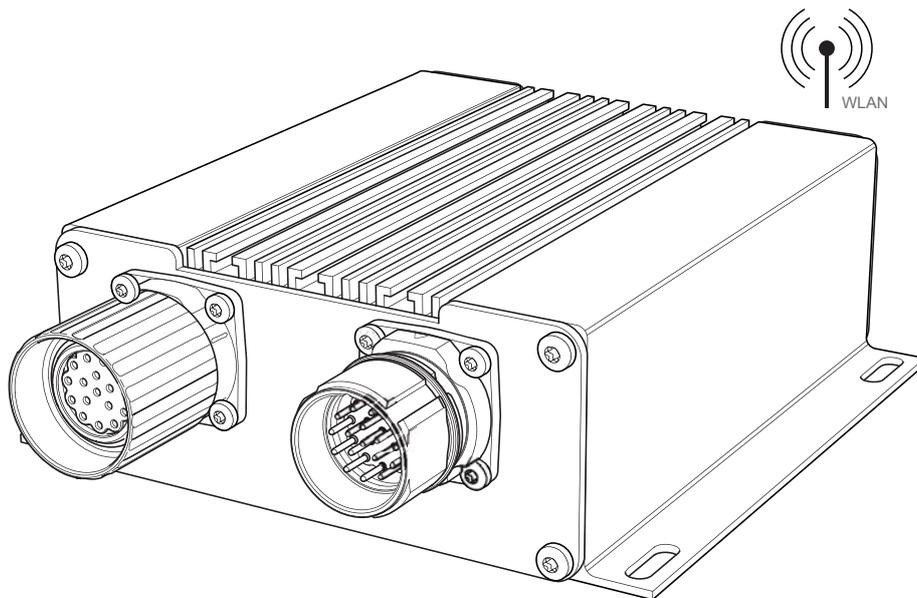


# Testing and programming unit

## ▶ **GEL 211**

for sensors with SIN/COS output 1 V<sub>pp</sub>

## Operating instructions



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# 1 General

## 1.1 About these Operating Instructions

These Operating Instructions are part of the product and describe how to use it safely.

- ▶ Please read the Operating Instructions carefully before you begin assembly.
- ▶ Keep the Operating Instructions for the entire service life of the product.
- ▶ Make sure that the Operating Instructions are available to personnel at all times.
- ▶ Pass the Operating Instructions on to each subsequent owner or user of the product.
- ▶ Insert all additions received from the manufacturer.
- ▶ To avoid property damage or malfunctions, read and observe the specifications provided in these Operating Instructions.

## 1.2 Validity

These Operating Instructions apply to the standard design of the product. This includes all types that are not marked with a **Y** behind the product number in the type code.

A product marked with **Y** is a customised design with a special assembly and/or modified technical specifications. Depending on the customised modification, additional or other documents may be valid.

## 1.3 Target group

These Operating Instructions are intended for electrical specialists and mechanics who are authorised to mount and electrically connect devices and systems, to put them into operation, and to label them under the terms of safety-related standards, as well as machinery operators and manufacturers.

## 1.4 Symbols used

- ! Notes on preventing malfunctions and damage
- i Information for understanding or optimising work processes
- ▶ Work step to be undertaken
- Reference to different page in the document or to a separate document

## 1.5 Terminology

MiniCODER	Protected name for Lenord + Bauer encoder kit of type GEL 24xx. However, in this document this term is also used generally for sensors that have a SIN/COS output with a signal amplitude of $1 V_{pp}$ and optionally a reference output (target wheel with reference mark). <sup>(1)</sup>
comfort	GEL 2444Kx1/R without/with amplitude regulation
plus	GEL 2444KxP programmable
BQ	Evaluation quotient, information on the quality of a measuring scale (calculated value), see also glossary → <a href="#">page 46</a>
Plant	Machine or machine tool in which the MiniCODER is installed, e.g. a high-speed spindle

You will find explanations on reference signal and SIN/COS signal as well as on the gear wheel analysis in the glossary → [page 45](#) pp.

## 1.6 Up-to-date documentation

Lenord + Bauer makes every effort to ensure that the documentation is always up-to-date. However, it cannot be excluded that changes to the firmware of GEL 211 (made at short notice) with their related functional and visual implications are not immediately included in these instructions.

These operating instructions apply to firmware versions from **2.03.03** (see also sections [Info](#) [→ [page 18](#)] and [Information group](#) [→ [page 35](#)]).

### “Screenshots”

The screenshots shown in the document are only to be considered examples. There may be variations in a specific case.

Some figures for the web-based user interface only show an extract of all the possibilities for reasons of space (also in reality). The situation is apparent by the display of a scroll bar on the right.

## 1.7 Access to the user interface

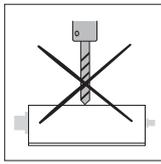
The GEL 211 is controlled via a web user interface. For this purpose a current browser and a modern operating system for mobile terminal devices is required:

- Firefox 10+
- Safari 5.0+
- Chrome 16+
- Opera 10+
- Android 3.0+
- iOS 5.0+
- Internet Explorer 9+ (not recommended)

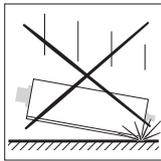
<sup>(1)</sup> On the usage of encoders from other manufacturers, please contact Technical Support at Lenord + Bauer.

## 2 Safety

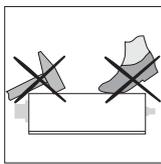
### 2.1 Safety instructions



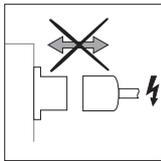
Do not drill holes in housing.



Do not bang or drop unit.



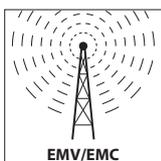
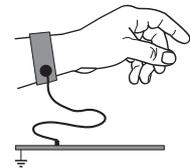
Do not hit or stand on the housing.



Only undo or make connections if electrically isolated.



Only touch connector pins and wires if you are suitably earthed (see EN 100015-1).



To improve the electromagnetic environment

- Use metallised connectors
- Connect screen to connector
- Keep unscreened cables as short as possible
- Short earth connections with a large cross-section
- Physically separate signal cables from power cables
- Lay equipotential bonding cables if currents should flow through the screens

#### ! Adjustment of MiniCODER plus:

You should **not** use this feature to correct extreme variations in signals caused by improper installation of the MiniCODER, e.g. excessively small/large air gap or tilted/twisted installation.

As a consequence internal control parameters could enter a border area and it will no longer be possible to compensate for mechanical changes that occur during the operation of the machine (spindle).

#### ! It is imperative you comply with the technical data and other information stated in the documentation.

## 2.2 Designated use

The testing and programming unit GEL 211 is used to test the function of MiniCODERs and to set operating parameters, especially for the MiniCODER plus.

It can be operated separately or incorporated into an existing measuring circuit.

The unit only communicates via WLAN with a client with web support (mobile terminal device or PC) and has FCC approval:

FCCID: YOPGS1011MEE

ICID: 9154A-GS1011MEE

## 2.3 Non-designated use

It is not allowed to operate the testing and programming unit

- In potentially explosive atmospheres
- In environments with caustic and/or electrically conductive acids, bases, oils, vapours or dusts
- In environments with requirements on the protection class higher than those defined for this unit
- As a fixed (installed) element in the control loop for the object measured
- In the household area

## 3 Product identification

### 3.1 Scope of supply

The unit is supplied in a cardboard box with foam insert or in a case with USB power supply unit and MiniCODER adapter cable.

