Operating Manual CMGZ433

Digital microprocessor controlled tension control unit for drives on winding applications

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.

Pilot control: If pilot control is activated, a reel diameter signal (for ex. from diameter calculator, distance sensor, PLC o.e.) is taken into the calculation of the drive power and the drive will be „pilot controlled“ with the calculated value. Then, the controller has only to control the variation of the material tension. Due to that, the stability of controlling will be improved.

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 unwind 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 CMGZ433
- 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 diameter or 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 (CMGZ433.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 an winding application C433003e

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 CMGZ433. The electronic unit amplifies the mV signal and calculates the error to the reference value. If the material tension is too low, the drive will be driven faster; if the material tension is too high, the drive will be driven slower.

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 CMGZ433 by a very accurate power supply.

4.3 Electronic unit CMGZ433

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. From this signal and the actual output value, the controller then calculates the actual reel diameter and the pilot control resulting from that. The PI- resp. PID-values are adustjed dynamically according to the changing reel diameter.
The diameter signal can also be read directly from a distance sensor or other 0...10V source.

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 CMGZ433 C432002e

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

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 CMGZ433 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.

fig 3: Step response of a PID controller
C432003e

„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?
  – Tension reduction?
  – Diameter input required?
  – Linking by interface etc.?
  – Emergency stop procedures?

- Draw your final wiring diagram according to wiring diagrams (ref. to „8.4 Wiring diagram variant for insert card support block“ / „8.5 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 pilot control (ref. to „9.9 Setup of external pilot control“ resp. „9.10 Setup of internal pilot control“)
- If required, setup the tension reduction (ref. to „9.11 Tension reduction“)
- If required, do additional settings (ref. to „9.12 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 (CMGZ433)

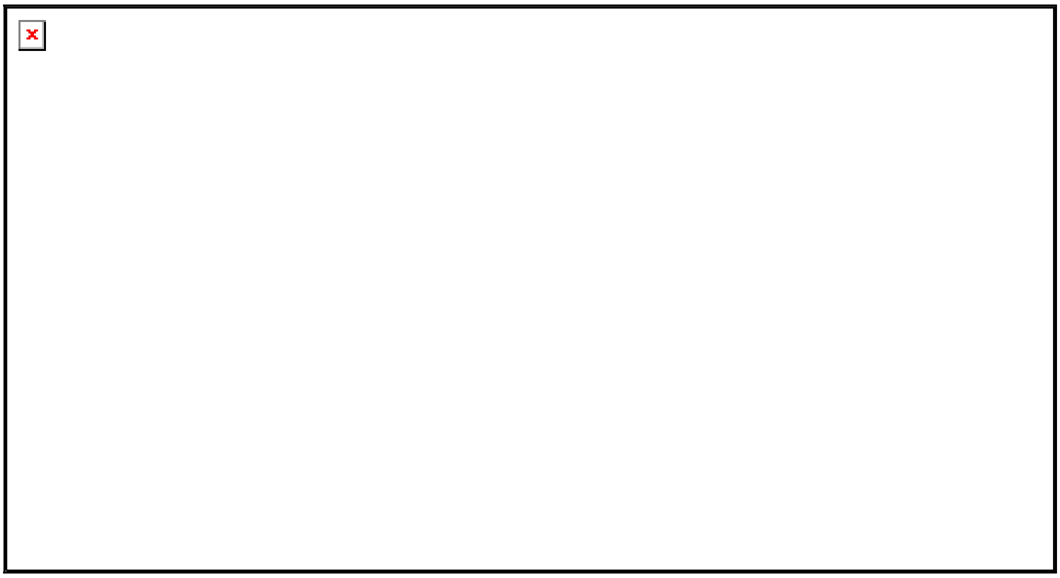

fig. 4: Dimensions of the variant using insert card support block (series CMGZ400). The support block EMGZ555959 has to be ordered separately. C431006us

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 (CMGZ433.E)

