | 100.0 |
| **Increment:** | 0.1 | | | **Unit:** | [%] |

## PID-configuration

| | | | | | |
|---|---|---|---|---|---|
| **Use:** | This parameter determines if the controller is operated as PI- or as PID- controller. If it is operated as PI-controller, the parameters *Derivative D0...D3* are ineffective. | | | | |
| **Range:** | PI, PID | | | **Default:** | PI |

## Proportional P0

| | | | | | |
|---|---|---|---|---|---|
| **Use:** | This value determines the behaviour of the „P“ component of the controller. It is active if the BCD inputs are set to „0“. If the value stored here is 1.00 the P controller will produce an output signal of 0.5V resp. 0.5mA at a control error of 100N.<br>This parameter can be changed while the controller is enabled. The new value is taken for the control loop when quit parameter mode. | | | | |
| **Range:** | 0.01 | to | 100.00 | **Default:** | 1.00 |
| **Increment:** | 0.01 | | | **Unit:** | [-] |

## Integral I0

| | | | | | |
|---|---|---|---|---|---|
| **Use:** | This value determines the behaviour of the „I“ component of the controller. It is active if the BCD inputs are set to „0“. If the value stored here is 1.00 the I controller will produce an output signal changement of 1V/s resp. 1mA/s at a control error of 100N.<br>This parameter can be changed while the controller is enabled. The new value is taken for the control loop when quit parameter mode. | | | | |
| **Range:** | 0.01 | to | 100.00 | **Default:** | 1.00 |
| **Increment:** | 0.01 | | | **Unit:** | [s] |

## Derivative D0

| | | | | | |
|---|---|---|---|---|---|
| **Use:** | This value determines the behaviour of the „D“ component of the controller. It is active if the BCD inputs are set to „0“.<br>This parameter can be changed while the controller is enabled. The new value is taken for the control loop when quit parameter mode. | | | | |
| **Range:** | 0.001 | to | 10.000 | **Default:** | 0.010 |
| **Increment:** | 0.001 | | | **Unit:** | [s] |

## Proportional P1

**Use:** Description and function see *Proportional P0*. Active if the BCD inputs are set to „1“.

## Integral I1

**Use:** Description and function see *Integral I0*. Active if the BCD inputs are set to „1“.

## Derivative D1

**Use:** Description and function see *Derivative D0*. Active if the BCD inputs are set to „1“.

## Proportional P2

**Use:** Description and function see *Proportional P0*. Active if the BCD inputs are set to „2“.

## Integral I2

**Use:** Description and function see *Integral I0*. Active if the BCD inputs are set to „2“.

## Derivative D2

**Use:** Description and function see *Derivative D0*. Active if the BCD inputs are set to „2“.

## Proportional P3

**Use:** Description and function see *Proportional P0*. Active if the BCD inputs are set to „3“.

## Integral I3

**Use:** Description and function see *Integral I0*. Active if the BCD inputs are set to „3“.

## Derivative D3

**Use:** Description and function see *Derivative D0*. Active if the BCD inputs are set to „3“.

## Alarm limit error

**Use:** The digital output „Alarm controller error“ and the LED „Alarm controller error“ will be activated if the control error exceeds the tolerance set in this parameter.

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

## Output limit

**Use:** This parameter defines the range for the output signal. „80%“ refers to „±8V“ resp. „0...8V“ resp. „0...16mA“ resp. „4...16.8mA“, depending on parameter *Output configuration*.

