



# Operating Manual

## EMGZ306A/ EMGZ306A.10V

### EMGZ306A.CAL

Compact analogue Tension Measuring Amplifier

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Diese Bedienungsanleitung ist auch in Deutsch, Französisch und Italienisch erhältlich.  
Bitte kontaktieren Sie Ihren nächstgelegenen FMS Vertreter.

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# 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 mechanical damage. This warning has to be followed absolutely.

### c) Note for proper function



#### **Note**

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 Measuring Amplifier 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.
- 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.

## 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:**

The 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.

## 3 System Components

The EMGZ306A 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*
- *Force measuring bearing block*

**Measuring amplifier EMGZ306A**

- Design with compact plastic housing
- Housing fits directly to a DIN mounting rail
- Gain and offset adjustable infinitely with 20-turn trimmers
- Freely configurable lowpass filter
- Freely configurable outputs ( $\pm 10V$ ; 0...20mA; 4...20mA)
- Supports connection of an external feedback display
- *Compound-filled version EMGZ306A.581820 with extended vibration proofness, for ex. for rotating applications*
- *Measuring amplifier EMGZ306A.CAL, Calibration without weight*

*(components in italic text are variants or options)*

## 4 System description

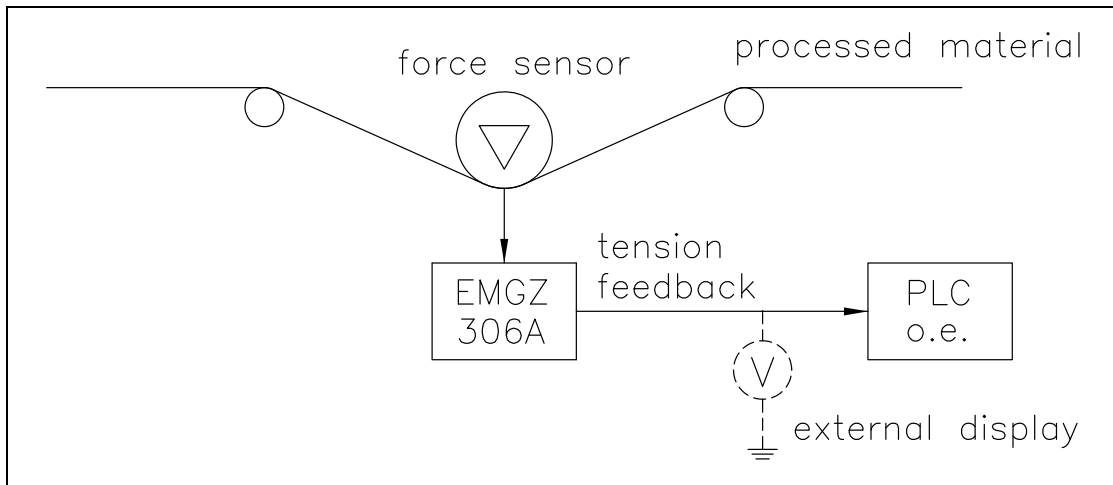


Fig. 1: Basic structure of the EMGZ306A Tension Measuring Amplifier E306001e

### 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 measuring amplifier EMGZ306A. The measuring amplifier amplifies the mV signal depending on configuration. The resulting feedback value can be transmitted to an analog instrument, a PLC or equivalent devices.

### 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 measuring amplifier 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 EMGZ306A by a very accurate power supply.

### 4.3 Measuring amplifier EMGZ306A

The EMGZ306A is a single channel analog Tension Measuring Amplifier. It is delivered in a compact housing which may be snapped on a DIN mounting rail directly. All connections are led to screw terminals. There can be connected 1 or 2 force sensors of 350Ω. The amplifier provides the highly accurate 5V power supply and amplifies the mV signal of the force sensors to a level of 10V and 20mA. Tension and current output are active the same time. The technology ensures both good thermal and electrical characteristics. Measuring circuit and power supply are galvanic insulated. Setting of gain and offset is done by 2 trimmers. For filtering of the signals, a non-polarized capacitor can be connected.