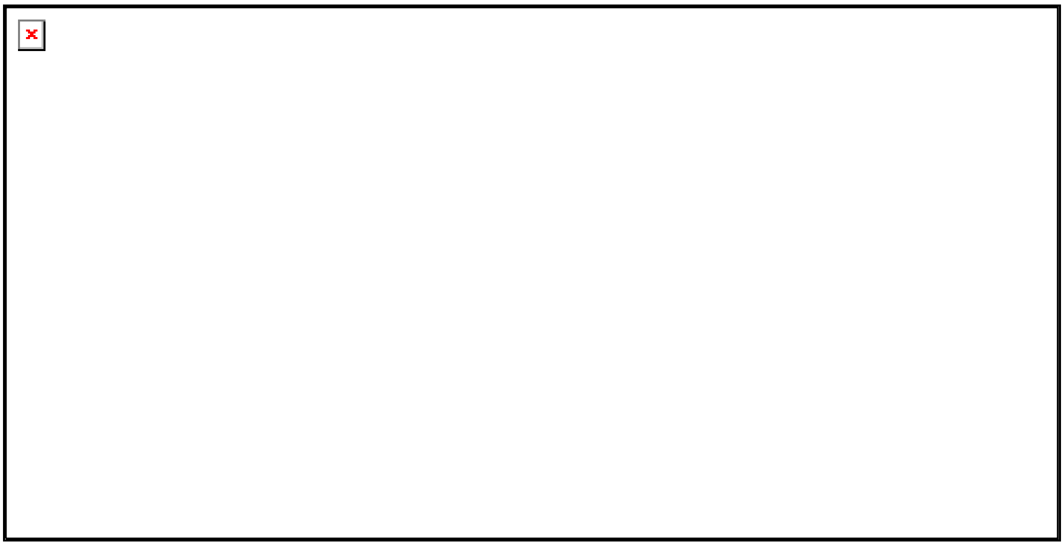

fig. 5: Dimensions of the variant using separate housing (Option, series CMGZ400.E) C431003e

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 (CMGZ433)

The insert card support block can be mounted in a control cabinet. Wiring to the terminals is done according to „8.4 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 (CMGZ433.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 „8.5 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).

STOP **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 Wiring diagram: Variant for insert card support block (CMGZ433)

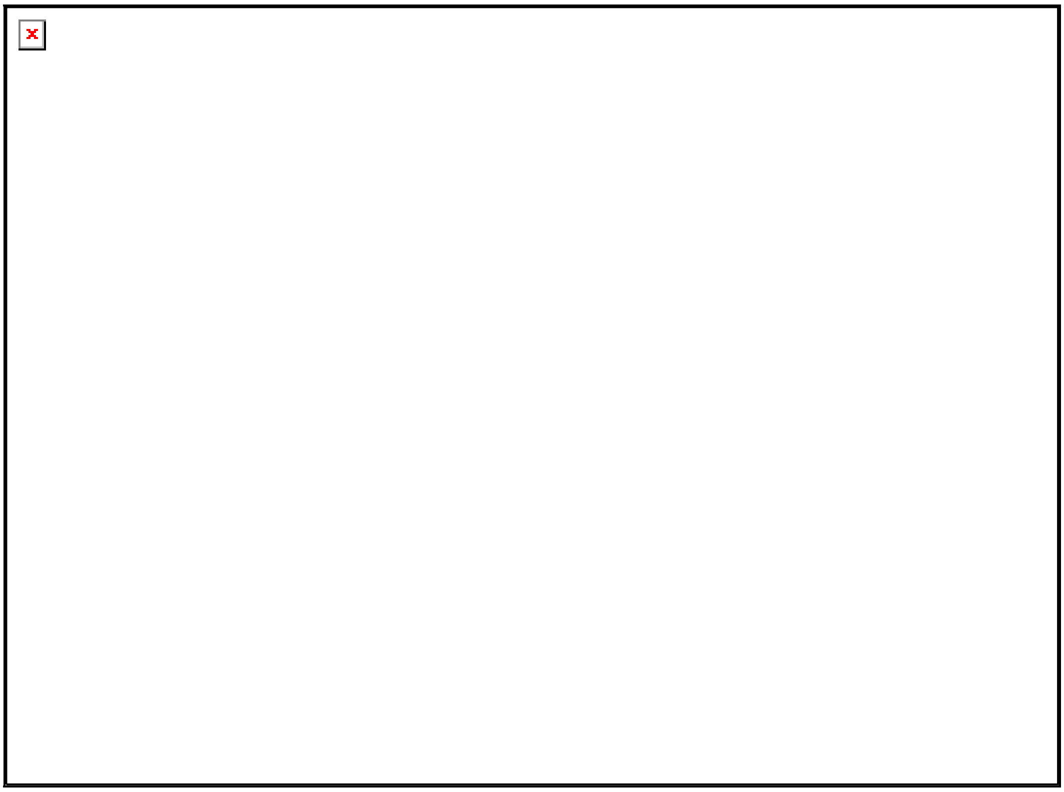

fig. 6: Wiring diagram: Variant for insert card suppor block C433006e

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.

8.5 Wiring diagram: Variant with separate housing (CMGZ433.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 C433009e

fig. 8: Screw terminal arrangement on Terminal board C432007e

8.6 Mounting the distance sensor

If the control loop is operated with external pilot control (processing of reel diameter), the actual reel diameter has to be transmitted to the electronic unit. For this purpose the actual reel diameter is detected with a distance sensor and the distance signal is fed to the analog diameter input (terminals d6 / d8 resp. 7 / 8).
It has to be ensured that the measuring axis of the distance sensor is straight radial to the reel (refer to fig. 1 and 9).