### 3.2 Rating plate

Type and serial number for the unit are printed on the rear of the unit:

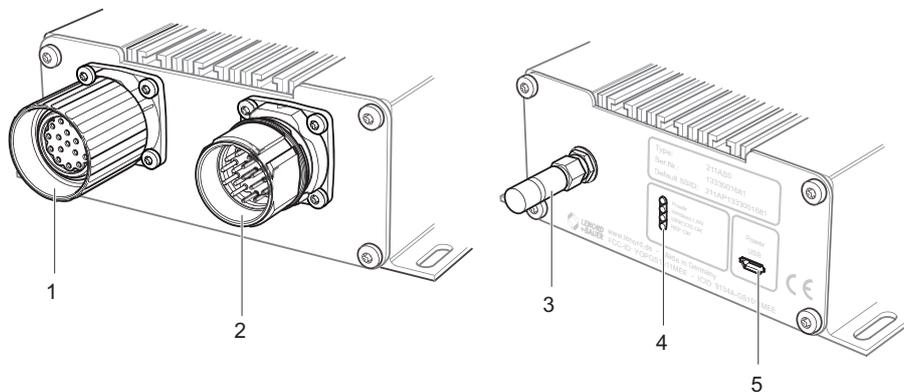
Type:	211AS0
Ser.Nr.:	1333001681
Default SSID:	211AP1333001681

Type	Type as per order code in the separate document Technical information
Ser.Nr.	Serial number (year and week of manufacture as well as unique production number)
Default SSID	WLAN identifier (operation as access point)

- i** A Y number after the product identifier – e.g. GEL 211**Y001** – identifies a customer-specific version that may vary from the standard technical specification. Then the additional documentation supplied is definitive.

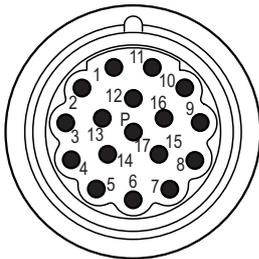
### 3.3 Parts named

#### 3.3.1 Overview



- 1 MiniCODER connection; female connector M23, 17-pin
- 2 Connector feature for the higher level control system; male connector M23, 17-pin
- 3 WLAN antenna
- 4 LED displays
- 5 Micro USB port (type B) for supply voltage 5 V and/or local connection to a PC for configuration purposes

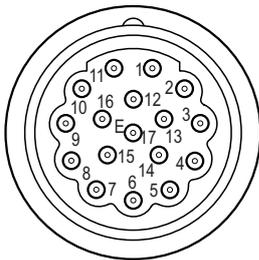
### 3.3.2 Connection



Female

Input

(← MiniCODER)



Male

Output

(→ e.g. tester)

Pin	Function (evaluated by the GEL 211)	
1	Signal track 1	SIN+
2	Inverse signal track 1	SIN-
3	Reference track (zero signal)	REF+
7	Earth, encoder supply	GND
10	Encoder supply +5 V (see also information → <a href="#">page 13</a> )	+U <sub>B</sub>
11	Signal track 2	COS+
12	Inverse signal track 2	COS-
13	Inverse reference track (zero signal)	REF-

The pin layout corresponds to the MiniCODER standard. Input and output connections with the same number (1–9, 11–15, 17) are looped through; the Sense input 16 is connected to input 10 (encoder supply).

Connections not listed are not used by the GEL 211.



If the unit is operated with a connection to a higher level control system, a differentiation must be made between two operating modes:

- Measurement/analysis: No restriction on operation
- Configuration/calibration: Restriction on operation, as the MiniCODER plus is temporarily placed in a programming mode in which “Safety integrated” is no longer ensured.

### 3.3.3 Displays

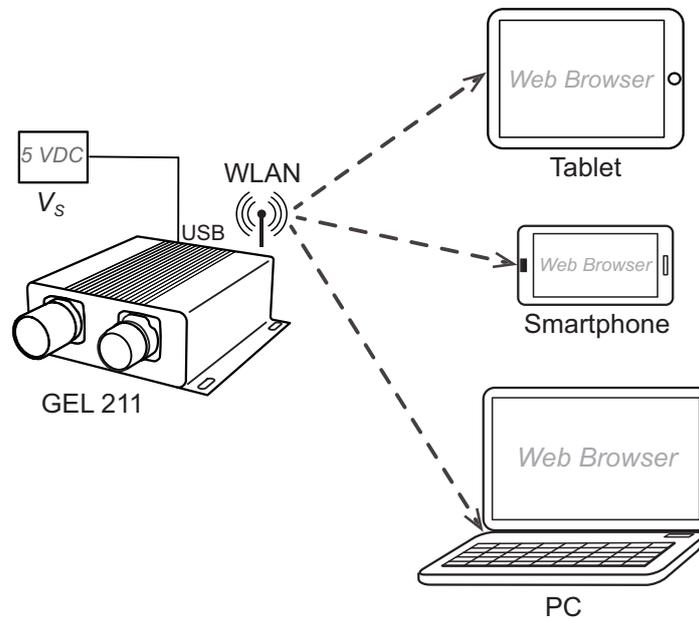
LED	Colour/flashing pattern	Significance
POWER	green	Unit supplied with power
	green flashing	Loading new firmware (a few seconds)
Wireless LAN	green flashing slowly	Ready for connection
	green flashing quickly	WLAN error
	green/red flashing	Firmware update in progress
	green	Connected
	red	Activity, data transmission
SIN/COS OK <sup>(1)</sup>	green	SIN/COS level ok
	off	SIN/COS level not ok
REF OK <sup>(1)</sup>	green	Zero signal quiescent level ok, signal detected in the last 2 s
	blue	Zero signal quiescent level ok, no signal in the last 2 s
	red	Zero signal quiescent level not ok or unit is waiting for position information

<sup>(1)</sup> Behaviour undefined if MiniCODER not connected.

## 4 Commissioning

### 4.1 WLAN connection (default)

By default the testing and programming unit is operated as a WLAN **access point** and can therefore communicate directly with a mobile terminal device (tablet, smartphone or laptop/PC), as soon as this has been configured as a client and connected.



$V_S$  Power supply for the GEL 211: A USB plug-type power supply unit or a powerpack (rechargeable battery) connected to the micro-USB socket (also possible: USB port on a PC)

- ▶ Connect the mobile terminal device (client) via WLAN to the GEL 211:

In the WLAN monitor on the mobile terminal device select the SSID for the GEL 211 (stated on the rating plate) and establish the connection by entering the password (default: 12345678).

- ▶ On the mobile terminal device, open a web browser and open the web user interface on the GEL 211 by entering the IP address **192.168.141.1** (default).

After a few seconds the start screen for the user interface is displayed in the browser (→ [page 24](#)).

- i** It is also possible to integrate the unit into an existing wireless network. For this purpose it must be connected to a PC via USB and correspondingly configured. The statement also applies if a default setting such as the WLAN password is to be changed or new firmware is to be installed. Information on this aspect is provided in the [Annex: Changing operation mode](#).