### 4.4 Measuring amplifier EMGZ306A.CAL

The EMGZ306A.CAL provides a “CAL” push button function which can be used for calibration of the amplifier without having to use weight. The calibration is done based on a calculation method using application and geometry data.

The accuracy of this type of calibration is lower than the standard calibration with a weight.

### 4.5 Block Diagram

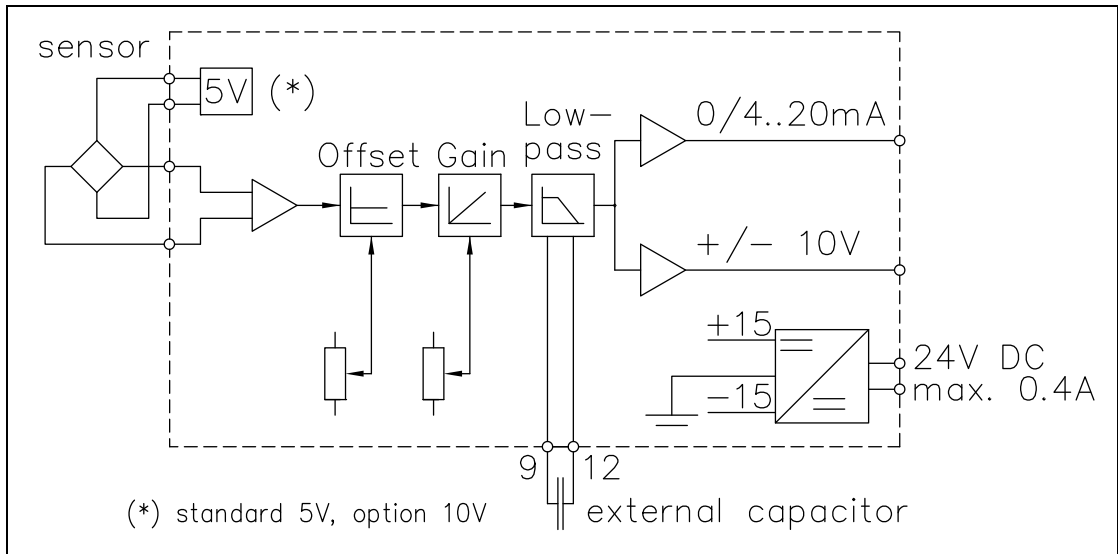


Fig. 2

E306007e

### 4.6 Dimensions

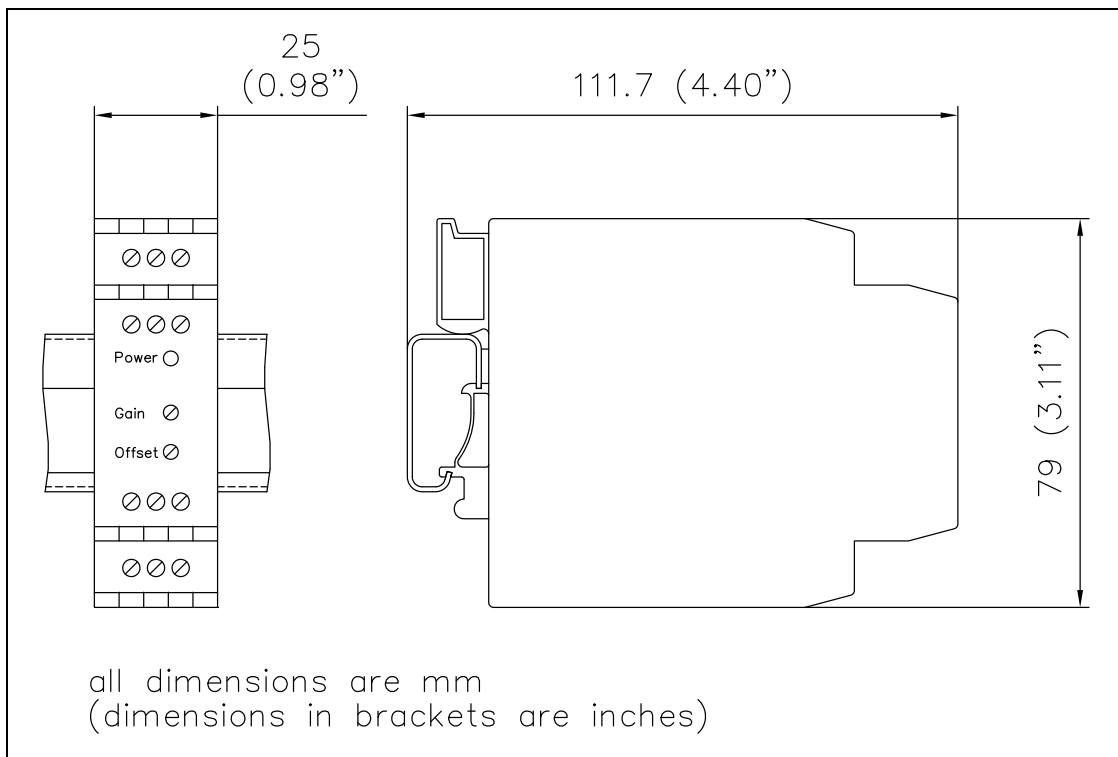


Fig. 3

E306008us