Optical distance sensor CMGZ581934
FMS recommends to use the optical distance sensor CMGZ581934 because its accuracy and signal output is adapted to the FMS measuring amplifiers and Tension Controllers.

fig. 9: Mounting of the distance sensor CMGZ581924 E411012e

The distance sensor operates with the 3-beam-correction principle. It is considerable insensible to secondary light and changes of the surface colour of the detected object. But while mounting it must be ensured that the sensor is mounted in „horizontal“ position (fig. 9).
The output signal is proportional to the reel radius: Small radius = small signal; large radius = large signal.

Technical data distance sensor CMGZ581934

Type	HT77MGV80, Infrared light 880nm
Measuring range	1000mm [40“]
Ø Measuring distance	800mm [32“]
Min. measuring distance	300mm [12“]
Max. measuring distance	1300mm [51“]
Resolution	0.2...30mm [.008...1.2“] depending on width of spot
Reaction time	10ms
Linearity	2%
Temperature drift	0.5mm / K [.01“ / °F]
Supply voltage	18...30VDC / 70mA
Temperature range	–10...+60°C [14...140°F]
Protection class	IP67

9 Operation

9.1 View of the operating panel

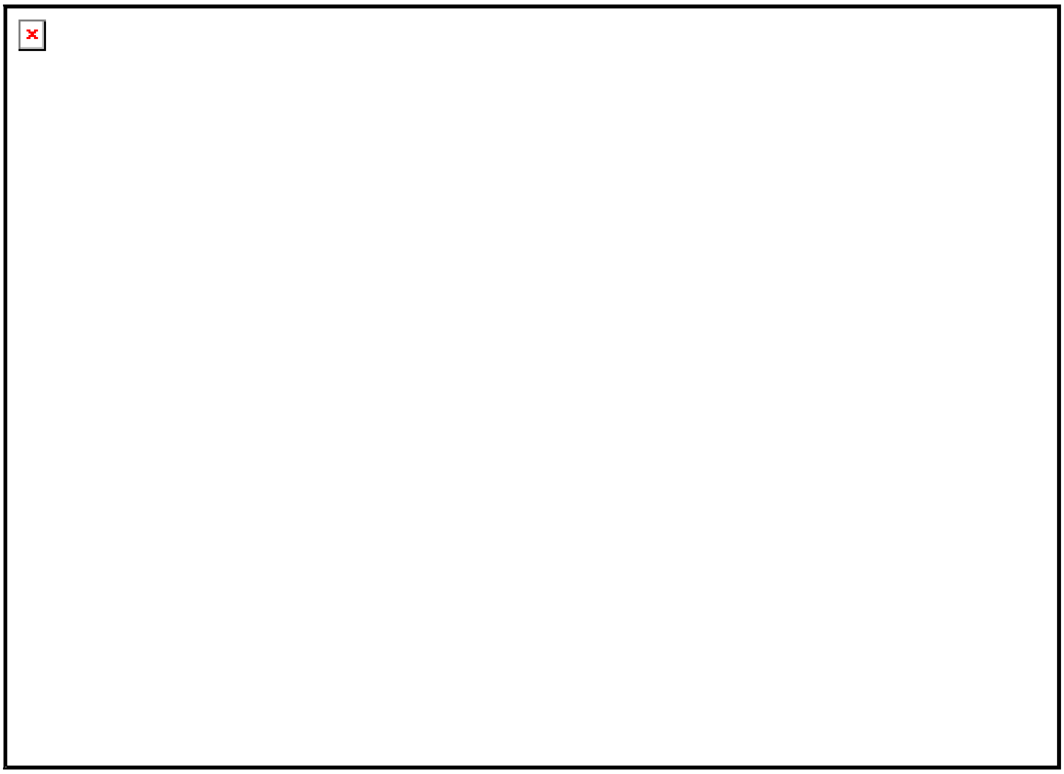

fig. 10: Operating panel: Variant for insert card support block (CMGZ433) C433001e