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

## Output configuration

| | | | | |
|---|---|---|---|---|
| **Use:** | With this parameter, you can choose the output signal depending on the drive unit used. | | | |
| **Range:** | ±10V, 0...10V, 0...20mA, 4...20mA | | **Default:** | ±10V |

## Position of line drive

| | | | | |
|---|---|---|---|---|
| **Use:** | The output value of the controller depends on the line drive being mounted before or after the force sensors (ref. to fig. 1). Depending on the position, the polarity of the output value is different. | | | |
| **Range:** | After sensors, Before sensors | | **Default:** | After sensors |

## Ramp reference

| | | | | | |
|---|---|---|---|---|---|
| **Use:** | To optimize the controller against disturbances, the reference value should not change too fast. For this, the reference value signal is led internally to a ramp. Its rate of rise is defined using this parameter. The length of the ramp defines the settling time the reference will take to set to the new value. | | | | |
| **Range:** | 0.1 | to | 20.0 | **Default:** | 1.0 |
| **Increment:** | 0.1 | | | **Unit:** | [s] |

## Reference Internal / External

| | | | | |
|---|---|---|---|---|
| **Use:** | If the reference value will be set using the operating panel or the interface, this parameter has to be set to *internal*. If the reference value will be set using a 0...10V signal led to the analog input, this parameter has to be set to *external*. | | | |
| **Range:** | Internal, External | | **Default:** | Internal |

## Scale reference input

| | | | | | |
|---|---|---|---|---|---|
| **Use:** | This parameter defines how many N resp. kN are assigned to the 0...10 V signal on the analog input.<br>If no 10V signal is available, you can use a signal with any tension range, but you must scale the entry in this parameter corresponding to the tension range. If you have for ex. only a 4V tension (for ex. terminals d4 / d10 resp. 6 / 9), the needed nominal force value has to be multiplied with the factor (10V / 4V = **2.5**). | | | | |
| **Range:** | 0 | to | 9999 | **Default:** | 10 |
| **Increment:** | 1 | | | **Unit:** | [N,kN] |

## Tacho voltage

| | | | | | |
|---|---|---|---|---|---|
| **Use:** | This parameter stores the number of rotations which will generate 1V tension on the tacho generator. The value is used to calculate the line speed overlay function. | | | | |
| **Range:** | 1 | to | 1000 | **Default:** | 100 |
| **Increment:** | 1 | | | **Unit:** | [rpm/V] |

## Controlled drive

| | | | | | |
|---|---|---|---|---|---|
| **Use:** | This parameter stores the number of rotations of the drive roller if it is driven by a speed signal of 1V. The value is used to calculate the line speed overlay function. | | | | |
| **Range:** | 10 | to | 1000 | **Default:** | 300 |
| **Increment:** | 1 | | | **Unit:** | [rpm/V] |

## Tacho diameter

| | | | | | |
|---|---|---|---|---|---|
| **Use:** | This parameter stores the diameter of the tacho roller. The value is used to calculate the line speed overlay function. | | | | |
| **Range:** | 10 | to | 1000 | **Default:** | 100 |
| **Increment:** | 1 | | | **Unit:** | [mm] |

## Center diameter

| | | | | | |
|---|---|---|---|---|---|
| **Use:** | This parameter stores the diameter of the drive roller. The value is used to calculate the line speed overlay function. | | | | |
| **Range:** | 10 | to | 5000 | **Default:** | 100 |
| **Increment:** | 1 | | | **Unit:** | [mm] |

## Identifier

| | | | | | |
|---|---|---|---|---|---|
| **Use:** | This parameter is to identificate the device when using a CAN-Bus interface. For future applications. | | | | |
| **Range:** | 0 | to | 127 | **Default:** | 0 |
| **Increment:** | 1 | | | **Unit:** | [-] |

## Baud rate RS232

| | | | |
|---|---|---|---|
| **Use:** | Setting of the transmission rate of the RS 232 interface. | | |
| **Range:** | 300, 600, 1200, 2400, 4800, 9600 baud | **Default:** | 9600 |

## 7 or 8 data bit

| | | | | | |
|---|---|---|---|---|---|
| **Use:** | Setting of the number of data bits of the RS 232 interface. | | | | |
| **Range:** | 7 | to | 8 | **Default:** | 8 |
| **Increment:** | 1 | | | **Unit:** | [-] |

## 1 or 2 stop bit

| | | | | | |
|---|---|---|---|---|---|
| **Use:** | Setting of the number of stop bits of the RS 232 interface. | | | | |
| **Range:** | 1 | to | 2 | **Default:** | 1 |
| **Increment:** | 1 | | | **Unit:** | [-] |