## 4.2 Measurement setup

Here a differentiation is to be made between two applications:

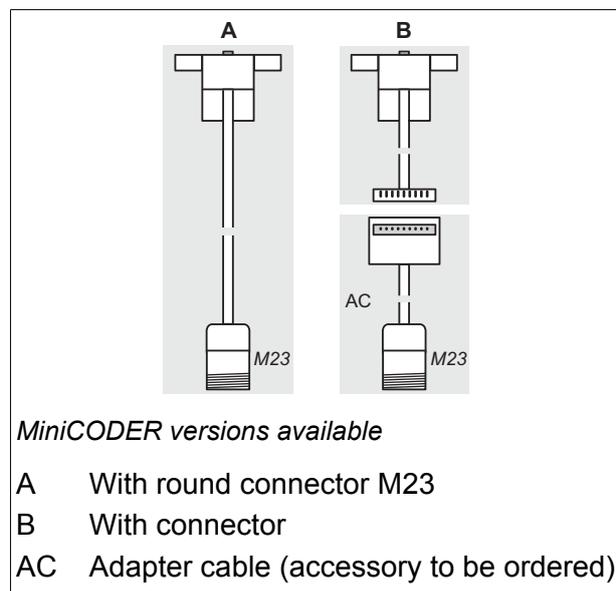
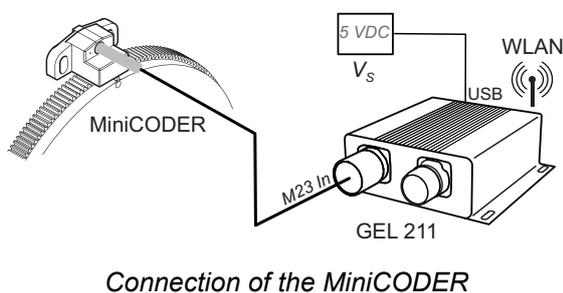
1. Separate measurement/calibration process
2. Inline measurement/calibration

### 4.2.1 Separate measurement/calibration process

In this situation the MiniCODER is disconnected from the control system.

For the measurement the target wheel must be rotated suitably either manually, via a test system or via the control system (see information → [page 19](#)).

The power is supplied to the GEL 211 ( $V_S$ ) and the MiniCODER via the USB input.



### 4.2.2 Inline measurement/calibration

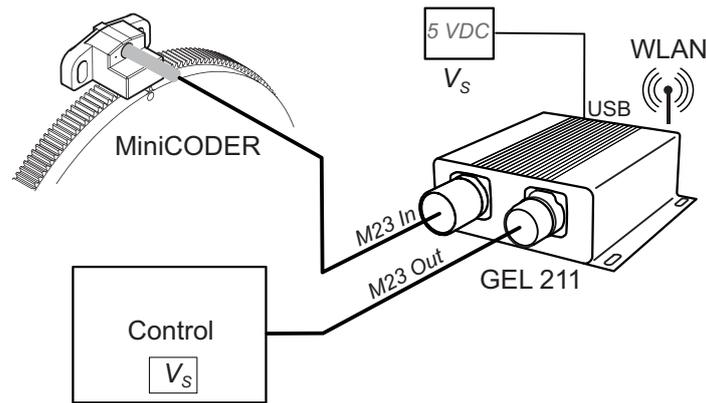
In this situation the connection between the MiniCODER and the control system is initially disconnected and then made again via the GEL 211 for the measurement/calibration process (including an existing *Sense* cable).

For the measurement the target wheel must be rotated suitably via the control system (see information → [page 19](#)).

**!** Even if the power is supplied to the GEL 211 ( $V_S$ ) via the control system, the power supply must still be connected to the USB input (see also the note below).

**i** Power supply priority:

If the unit is supplied with power both via USB and via the connector M23 Out, the latter has priority. Only if this voltage is too low, not available or no longer available, does the unit switch automatically to USB supply.



Connection of MiniCODER and control system

- ! The inline measurement setup must not be permanently installed. By connecting the GEL 211 in between, “Safety integrated” for the plant is no longer ensured. Measurements and calibrations must always be made with “supervision”. The plant must then be returned to normal operation again.

### 4.3 Tolerances

For a clear interpretation of the measurement results, plant-specific limits can be defined that must be met by the MiniCODER to ensure the correct operation of the plant.

The default settings provided by Lenord + Bauer are values determined empirically. They must be evaluated critically by the user and adapted to the requirements of the related plant.

Recommended procedure:

Pre-condition: MiniCODER is correctly installed and aligned in the plant

- ▶ Read measured values on a MiniCODER in a plant that is operating optimally and save (save report).
- ▶ Read measured values on a MiniCODER in a plant that is still just operating correctly; save report.
- ▶ Interpret values from both reports and determine the permissible limits.
- ▶ Further optimise tolerances based on practical experience.

Further information is provided in section [5.4.1 Tolerance presets](#).

## 5 Functions of the GEL 211

- !** Possible measuring error:  
During all measurements undertaken, make sure that the correct (known) number of teeth on the target wheel is given under the graphics to prevent the incorrect interpretation of the measurement results.



### 5.1 What you can do

Using the GEL 211 you can run the following primary functions:

- **Measurement/analysis**
  - Manual
    - Reference signal (→ section 5.4.3)
    - SIN/COS signals (→ section 5.4.4)
    - Gear wheel analysis (→ section 5.4.5)
  - Automated using wizard (→ section 5.4.7), where the automatic calibration of amplitude and offset is deactivated (→ page 18)
    - SIN/COS signals (“Signal check”)
    - Reference signal (“REF measurement”)
    - Gear wheel analysis (“Gear measurement”); can be deactivated (→ page 18)
- **Calibration/optimisation**
  - Manual
    - SIN/COS amplitude (→ section 5.4.4, Ampl. auto adjust. -/+ buttons)
  - Automatic
    - SIN/COS amplitude synchronism (→ section 5.4.4, Ampl. auto adjust. 0 button)
    - SIN/COS offset (→ section 5.4.4, Offset auto adjustment button)
    - SIN/COS phase correction (→ section 5.4.4, Phase auto adjustment button)
  - Automated using wizard (→ section 5.4.7)
    - SIN/COS amplitude (“Automatic SIN/COS amplitude adjustment”)
    - SIN/COS offset (“Automatic SIN/COS offset optimization”)
- **Read/configure operating times** (spindle histogram, → section 5.5)

These options apply without restriction for **programmable** MiniCODERs **with reference signal** (“MiniCODER plus”). For other types there are a few restrictions or special aspects on the usage of the GEL 211:

### Restrictions for MiniCODER ...

<b>with amplitude control</b> Type: GEL 2444KxRx... <sup>(1)</sup>	<ul style="list-style-type: none"> <li>Do not undertake a gear wheel analysis</li> <li>On the usage of the wizard, deactivate the gear wheel analysis (→ <a href="#">page 18</a>)</li> </ul>
<b>without reference signal</b> Type: GEL 2444K-xx...	<ul style="list-style-type: none"> <li>Wizard cannot be used</li> <li>During the SIN/COS measurement and the gear wheel analysis, deactivate the reference signal and enter the number of teeth (→ <a href="#">page 24</a>)</li> </ul>
<b>not programmable</b> Type: GEL 2444Kx_x... with _ ≠ P	<ul style="list-style-type: none"> <li>Calibration/optimisation not possible</li> <li>Read/configure spindle histogram not possible</li> </ul>

## 5.2 Application profiles

For the specific usage of the GEL 211, three user profiles (applications) can be defined:

Profile	Description	Measures
Service	Maintenance of the plant	Manual measurement of REF, S/C; GWA *
Individual production	<ul style="list-style-type: none"> <li>Production</li> <li>Repair</li> <li>Replacement of a MiniCODER</li> </ul>	Manual measurement of REF, S/C and GWA and manual amplitude adjustment of S/C
Series production	Process-based production	<ul style="list-style-type: none"> <li>Manual measurement of REF and S/C (possibly also GWA) and automatic optimisation of S/C</li> <li>Automated measurement and optimisation using the wizard</li> </ul>