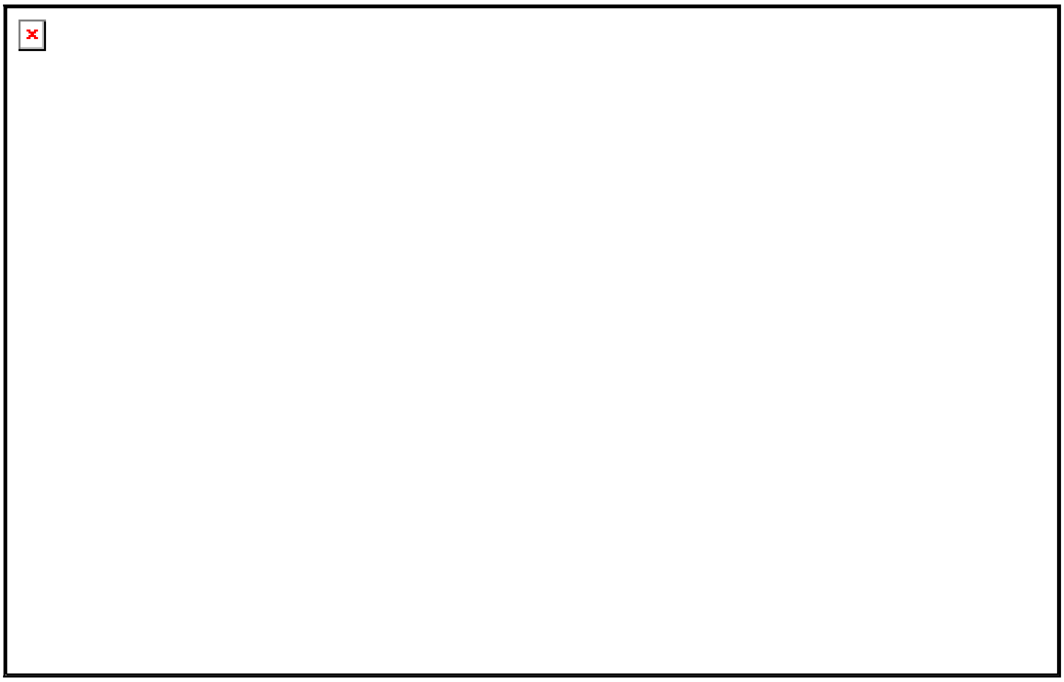

fig. 11: Operating panel: Variant with separate housing (CMGZ433.E) C433002e

9.2 Schematic diagram of main operating menu

fig. 12 C432010e

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)
- *Pilot control* (for the time being set to *None*)
- *PID-configuration* (for the time being set to *PI*; if PID configuration is required, refer to „9.12 Additional Settings“)
- *Output limit* (set according to the drive used)
- *Output configuration* (set according to the drive used)
- *Ramp diameter* (reset to default)
- *Ramp reference* (reset to default)
- *Reference* (depending on machine configuration)
- *Scale ref. input* (if reference potentiometer is used)
- *Tension reduction* (for the time being set to *No*)
- *Start speed* (for the time being set to 0.00)
- *Limit speed* (for the time being set to 0.0)

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. 13).

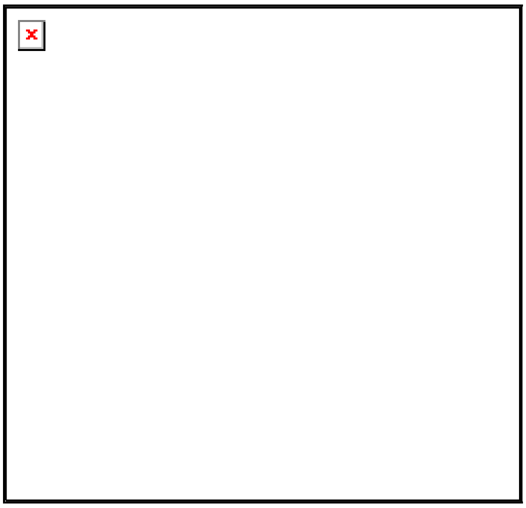

fig. 13: Calibrating the measuring amplifier C431011e

- 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. 13)
- Activate parameter function *calibrate feedback.* Input the force referring to the applied weight (refer to „11. 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 „11. Parametrization“).