## Parity bit RS232

| | | | |
|---|---|---|---|
| **Use:** | Setting of the paroty of the RS 232 interface. | | |
| **Range:** | none, odd, even | **Default:** | none |

# 12 Trouble shooting

| Error | Cause | Corrective action |
|---|---|---|
| **„Err1“ is displayed: A/D-converter receives values < -9.7mV continuously** | Force sensors are wrong connected | Exchange wires on terminals z6 / z8 (resp. 2 / 3) |
| | Parting of the cable | Replace connection cable between force sensor and electronik unit |
| **„Err2“ is displayed: A/D-converter receives values > 9.7mV continuously** | Force sensors are wrong connected | Exchange excitation and signal (terminals z4 ... z10 resp. 1 ... 4) |
| | Short circuit in the plug or connection cable | Check and correct wiring |
| | Force sensor overload | Use sensor with higher nominal force |
| | Force sensor has too much sensitivity | Set parameter *sensitivity* to the correct value or use other sensor |
| **„Alarm controller error“ is displayed** | The control error has exceeded the tolerance band set in parameter *Alarm limit error* | Enlarge parameter *Alarm limit error* or adjust controller parameters (P; I; D) more accurate and restart controlling (enable controller again) |
| **Roller does stay when enabling the controller; ev. material cracking** | Using line speed overlay: The line speed signal gives „0“; tacho generator defect | Check tacho generator and wiring to the terminals d6 / d8 (resp. 7 / 8); replace if needed |
| **Roller rewinds fast when enabling the controller; ev. material cracking** | Parameter *Pos. line drive* set wrong | Change parameter *Pos. line drive* |
| **No message on the display** | Display contrast setting is bad | Set display potentiometer correctly. (It is located on the processor board on the upper right edge beside the ribbon connector) |
| | Fuse blown | Replace fuse on power supply |
| | Power supply not correct | Check / correct power supply |
| | Electronic unit defect | Contact FMS customer service |

# 13 Technical data CMGZ434

| | |
|---|---|
| Connection of force sensors | 1 or 2 parallel force sensors of 350Ω |
| Excitation of sensors | 4VDC |
| Input signal voltage | 9.9mV |
| Resolution A/D-converter | ±4095 Digit (13 Bit) |
| Measuring error | <0.05% FS |
| Cycle time | 4ms |
| Operation | 4 keys, LCD display 2x16 characters, 4 LED |
| Setting of reference value | Alternatively: Operating panel<br>Analog input 0...10V<br>RS232<br>CAN-Bus (option) |
| Configuration | Line drive |
| Integrated brake amplifier | 4A / 24V (option; only available with CMGZ431.E) |
| Analog output 1 (output value) | ±10V (12 Bit) |
| Analog output 2 (tension feedback) | 0...10V (12 Bit) |
| Analog output 3 (not connected) | 0...5V (8 Bit) Ri=500Ω |
| Analog output 4 (not connected) | 0...5V (8 Bit) Ri=500Ω |
| Digital output 1 (controller ok) | Open Collector, galvanic separated |
| Digital output 2 (alarm controller error) | Open Collector, galvanic separated |
| Digital output 3 (limit value 1) | Open Collector, galvanic separated |
| Digital output 4 (limit value 2) | Open Collector, galvanic separated |
| Digital input 1 (enable controller) | 24VDC galvanic separated |
| Digital input 2 (reserved) | 24VDC galvanic separated |
| Digital input 3 (BCD cipher 0) | 24VDC galvanic separated |
| Digital input 4 (BCD cipher 1) | 24VDC galvanic separated |
| Interface RS232 | standard |
| Interface RS485 galvanic separated | Option |
| Interface CAN-Bus | Option |
| Power supply | 24VDC (18...36VDC) 0.15A<br>(CMGZ434.E: 230VAC, 110VAC or 24VDC) |
| Main connector | DIN41612 version F b+d+z |
| Temperature range | 0...50°C [32...122°F] |
| Weight | 0.22kg [0.5lbs] |

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