## 5 Installation and Wiring



### Caution

Proper function of the Tension Measuring Amplifier 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.

### 5.1 Mounting and wiring of the electronic unit

The plastic housing of the measuring amplifier can be mounted in a control cabinet. It is snapped on a DIN mounting rail directly. Wiring to the terminals is done according to wiring diagram (Fig. 4).

### 5.2 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.

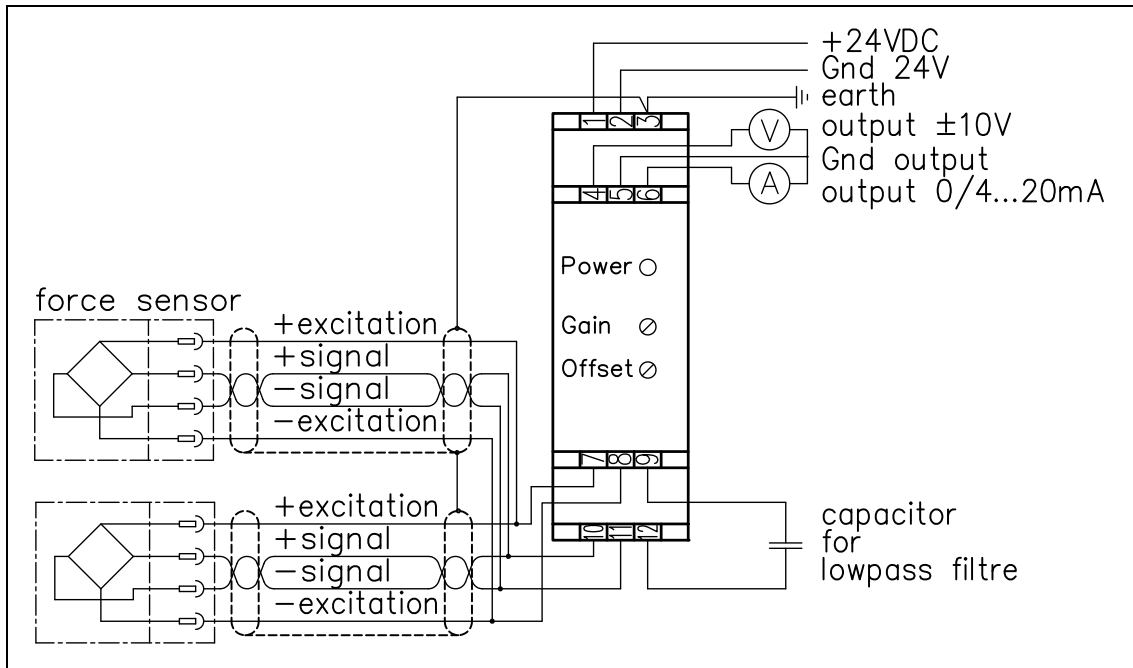
Wiring to the terminals of the electronic unit is done according to wiring diagram (Fig. 4).