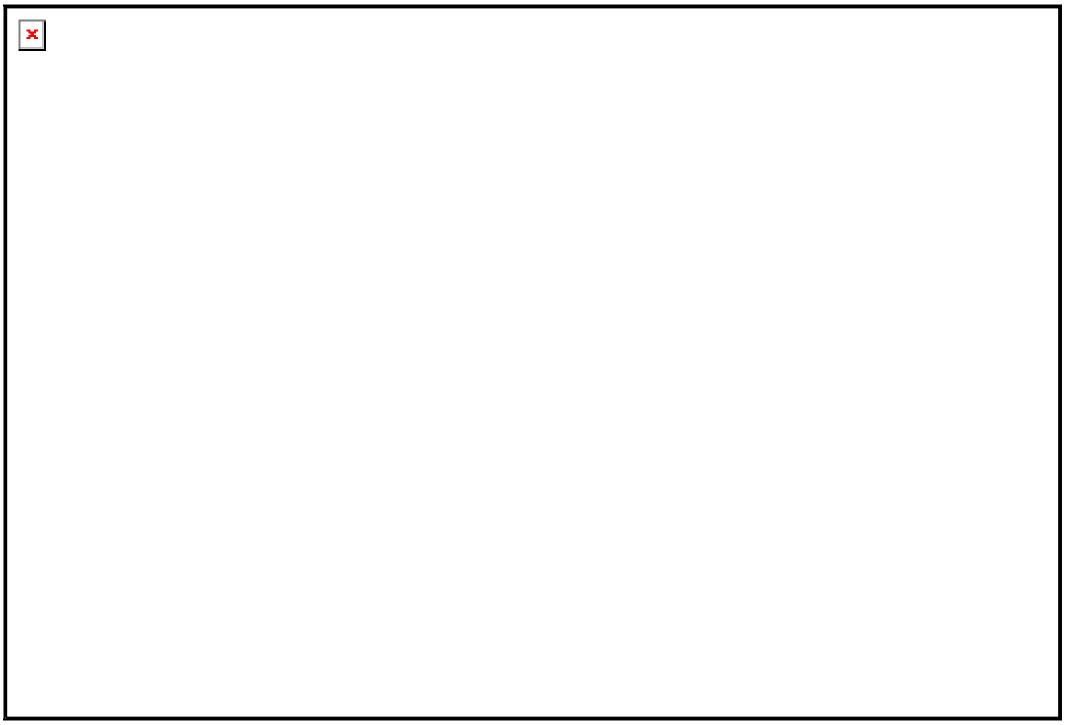

fig. 14: Force vectors in the FMS force measuring bearing C431012e

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

Definition of symbols:

α	angle between vertical and measuring web axis	F_B	material tension
β	angle between vertical and F_M	F_G	roller weight
γ	wrap angle of material	F_M	measuring force resulting from F_B
γ_1	entry angle of material	F_{Meff}	effective measuring force
γ_2	exit angle of material	n	number of force sensors
δ	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. 12). 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 „11. 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. 15):

- 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*

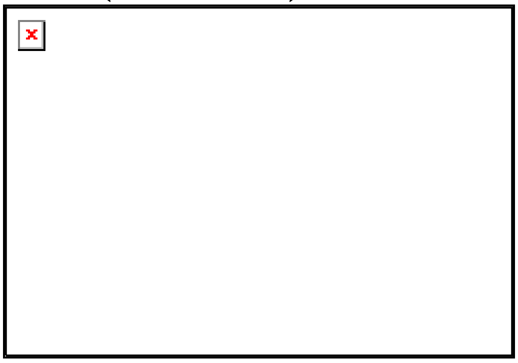

fig. 15: Transient effect of the control system C431013e

- 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.

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 control 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 control 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 tighten the material with the speed given by parameter *Start speed* until an initial material tension (parameter *Start limit*) is reached. Then, the material tension is increased to the reference value resp. the pilot control value (depending on parameter *Pilot control*; refer to „11. Parametrization“) 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 external pilot control

The external pilot control enables to evaluate the actual reel diameter (diameter signal is read from external source) and to calculate a drive output adapted to the reel diameter (pilot control signal). In addition, the PI resp. PID control parameters are dynamically adapted to the reel diameter continuously. Therefore the controller now is only responsible for the non-synchronous part. This will increase controlling stability.

Notice

The external pilot control is only suitable with a torque controlled drive.Using a speed controlled drive the internal pilot control has to be used.

Transmission of diameter signal

To transmit the actual reel diameter to the electronic unit, an analog signal 0...10V (from a distance sensor or other source) is fed to the analog input (terminals d6 / d8 resp. 7 / 8; refer to „8.6 Mounting the distance sensor“)

Diameter adjustment

To get the electronic unit knowing the actual reel diameter, the distance sensor signal has to be assigned to a diameter range:

- Set parameter *Pilot control* to *external*
- Insert reel with small diameter to get a signal according to the small diameter from the distance sensor
- Proceed parameter function *Auto. diameter adjustment* (ref. to „11. Parametrisation“ and fig. 16). Input the actual reel diameter into „1. diameter“. After confirmation with ↵ key the diameter is saved together with the referring voltage signal.

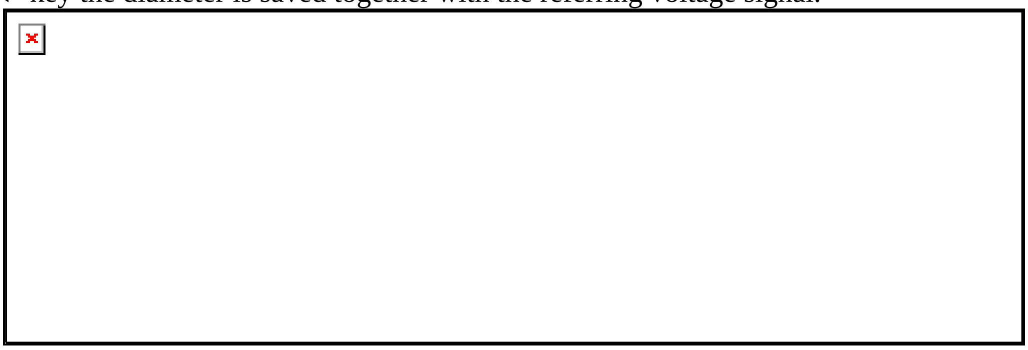

fig. 16: Program flow „Auto. diameter adjust“ C431015e

- Insert reel with large diameter to get a signal according to the large diameter from the distance sensor
- Proceed parameter function *Auto. diameter adjustment* (ref. to „11. Parametrisation“ and fig. 16). Input the actual reel diameter into „2. diameter“. After confirmation with ↵ key the diameter is saved together with the referring voltage signal.