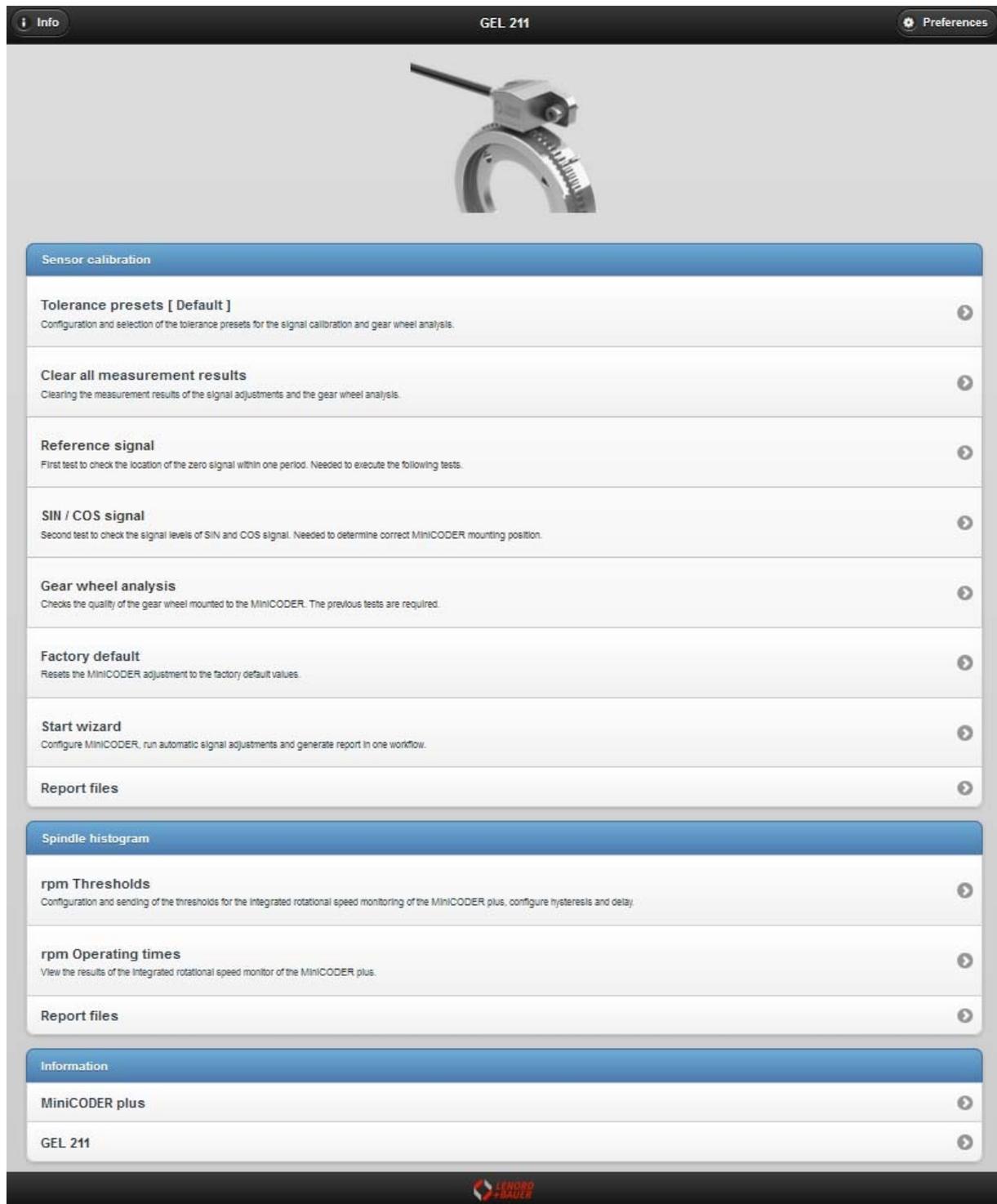
\* REF: Reference signal, S/C: SIN/COS signals, GWA: Gear wheel analysis

On the programmable MiniCODER plus, in all cases it can also be necessary to read the spindle histogram and its configuration.

<sup>(1)</sup> Information on the sensor's rating plate; x = any character; ... = further characters

## 5.3 Home

On the **Home screen** the user interface provides the features shown in the following (select by clicking the corresponding button):



*Start screen for the web interface (complete view)*

### 5.3.1 Info

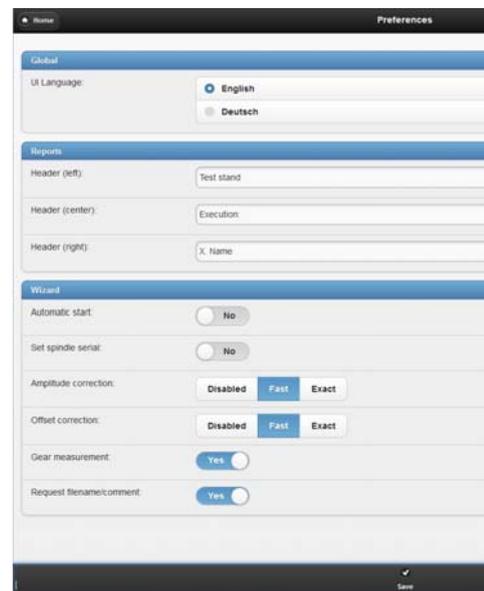
Using the Info button you can check the information on the web interface as well as the actual firmware version in the GEL 211, e.g.



### 5.3.2 Preferences

You can change or enter the following parameters using the Preferences button:

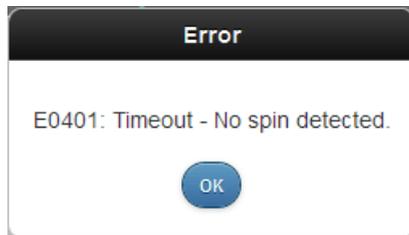
- Language for the user interface
- Texts for the report header
- Configuration of the **wizard**:
  - Automatic start  
The wizard starts immediately after the connection of the MiniCODER, that is without prior actuation of the corresponding button (Yes).
  - Set spindle serial  
If you click Yes the spindle number is transmitted to the MiniCODER. During this process existing calibration values and any existing spindle history (operating times) are deleted. You can prevent this action by clicking No.
  - Amplitude correction, Offset correction  
These steps in the wizard can be skipped (Disabled) or configured (optimisation must be Fast or Exact i.e. with fine resolution).
  - Gear measurement  
This step can be left out, if not necessary or required (No).
  - Request filename/comment  
The dialog box for saving the report and that appears after the completion of the measurement and adjustment process can be disabled here, if such a process is not necessary.



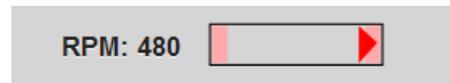
Changes made are only saved after you click the Save button!

## 5.4 Sensor calibration group

- i** The target wheel must rotate at **30...300 min<sup>-1</sup>** for the measurements described in the following.



*Example for a stationary target wheel*



*Example for an excessively high rotational speed*

- i** After the successful completion of the analysis (Reference, SIN/COS, gear wheel) the related button on the Home screen is displayed with a yellow background.

### 5.4.1 Tolerance presets

Here the user can define various limits for the measured values; these limits are saved as a record in the GEL 211 and can subsequently be opened again using the corresponding button. The values set act directly on the indications in the various analysis windows (tolerance fields, measured value colours).

GEL 211 Configuration			
Default			
<b>Reference signal analysis</b>			
	high	low	
Vpp:	825	175	
Offset:	-150	-600	
Phase (rising edge):	-90	-270	
Phase (falling edge):	270	90	
<b>SIN / COS signal analysis</b>			
	high	low	
Δ Vpp:	1200	800	
Δ Offset:	20	-20	
Δ Phase:	1	-1	
Vpp deviation:	50	-50	
<b>Gear wheel analysis</b>			
	high	low	
Δ Vpp beat:	150		
BQ std. deviation:	8		
BQ value:	351	291	

*"Default" record with defined tolerances*

**i** The active record is also displayed on the Home screen:



You can prepare a new (blank) record using the New button and save it in the GEL 211 with the name defined above using the Save button. The values can be further optimised later.