### Note

Connecting the shield of the signal cable to the electronic unit and to the force sensor may cause ground circuits which may interfere with the measuring signal. 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.

### 5.3 Wiring



**Fig. 4:** Wiring Diagram

E306009e

There can be connected 1 or 2 force sensors to the measuring amplifier. Using 2 force sensors, the connections will be wired parallel. The output signal of the measuring amplifier then will correspond to the average value of the 2 sensors.

The connection between force sensors and measuring amplifier has to be done using  $2 \times 2 \times 0.75 \text{ mm}^2$  [AWG 18] shielded twisted-pair cable. (With cable length below 15m,  $2 \times 2 \times 0.25 \text{ mm}^2$  [AWG 23] is also suitable.) The cable must be installed separate from power lines.

Terminal 3 has to be connected to earth.



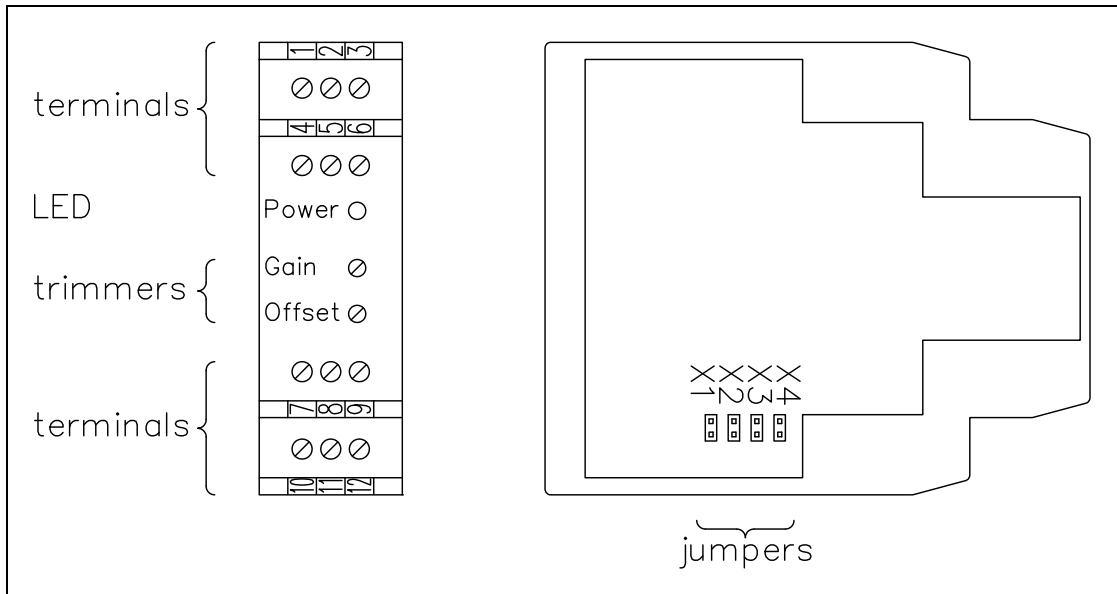
#### Caution

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.