Adjustment of pilot control

To get the electronic unit calculating the pilot control correct, a certain drive torque has to be assigned to a certain diameter:

- Set parameter *Pilot control* to *No*
- Proceed for a test run. If the control loop runs stable at a diameter as large as possible, the actual reference value and, after pressing the „Mode“ key, the actual output value can be read from the display. Note these two values:

  Actual reference value REF = _______________ [N]

  Actual output value OUTPUT = _______________ [V, mA]

  The drive torque for the pilot control is now determined.

- Terminate test run
- Set parameter *Pilot control* to *external*
- Proceed parameter function *Adjustment of pilot control* (ref. to „11. Parametrisation“ and fig. 17). The reel diameter has to be the same as during the test run.
  First, select the polarity of the diameter signal.
  Input the formerly noted output value into „%-torque“ (for ex. output value = 7.2V => %-torque = 72%, or output value = 12.0mA => %-torque = 60%, etc.)
  Input the formerly noted reference value [N] into „Reference“.
  After confirmation with ↵ key the calculated pilot control is saved together with the actual diameter signal.

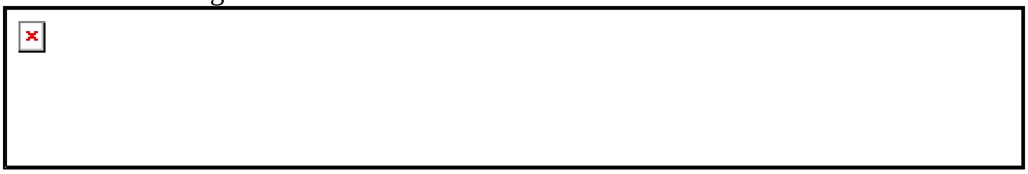

fig. 17: Program flow „Adjustment of pilot control“ C431016e

Notice

While changing parameter *Output configuration*, the adjustment of pilot control is lost.If parameter *Output configuration* will be changed after pilot control already being adjusted, you have to proceed again for adjustment of pilot control!

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

- 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 Setup of internal pilot control

The internal pilot control enables to evaluate the actual line speed. This operation mode is suitable if the line speed signal is provided in the machine. The reel diameter is then calculated internally from the proportion between line speed and actual output value. Therefore a separate distance sensor is not required.
During operation, a drive output adapted to the reel diameter is continuously calculated (pilot control signal). In addition, the PI resp. PID control parameters are dynamically adapted to the reel diameter continuously. Therefore the controller now is only responsible for the non-synchronous part. This will increase controlling stability.

Notice

The internal pilot control is only suitable with a speed controlled drive.Using a torque controlled drive the external pilot control has to be used.

(To be developped – ask FMS customer service)

9.11 Tension reduction

If the end of the reel should be wound smoother than the center of the reel, a tension reduction can be parametrized. The characteristic curve can be chosen as a linear, square or square root function (fig. 18). But, the tension reduction is only active if the pilot control is also active, that means the actual diameter has to be calculated internal or external.
The tension reduction is parametrized as follows:

fig. 18: Characteristic curve of the tension reduction C433007e

- Activate pilot control (ref. to „9.9 Setup of external pilot control“ or „9.10 Setup of internal pilot control“)
- Set parameter *Tension reduction* to required curve (fig. 18) (ref. to „11. Parametrization“)
- Set parameter *Reduction factor* to required value (ref. to „11. Parametrization“)
- Store diameter of the empty reel (Dmin) to parameter *Center diameter* (ref. to „11. Parametrization“)
- Store diameter of the fully wound reel (Dmax) to parameter *Max. diameter* (ref. to „11. Parametrization“)

9.12 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 + Quite good behaviour + 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) – 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.

Automatic start function

With the integrated automatic start function, it is possible to start very carefully even if the material has some slack, because the controller operates with only a small start speed until a certain minimum tension value is reached. After reaching the minimum tension, controlling will be fully activated.
To enable automatic start function, the parameters *Start speed* and *Limit speed* are set to appropriate values (ref. to „11. Parametrization“).