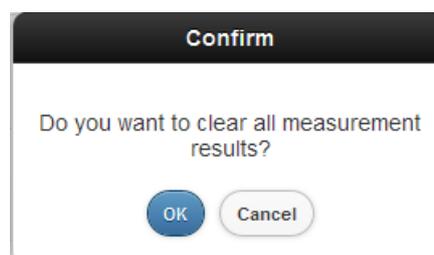
The individual tolerances can be set either by entering/changing the numerical entry or by dragging the related slider.

Section	Parameter	Value
Reference signal analysis	Vpp [mV]	175
	Offset [mV]	-60
	Phase (rising edge) [°]	-27
	Phase (falling edge) [°]	90
SIN / COS signal analysis	Δ Vpp [mV]	800
	Δ Offset [mV]	20
	Δ Phase [°]	1
	Vpp deviation [%]	5
Gear wheel analysis	Δ Vpp beat [mV]	150
	BQ std. deviation	8
	BQ value	295

*Window for entering a new record*

## 5.4.2 Clearing all measurement results

After accepting a corresponding confirmation prompt, here you can clear all the measured data and graphs collected in the GEL 211 (reference, SIN/COS, gear wheel).



### 5.4.3 Reference signal

A differentiation is made between two measurement processes for this function:

1. Instantaneous value measurement: Continuous indication of the signals on the reference output (predominantly the quiescent level):



2. Analysis measurement: Single or continuous measurement of the reference signal (track N, digital or analogue) and graphic display in relation to the sine and cosine signal, averaged over one turn of the target wheel

The following parameters are determined:

Measured value	Significance
1. Instantaneous value measurement	
V idle	Quiescent or active level of the reference signal
2. Analysis measurement	
Vp[p]	Max. signal swing in relation to 0 V
Offset	Offset on the quiescent level in relation to 0 V
Phase rising edge	Phase position of the rising reference signal on passing through zero
Phase falling edge	Phase position of the falling reference signal on passing through zero
Signal width	Difference between the two phase positions
Signal offset	Offset on the middle of the signal in relation to the intersection point between the SIN/COS signals (135°)
Q	Direction of rotation of the gear wheel during the measurement

**i** You will find explanations on this topic in the glossary (→ [page 45](#)).

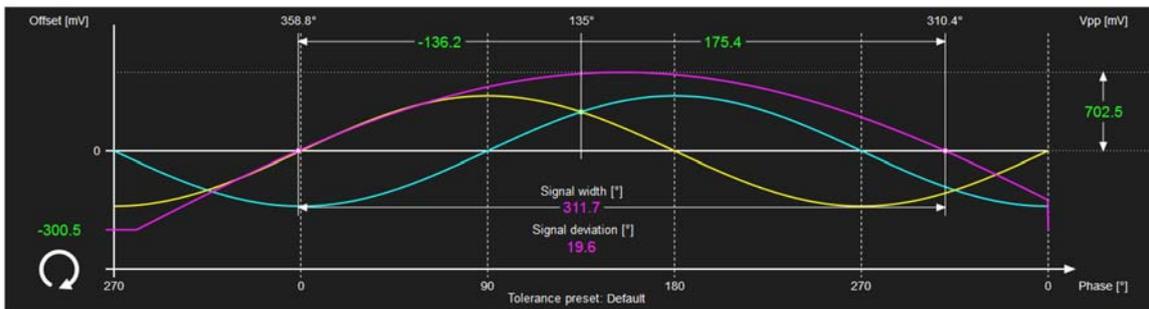
The measurement is undertaken as soon as you press the Start reference signal analysis button. By default a single measurement is undertaken; however, the values can be acquired and displayed continuously (Single/Continuous button).

A report should not be saved with continuous measurement (incorrect display).



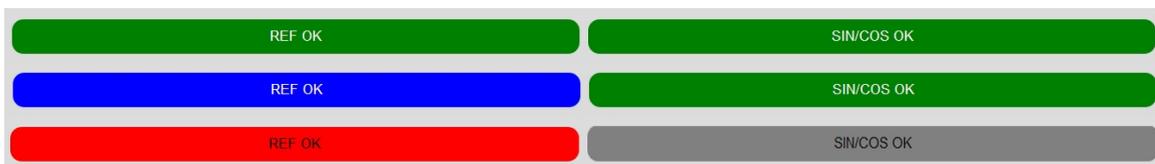


Graph and measured values for a digital reference signal (values within the tolerance defined are displayed in green, otherwise in red)



Graph for an analogue reference signal

- The status fields for the REF and SIN/COS signals displayed under the header bar have the same colour as the equivalent LEDs on the rear of the unit (→ page 11):

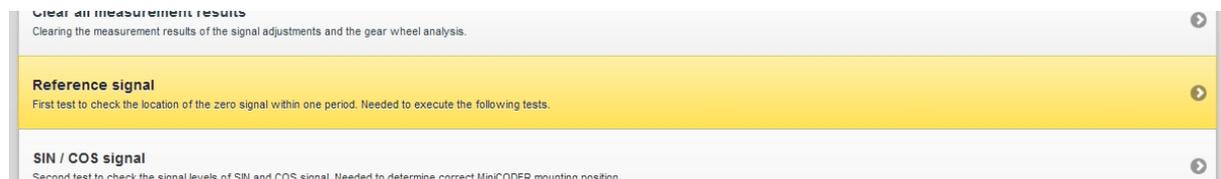


Status indications for reference and SIN/COS analysis

(for black and white printing: REF from top = green → blue → red, SIN/COS bottom = grey)

Using the **Save** button in the status line you can save the results of the most recent analyses (REF, SIN/COS, gear wheel) in a report.

After a measurement has been undertaken, the corresponding entry on the Home screen is displayed with a yellow background (also occurs on measurement/calibration via the wizard):



#### 5.4.4 SIN/COS signals

A differentiation is made between two measurement processes for this function:

1. Instantaneous value measurement: Continuous display of instantaneous values from tooth to tooth:



2. Analysis measurement: Single or continuous measurement and graphic display of values that are averaged over one turn of the target wheel

The following parameters are determined:

Measured value	Significance
1. Instantaneous value measurement (values pro tooth)	
Vpp' SIN	Amplitude (peak-peak) of the sine signal
Vpp' COS	Amplitude (peak-peak) of the cosine signal
Offset' SIN	Zero offset on the sine signal
Offset' COS	Zero offset on the cosine signal
2. Analysis measurement (values averaged over 1 turn)	
Vpp SIN	Amplitude (peak-peak) of the sine signal
Vpp COS	Amplitude (peak-peak) of the cosine signal
Vpp deviation SIN/COS	Difference between the two signal amplitudes
Offset SIN	Zero offset on the sine signal
Offset COS	Zero offset on the cosine signal
Phase SIN/COS ( $\Delta\Phi$ )	Phase error between sine and cosine signal
	Direction of rotation of the gear wheel during the measurement

 You will find explanations on this topic in the glossary ([→ page 45](#)).

On the usage of a MiniCODER **without** a reference signal, you must set this configuration using the related button and enter the number of teeth on the gear wheel used prior to the measurement.



The measurement is undertaken as soon as you press the Start SIN/COS signal analysis button. By default a single measurement is undertaken; however, the values can be acquired and displayed continuously (Single/Continuous button).



A report should not be saved with continuous measurement (incorrect display).

Using the Save button you can save the results of the most recent analyses (REF, SIN/ COS, gear wheel) in a report and add a comment.