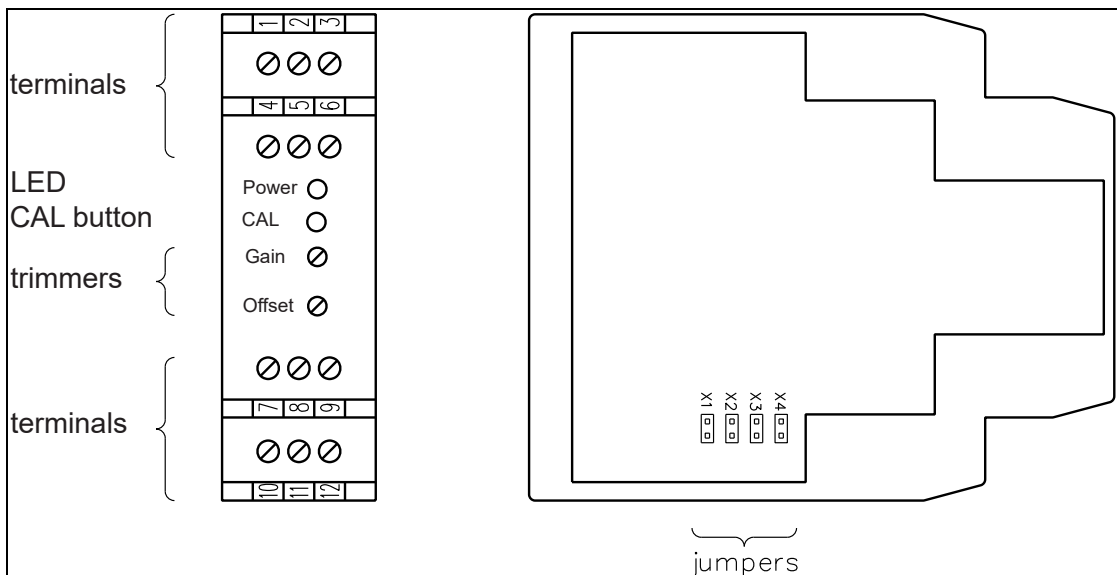
## 6 Setting into Operation

### 6.1 View of the Setting Elements EMGZ306A



**Fig. 5a:** Setting elements EMGZ306A. The LED is for monitoring the supply voltage  
E306010e

### 6.2 View of the Setting Elements EMGZ306A.CAL



**Fig. 5b:** Setting elements EMGZ306A.CAL. The LED is for monitoring the supply voltage

E306011e

## 6.3 Configuring the Outputs

### Open the housing

To access the jumpers, the housing has to be opened. Therefore, pull the 2 housing halves carefully and take off the left side.

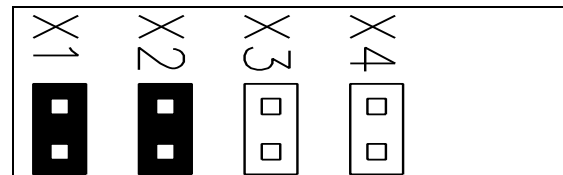
The measuring amplifier provides a tension output ( $\pm 10V$ ) and a current output (0...20mA or 4...20mA) which are active simultaneously. The signal of the current output is configured as follows:

### Current output 4...20mA

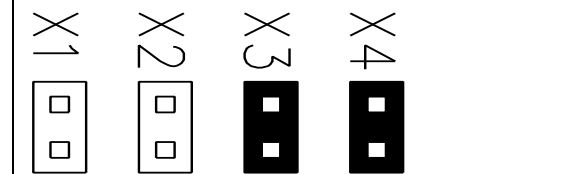
The jumpers have to be set to X1 / X2 (fig. 6). This is the standard FMS factory setting.

### Current output 0...20mA

The jumpers have to be set to X3 / X4 (fig. 7).



**Fig. 6:** Jumper setting for current output 4...20mA E306006a



**Fig. 7:** Jumper setting for current output 0...20mA E305006e

### Compound-filled version EMGZ306A.581820 for rotating applications:

Solder bridges are used instead of the jumpers to ensure the vibration proofness. Standard factory setting is 4...20mA. The current output can be reconfigured by resoldering the solder bridges.

## 6.4 Configuring the Lowpass Filter

The measuring amplifier provides a lowpass filter. It is used to eliminate faulty signal variations which may be caused by unbalanced rollers, vibrations of the machine, or equivalent.