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. 19: 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
DAKT<CR>	XXXXXX<CR>	read actual diameter
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 Pos.1...2 : Err1...Err2 Value of Pos. = 0 : No Err; Value of Pos. = 1 : Err active
FREI<CR>	PACC<CR> / FAIL<CR>	enable controller
IDNT<CR>	CMGZ433 V2.01 1098 < Typ > <Version> <S >	10 characters type, fix 10 characters version, fix 4 characters serial number, fix
INRS<CR>	PACC<CR> / FAIL<CR>	initialize interface (for ex. after loading of new interface parameters)
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 1-6 : feedback 7-11 : output value 12-16: reference after ramp 17 : error evaluation 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>	pilot control
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>	XX.X<CR>	ramp diameter
RP35<CR>	XX.X<CR>	ramp reference
RP36<CR>	X<CR>	reference internal / external
RP37<CR>	XXXX<CR>	scale of reference
RP38<CR>	X<CR>	tension reduction
RP39<CR>	X.XXX<CR>	reduction factor
RP40<CR>	XXX.XX<CR>	start speed
RP41<CR>	XXX.X<CR>	start limit
RP42<CR>	XXXX<CR>	leading drive
RP43<CR>	XXXX<CR>	controlled drive
RP44<CR>	XXXX<CR>	tacho diameter
RP45<CR>	XXXX<CR>	center diameter
RP46<CR>	XXXXX<CR>	max. diameter
RP47<CR>	XXX<CR>	Identifier
RP48<CR>	X<CR>	baud rate interface
RP49<CR>	X<CR>	data bit interface
RP50<CR>	X<CR>	stop bit interface
RP51<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>	pilot control
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.
WP34XX.X<CR>	PACC<CR> / FAIL<CR>	ramp diameter
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
WP38X<CR>	PACC<CR> / FAIL<CR>	tension reduction
WP39X.XXX<CR>	PACC<CR> / FAIL<CR>	reduction factor
WP40XXX.XX<CR>	PACC<CR> / FAIL<CR>	start speed
WP41XXX.X<CR>	PACC<CR> / FAIL<CR>	start limit
WP42XXXX<CR>	PACC<CR> / FAIL<CR>	leading drive
WP43XXXX<CR>	PACC<CR> / FAIL<CR>	controlled drive
WP44XXXX<CR>	PACC<CR> / FAIL<CR>	tacho diameter
WP45XXXX<CR>	PACC<CR> / FAIL<CR>	center diameter
WP46<CR>	PACC<CR> / FAIL<CR>	max. diameter
WP47XXX<CR>	PACC<CR> / FAIL<CR>	Identifier
WP48X<CR>	PACC<CR> / FAIL<CR>	baud rate interface
WP49X<CR>	PACC<CR> / FAIL<CR>	data bit interface
WP50X<CR>	PACC<CR> / FAIL<CR>	stop bit interface
WP51X<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)				________
Auto. diameter adjust	(Parameter function) [1]				
Adjustm. of pilot control	(Parameter function) [1]				
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				________
Pilot control	No, Internal, External				________
Influence of PI [2]	[%]	100.0	0.1	100.0	________
PID-configuration [2]	PI, PID	PI			________
Proportional P0 [2]	[-]	1.00	0.01	100.00	________
Integral I0 [2]	[s]	1.00	0.01	100.00	________
Derivative D0 [2]	[s]	0.010	0.001	10.000	________
Proportional P1 [2]	[-]	1.00	0.01	100.00	________
Integral I1 [2]	[s]	1.00	0.01	100.00	________
Derivative D1 [2]	[s]	0.010	0.001	10.000	________
Proportional P2 [2]	[-]	1.00	0.01	100.00	________
Integral I2 [2]	[s]	1.00	0.01	100.00	________
Derivative D2 [2]	[s]	0.010	0.001	10.000	________
Proportional P3 [2]	[-]	1.00	0.01	100.00	________
Integral I3 [2]	[s]	1.00	0.01	100.00	________
Derivative D3 [2]	[s]	0.010	0.001	10.000	________
Alarm limit error	[%]	10.0	0.1	100.0	________
Output limit	[%]	100.0	10.0	100.0	________

[1] Is displayed only if *pilot control* is active

[2] 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.

Output configuration	±10V, 0...10V, 0...20mA, 4...20mA				
Ramp diameter	[s]	1.0	0.1	60.0	
Ramp reference	[s]	1.0	0.1	20.0	
Reference	Internal, External	Internal			
Scale ref. input	[N,kN]	10	0	9999	
Tension reduction	No, Linear, Square, Root				
Reduction factor	[-]	0.000	0.000	1.000	
Start speed	[%Out]	0.00	0.00	100.00	
Limit speed	[%F_ref]	0.0	0.0	100.0	
Leading drive	[rpm/V]	300	1	1000	
Controlled drive	[rpm/V]	300	1	1000	
Tacho diameter	[mm]	100	10	1000	
Center diameter	[mm]	100	10	5000	
Max. diameter	[mm]	1000	10	10000	
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. 20 C432012e

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]

Auto. diameter adjust

Use: (Is displayed only if *pilot control* is set to *external*.)
By pressing the ↵ key for 3 seconds, an adjustment program is started which will assign a diameter range to the 0...10V analog input signal coming from a distance sensor, etc. (refer to „9.9 Setup of external pilot control“)

Adjustment of pilot control

Use: (Is displayed only if *pilot control* is set to *external*.)
By pressing the ↵ key for 3 seconds, an adjustment program is started which will record the characteristic of the connected brake. (refer to „9.9 Setup of external pilot control“)

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 „9.4 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. The lowpass output filter is independent of the other filters. **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. 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. 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

Pilot control

Use:	With this parameter, the operation mode of the pilot control is set.			
Range:	No, Internal, External		**Default:**	No

Definition:

No: No pilot control.
Internal: The line speed signal is evaluated; the reel diameter is calculated internally.
External: The diameter signal is evaluated; the reel diameter is read from this external source.