Tolerance preset: Default			
Name	Value	Min	Max
Vpp SIN [mV]:	1162.4	800	1200
Vpp COS [mV]:	1164.0	800	1200
Vpp deviation SIN/COS [mV]:	-1.6	-50	50
Offset SIN [mV]:	-4.1	-20	20
Offset COS [mV]:	-4.0	-20	20
Phase SIN/COS [°]:	0.0	-1	1

Measurement of SIN/COS signals

## Adjustments and corrections (only MiniCODER plus)

If the measurement results are not as expected or as required, you can make the following adjustments with the aid of the buttons:

- Ampl. auto adjust. -/+ : Manual step-wise reduction/increase of the signal amplitudes (in steps of approx. 50 mV)
- Ampl. auto adjust. 0: Automatic optimisation of the amplitude synchronism relative to the sine track ( $V_{pp} \text{ COS} \approx V_{pp} \text{ SIN}$ )
- Offset auto adjustment: Automatic minimisation of the offset on both signals
- Phase auto adjustment: Automatic minimisation of the phase error between the two signals ( $\Delta\phi \approx 0^\circ$ )

### 5.4.5 Gear wheel analysis

- i** Gear wheel analysis should not be undertaken on MiniCODERs with integrated amplitude control, as it will not produce meaningful results.

Using this function the quality of the measuring scale is determined over one turn (BQ value = evaluation quotient). The result is displayed graphically. The following measured values are determined:

Measured value	Significance
$\Delta V_{pp}$	Difference in the extremes of the amplitudes over 1 turn; curve: "Fluctuation" of the SIN/COS signal as a measure for the concentricity error (blue)
BQ standard deviation	Measure of the quality of the teeth
$\Delta BQ$	Difference between the extreme BQ values; detection of damage etc.; curve: BQ values (magenta colour)

- i** You will find explanations on this topic in the glossary ([→ page 46](#)).

The measurement is undertaken as soon as you press the Start gear wheel analysis button.

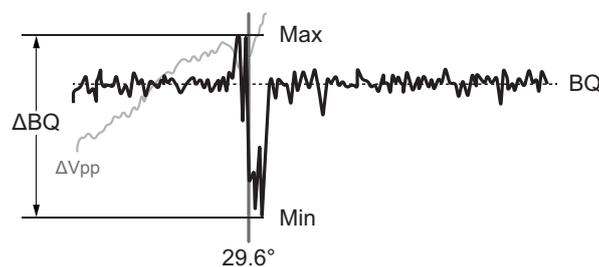




*Gear wheel signals (at around 30° it can be seen that a tooth may be damaged)*

A yellow vertical line shows the actual gear wheel position and can be moved over the entire range by slowly turning the tooth wheel. The angle reference point (0°/360°) is the position of the reference mark. The BQ value (magenta) and the Vpp value for the sine signal (blue) at this position can also be read using this feature.

Using this function you can also accurately locate a faulty point on the measuring scale:



*Localisation of a tooth error*

- i** Slight distortion of the curve at the edges of the window is due the magnetic effects of the reference mark.

Using the Save button you can save the results of the most recent analyses (REF, SIN/ COS, gear wheel) in a report.

### 5.4.6 Reset to factory setting

You can reset the configuration of the programmable MiniCODER plus to the factory setting after accepting a confirmation prompt, e.g. to reset an “incorrectly set” MiniCODER to the same state as delivered.



### 5.4.7 Wizard

**i** This function can only be used with MiniCODERs **with a reference signal**.

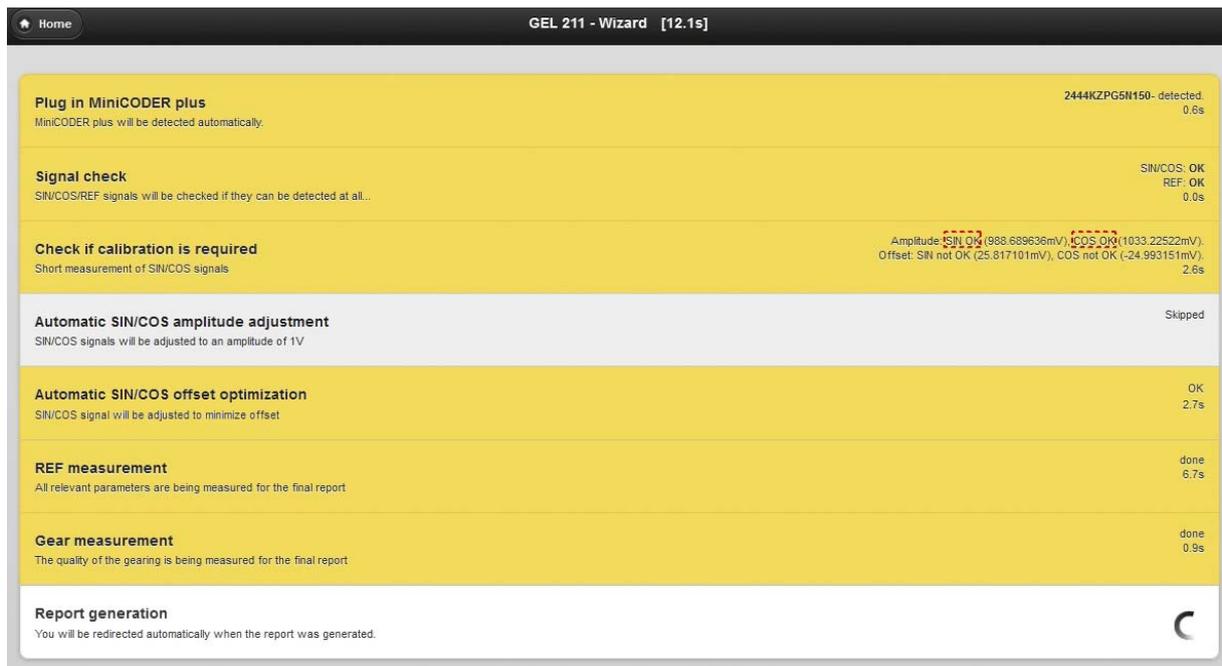
In less than one minute the wizard provides an overview of all parameters for the MiniCODER with just one click. All measurements and signal calibrations shown in the following figure are undertaken automatically one after the other. Completed steps are displayed with a yellow background.

At the end of the process you can save the automatically generated report using the prompt, if this feature is activated correspondingly in Preferences on the Home screen.

**i** If, in Preferences on the Home screen, “Set Spindle Serial#” is set to “Yes”, after the corresponding prompt the operating times and preferences already set in the MiniCODER are reset. You can prevent this action using the setting “No”.

The wizard calibrates the SIN/COS signals to  $1 V_{pp}$ , this value cannot be changed. If a different value is required, the calibration must be undertaken manually (→ section 5.4.4).

The two calibration processes as well as the gear wheel analysis can be suppressed so that only the automatic measurement of the signals takes place (→ page 18).



If the measured values for a category are within the tolerance presets defined internally for the fast and the exact measurement, an automatic calibration is not undertaken. This is the situation in the figure above for the SIN/COS calibration (“Skipped”). Otherwise the automatic calibration takes place, as shown above for the offset (Offset: SIN not OK...).

Amplitude: SIN OK (988.689636mV), COS OK (1033.22522mV).  
Offset: SIN not OK (25.817101mV), COS not OK (-24.993151mV).

### 5.4.8 Reports

Using this button you can open a list of all reports on sensor calibration saved up to now in the GEL 211; click one of the reports to open and display the file.