The lowpass filter is effective to both the tension- and the current output. The lower the cut-off frequency, the more sluggish the output signal will be. The configuration is made by connecting a non-polarized capacitor to the terminals 9 and 12 (refer to fig. 4). The capacitor will be determined referring to the following formula resp. list:

$$C = 10 / F$$

C: Capacity [ $\mu\text{F}$ ]  
 F: Cut-off frequency [Hz]

Cut-off frequency [Hz]	Capacitor [ $\mu\text{F}$ ]
1	10
2	5
5	2
10	1
20	0.5
50	0.2
100	0.1
200	0.05
500	0.02
1000	0.01



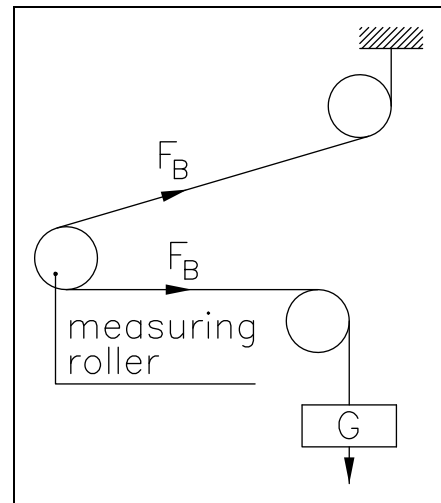
**Note**

You must not use electrolytic capacitors because positive and negative signals are appearing! They would damage the electrolytic capacitor.

## 6.5 Calibrating the Measuring Amplifier

**Calibration Steps:**

1. Connect gauge to the tension- resp. current output.
2. Connect the first force sensor
3. Check, if a positive output signal is appearing when loading the sensor in measuring direction. If not, exchange the two signal wires of the referring force sensor in the terminal block (terminals 10 / 11).
4. If used, connect the second force sensor.
5. Check, if a positive output signal is appearing when loading the sensor in measuring direction. If not, exchange the two signal wires of the referring force sensor in the terminal block (terminals 10 / 11).
6. Insert material or a rope loosely to the machine.
7. Adjust the offset trimmer until the output value is 0V or 4mA respectively.
8. Load material or rope with a defined weight (fig. 8).
9. Adjust the gain trimmer until the output value shows the needed value (for ex. 10V corresponding to 500N).



**Fig. 8:** Calibrating the measuring amplifier C431011e

## 6.6 Calibrating the Measuring Amplifier without a Weight (EMGZ306A.CAL only)

The EMGZ306A.CAL has a calibration button on the front side. Pushing this button simulates an input of 4.5mV at the amplifiers. This is used as reference point for the calibration without weight.

The calibration without weight of the EMGZ306A.CAL is done by pushing the calibration button and simultaneously adjusting the gain potentiometer until the output voltage is equal to the calculated gain (see below).

Note: The accuracy of this type of calibration is lower than if the calibration is done with weight (see 7.5)

### Method 1:

#### Calculating manually the gain / calculating the corresponding output voltage

Define a tension and an according output voltage

$F = \dots$  [N] @  $V = \dots$  [V]

Calculate the output voltage at 10V.  $F_{@10V} = \dots$  [N]

Calculate the output voltage to be set when pressing the CAL button on the amplifier according to the formula:

$$\begin{aligned} \text{Output Voltage} &= 10 * \frac{F_{\text{nominal}}}{F_{@10V}} * \frac{FB}{FMR} * 0.5 \\ &= 10 * \frac{F_{\text{nominal}}}{F_{@10V}} * \frac{n}{2 * \sin(\gamma/2) * \cos(\alpha)} * 0.5 \end{aligned}$$

$F_{\text{nominal}}$  = nominal force of sensor (see product label)

$F_{@10V}$  = desired Force corresponding to 10V voltage output

FB = Material Tension

FMR = resulting material tension in red point direction per sensor

$\gamma$  = wrap angle

$\alpha$  = angle between red point and resulting force

n = number of force sensors

(n=2 for LMGZ, AMGZ, ZMGZ, UMGZ, SMGZ, PMGZ)

(n=1 for RMGZ, IMGZ)