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.
„10%“ means 10% of the maximum output signal.
If parameter *Output limit* is set to less than 100% the influence value stored here should be adjusted accordingly.
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.
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. 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“. 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...P3

Use: Description and function see *Proportional P0*. Active if the BCD inputs are set to 1 resp. 2 resp. 3.

Integral I1...I3

Use: Description and function see *Integral I0*. Active if the BCD inputs are set to 1 resp. 2 resp. 3.

Derivative D1...D3

Use: Description and function see *Derivative D0*. Active if the BCD inputs are set to 1 resp. 2 resp. 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. With setting „±10V“, the drive unit can run and brake both in forward and reverse direction. With the other settings, the drive unit can only run and brake in forward direction. FMS recommends setting to „±10V“ if the used drive unit supports this signal.		
Range:	±10V, 0...10V, 0...20mA, 4...20mA	**Default:**	±10V

Ramp diameter

Use:	To optimize the controller against disturbances, the diameter should not change too fast. For this, the diameter signal is led internally to a ramp. Its rate of rise is defined using this parameter. The length of the ramp defines the time the diameter will take for a changement of 1mm.				
Range:	0.1	to	60.0	**Default:**	1.0
Increment:	0.1			**Unit:**	[s]

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. 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]

Tension reduction

Use:	This parameter defines the shape of the characteristic curve for the tension reduction (ref. to „9.11 Tension reduction“)				
Range:	No, Linear, Square, Root			**Default:**	No

Reduction factor

Use: This parameter stores the reduction factor for the tension reduction. It corresponds to the relation from reduced tension (at Dmax) to normal tension (at Dmin) and is calculated using the following formula:

$$\text{Reduction factor} = \frac{\text{reduced tension at Dmax [N]}}{\text{normal tension at Dmin [N]}}$$

Range:	0.000	to	1.000	**Default:**	0.000
Increment:	0.001			**Unit:**	[-]

Start speed

Use:	If the material is hanging loosely during enabling the controller, the controller would rewind the material with maximum speed to build the needed material tension. The drive unit then cannot brake fast enough, and cracking of the material can be the result. Therefore, the controller runs with a low speed stored in this parameter until an initial material tension (parameter *Start limit*) is reached. „10“ refers to 10% of the maximum output value, depending on parameter *Output configuration*.				
Range:	0.00	to	100.00	**Default:**	0.00
Increment:	0.01			**Unit:**	[%Out]

Start limit

Use:	If the material is hanging loosely during enabling the controller, the controller would rewind the material with maximum speed to build the needed material tension. The drive unit then cannot brake fast enough, and cracking of the material can be the result. Therefore, the controller runs with a low speed (parameter *Start speed*) until an initial material tension stored in this parameter is reached. „10“ refers to 10% of the reference value [N].				
Range:	0.0	to	100.0	**Default:**	0.0
Increment:	0.1			**Unit:**	[%F_ref]

Leading drive

Use:	This parameter is used to calculate the reel diameter from the line speed signal. *(To be developed – ask FMS customer service)*				
Range:	1	to	1000	**Default:**	300
Increment:	1			**Unit:**	[rpm/V]

Controlled drive

Use:	This parameter is used to calculate the reel diameter from the line speed signal. *(To be developed – ask FMS customer service)*				
Range:	1	to	1000	**Default:**	300
Increment:	1			**Unit:**	[rpm/V]

Tacho diameter

Use:	This parameter is used to calculate the reel diameter from the line speed signal. *(To be developed – ask FMS customer service)*				
Range:	10	to	1000	**Default:**	100
Increment:	1			**Unit:**	[mm]

Center diameter

Use:	This parameter stores the diameter of the empty reel (Dmin). It is used for tension reduction.				
Range:	10	to	5000	**Default:**	100
Increment:	1			**Unit:**	[mm]

Max. diameter

Use:	This parameter stores the diameter of the fully winded reel (Dmax). It is used for tension reduction.				
Range:	10	to	10000	**Default:**	1000
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 or winds too slow when enabling the controller	Parameter *Start speed* set too low	Increase parameter *Start speed*
	Parameter *Start limit* set too high	Decrease parameter *Start limit*
Roller winds fast when enabling the controller; ev. material cracking	Parameter *Start limit* set too low	Increase parameter *Start limit*
	Parameter *Start speed* set too high	Decrease parameter *Start speed*
Roller winds much too fast when enabling the controller	Using pilot control: The diameter signal gives „0“; diameter sensor defect	Check diameter sensor and wiring to the terminals d6 / d8 (resp. 7 / 8); replace if needed
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 CMGZ433

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 Analog input 0...10V RS232 CAN-Bus (option)
Configuration	Drive for winding applications
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 (CMGZ433.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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