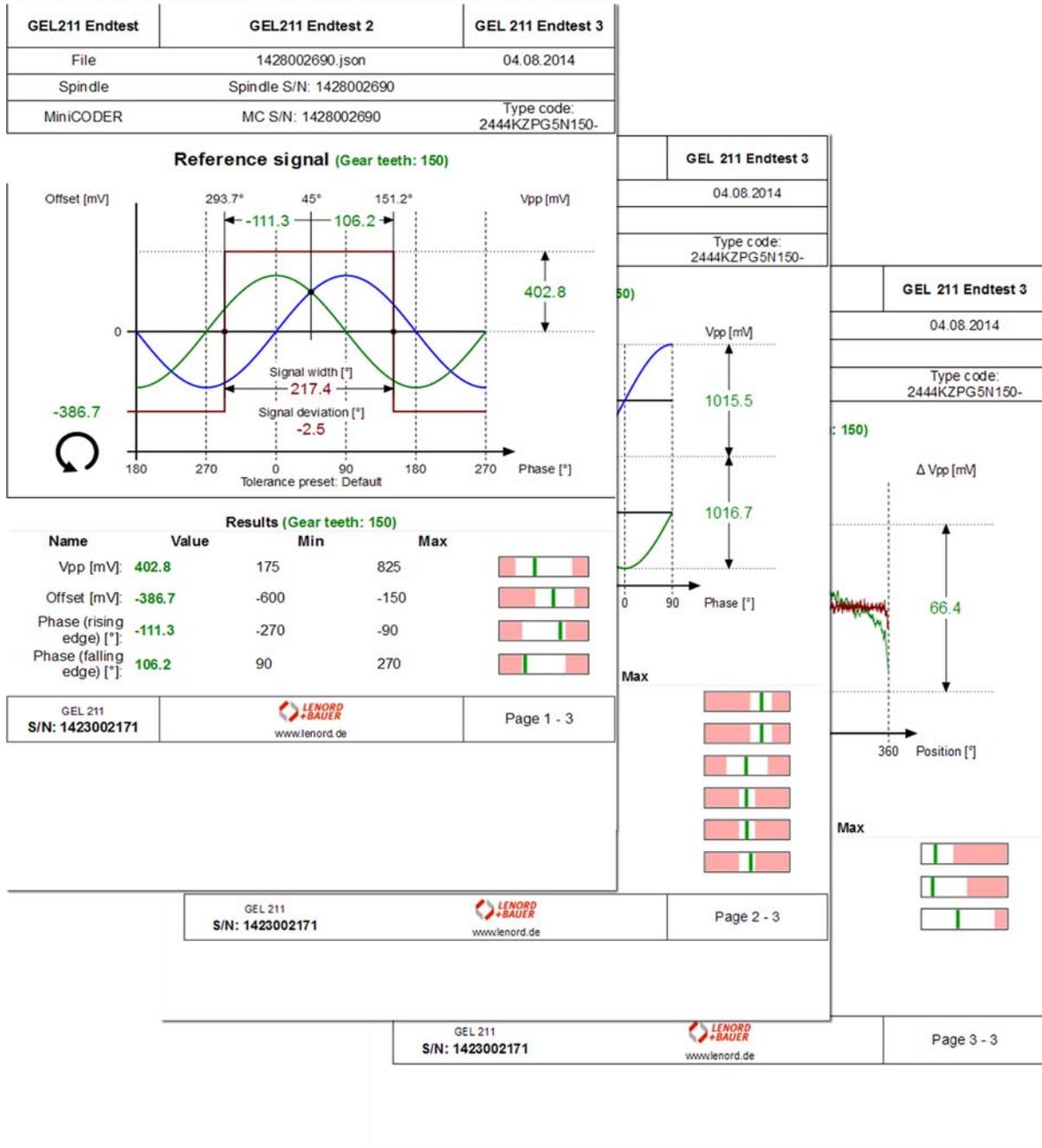
Extract from the report overview (each entry forms one button)



Automatically generated report, browser view

If you have entered a comment on saving the report, the comment appears above the footer in the report.

Using the Download button in the status line at the bottom you can save the report as a json file in the browser's download folder and view it there using the external Report-Viewer tool (→ [page 43](#)).

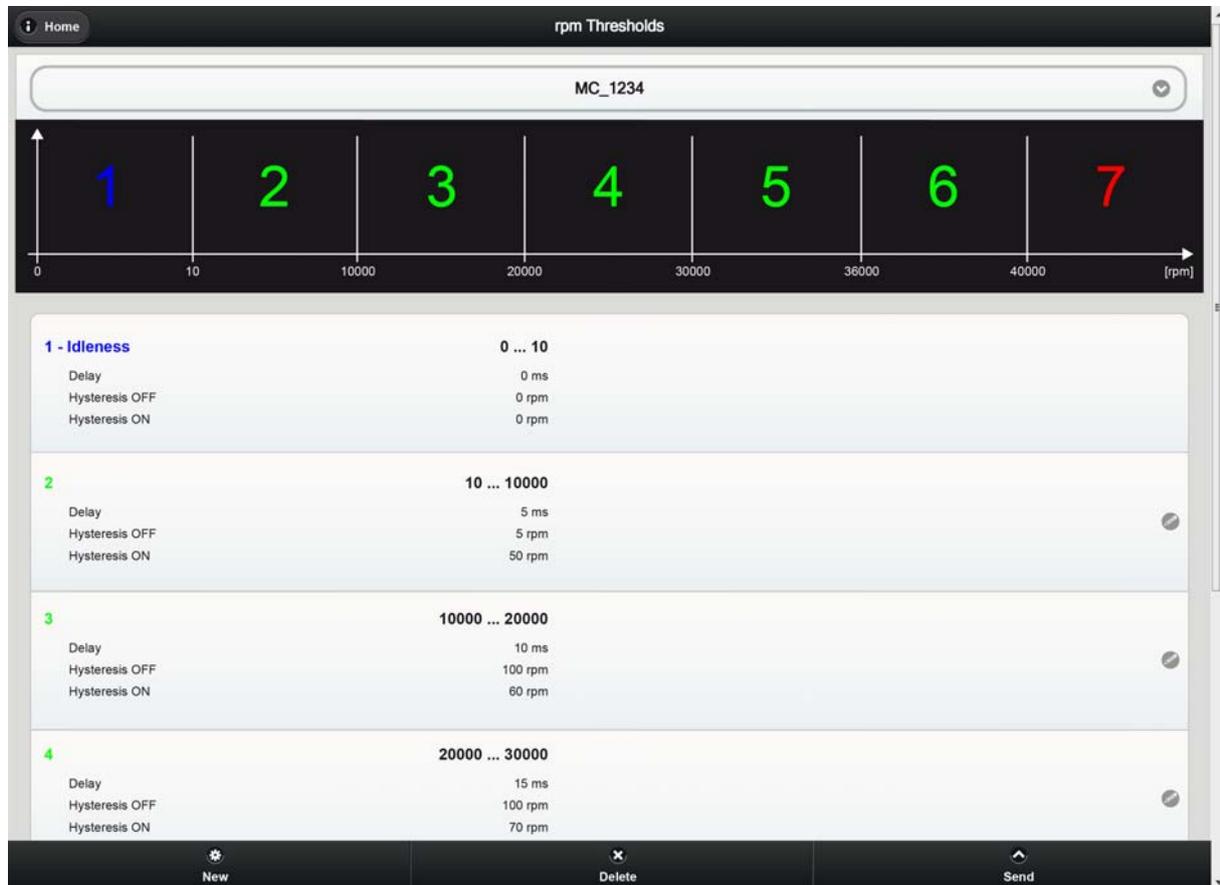


Automatically generated report, printed as PDF (margins removed in the figure)