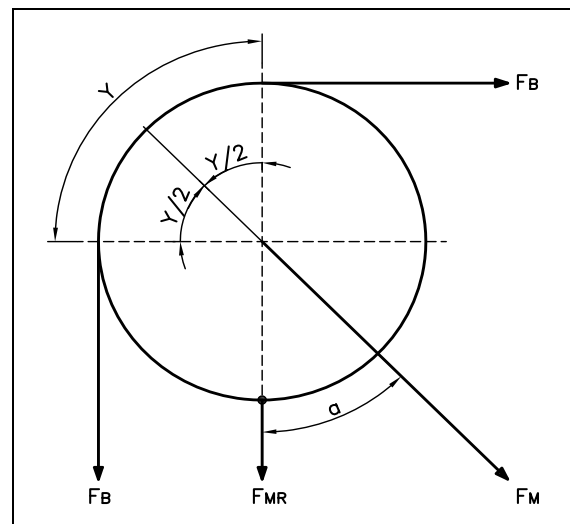


fig. 9: definition of angles and forces

MG306\_CAL

## Method 2: Using FMS-Calculator to calculate the gain

You need the FMS calculator V2.0 or higher.

If necessary download and install FMS Calculator from the FMS homepage at:

<http://www.fms-ag.ch/e/downloads/index.htm>

### Gain-Calculation-tool

The Gain Calculator is an optional feature of FMS Calculator used to calculate the gain value. The Gain Calculator is a tool for easy weightless calibration of FMS digital amplifiers and FMS analogue amplifier EMGZ306A.CAL.

1. First go through step 1 to 4 in the FMS-calculator and fill-in all relevant data.
2. Choose the appropriate sensor type.
3. Start the gain tool with a click on the corresponding symbol. Please note that the gain tool is only available when all data have been entered and the sensor type defined.
4. The gain calculator for FMS digital amplifier needs no input. All necessary inputs are taken from the previous steps.
5. The output voltage values for calibration is given in the result screen (see Fig.10)

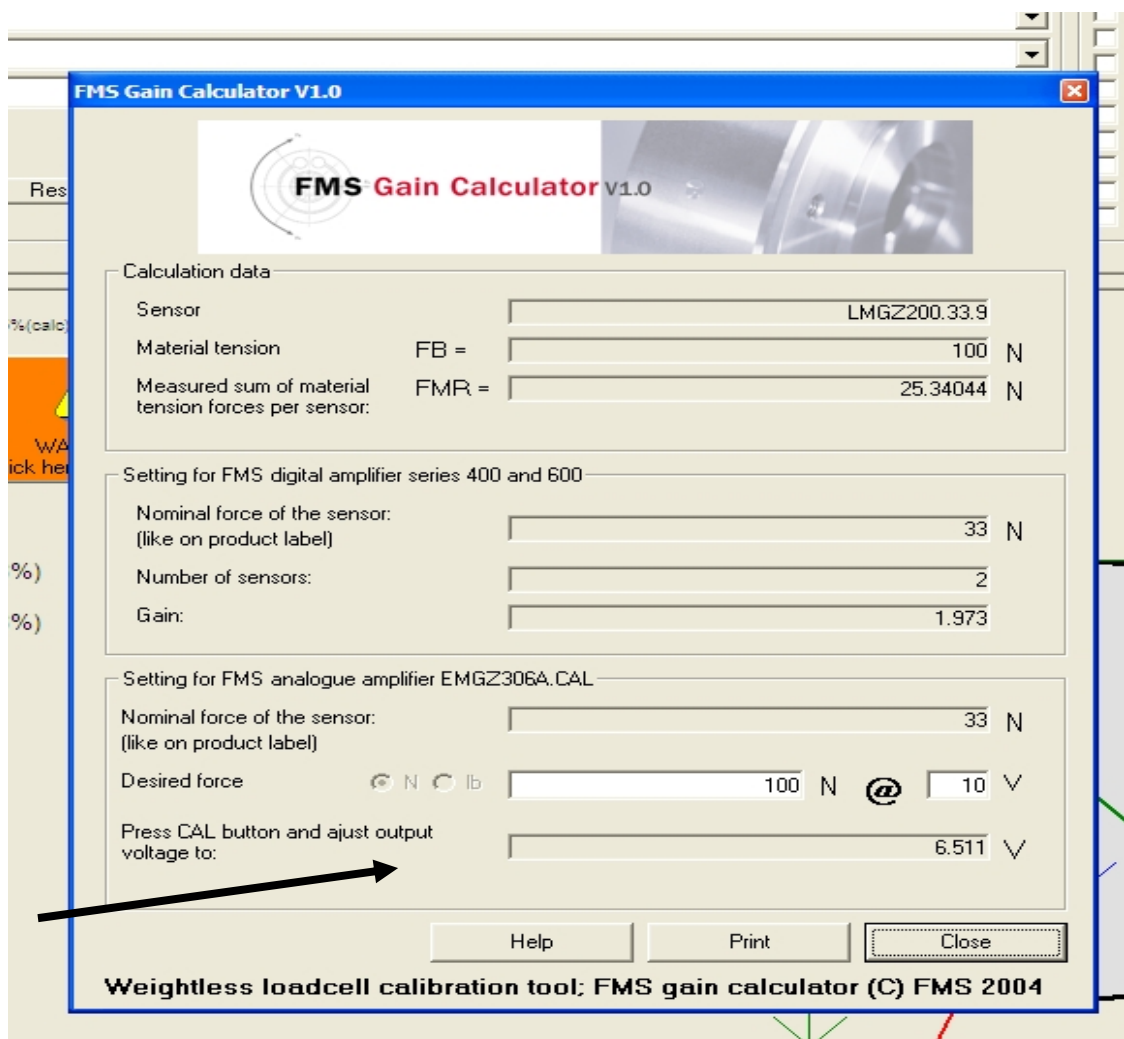


Fig. 10: Output screen of the gain calculation tool of the FMS calculator E3060\_gain1.jpg

**Calibration Steps:**

1. Connect gauge to the tension- resp. current output.
2. Connect the first force sensor
3. Check, if a positive output signal is appearing when loading the sensor in measuring direction. If not, exchange the two signal wires of the referring force sensor in the terminal block (terminals 10 / 11).
4. If used, connect the second force sensor.
5. Check, if a positive output signal is appearing when loading the sensor in measuring direction. If not, exchange the two signal wires of the referring force sensor in the terminal block (terminals 10 / 11).
6. Insert material or a rope loosely to the machine.
7. Adjust the offset trimmer until the output value is zero.
8. Connect a voltmeter to the voltage output of the EMGZ306A.CAL, press the CAL button and simultaneously adjust the gain potentiometer until the output reads the "Output Voltage" as calculated before or as given by the FMS gain-tool.

## 7 Trouble Shooting

Error	Cause	Corrective action
<b>Output shows signal &gt; 0 although material has no tension</b>	Offset setting is bad	Re-adjust offset (refer to „7.4 Calibrating the measuring amplifier“)
	Current output is configured for 4...20mA	Change jumper setting if required
<b>Output signal is not stable although material tension doesn't change</b>	Cut-off frequency too high	Adjust cut-off frequency (refer to „7.3 Configuring the lowpass filter“)
	Ground terminal of the output isn't 0V	Connect Gnd terminal of the output (terminal 5) with earth (terminal 3)
<b>Output shows no reaction, or LED don't light</b>	Fuse blown	Replace fuse on power supply
	Power supply not correct	Check / correct power supply
	Measuring amplifier defect	Contact FMS customer service

## 8 Technical Data

Sensor excitation	5VDC max. 30mA high precision (option 10VDC)
Gain factor range	500...5000
Offset range	±9mV
Temperature drift offset	< 0.01% / K [0.006% / °F]
Linearity error	< 0.1%
Tension output	±10V min. 1kΩ
Current output	0/4...20mA max. 500Ω
Lowpass cut-off frequency	adjustable, ca. 1...1000Hz
Power supply	24VDC (18...36VDC) max. 0.1A
Power consumption	max. 2.5W
Temperature range	-10...+60°C [14...140°F]
Protection class	IP20



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