## 5.5 Spindle histogram group (only MiniCODER plus)

### 5.5.1 Definition of speed ranges (rpm Thresholds)

The operating hours over 7 speed ranges are recorded:



*"MC\_1234" record with defined speed ranges*

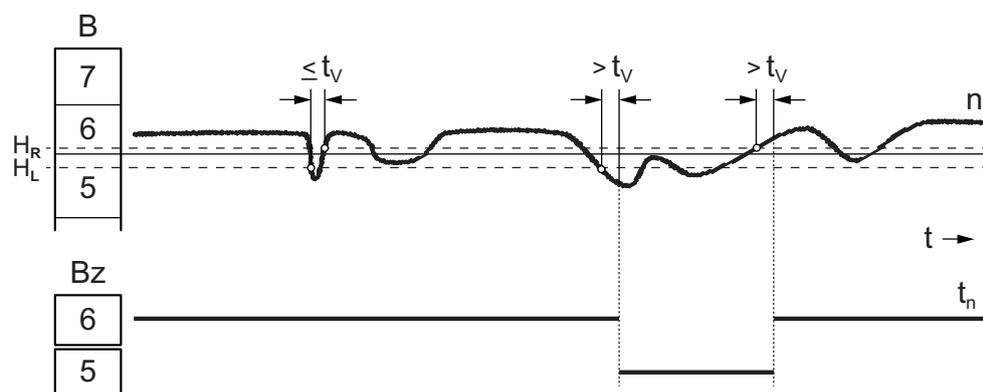
Here the user can define various speed ranges for recording the operating hours; these speed ranges are saved as a record in the GEL 211 and can subsequently be opened again using the corresponding button (here "MC\_1234").

On setting up a new record, a window for entering the data appears where you can make the following entries:

Window for entering a new record

Editing a record entry

- Name** Name for the record saved in the GEL 211
- Idleness** Rotational speed up to which standstill is still recorded (range 1, blue)
- Overspeed** Maximum rotational speed allowed (range 7, red)
- Delay** Time in ms during which a range change is ignored
- Hysteresis** Rotational speed ranges referred to the lower range limit (ranges 2 to 7), within which minor, brief ( $\rightarrow$  delay) fluctuations in the rotational speed are ignored; left: coming from higher rotational speeds, right: vice versa



Example hysteresis ( $B$ = range,  $Bz$ = operating hours counter in the range,  $t_v$ = delay,  $H_L/H_R$ = hysteresis left/right,  $n$ = rotational speed,  $t_n$ = operating time recorded)

After you accept using Ok, new ranges based on the entries set are generated using a defined algorithm. You can now select and edit the individual ranges 2 to 7 using their buttons, if the delay or the hysteresis values need to be modified. You can also change the range limits.

Once you have defined all the necessary entries, the record can be transferred to the MiniCODER (Send button in the status line at the bottom).

Prior to the execution of this action the following (confirmation) prompts must be answered or accepted:

- Required entry of a spindle serial number (or other designation) for unique allocation of the MiniCODER
- Deletion of already existing operating times in the MiniCODER

After successful transmission, the configuration timestamp in the MiniCODER is adjusted correspondingly, i.e. set to the actual duration of operation of the MiniCODER.

### 5.5.2 Reading operating times (*rpm Operating times*)

Using this function you can retrieve the histogram data from the MiniCODER plus and save the data in a report as necessary (Save button in the status line at the bottom).

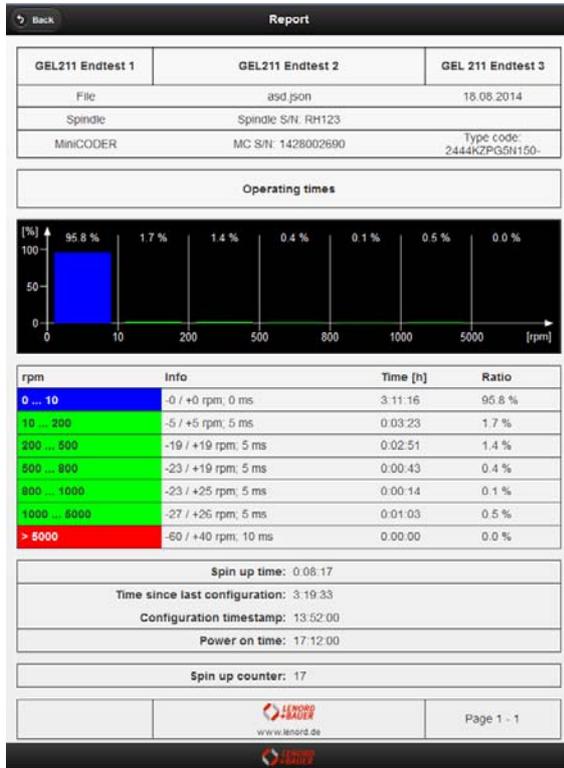


*Duration of operation in the different speed ranges*

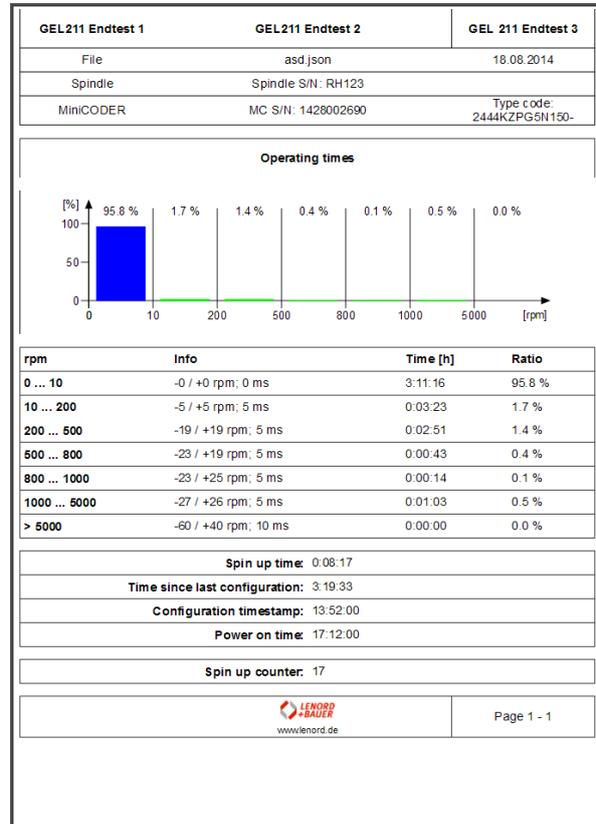
- i** The MiniCODER plus saves its operating times at fixed intervals. At least 3 minutes must elapse between two retrieval actions.

### 5.5.3 Reports

Using this button you can open a list of all reports on the spindle histogram saved up to now in the GEL 211; click one of the reports to open and display the file.



Spindle histogram in the browser view



Spindle histogram printed in a PDF file

## 5.6 Information group

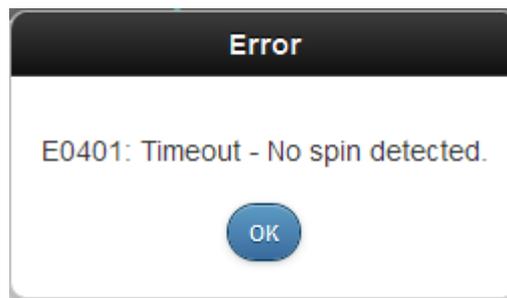
You can open the following system information using the buttons (on the left only on the MiniCODER plus):

MiniCODER Information	GEL 211 Information
<b>MiniCODER plus</b> Last update: 15:32:31	<b>GEL 211</b>
Version: <b>1.07</b>	Version: <b>V2.03.03</b>
Free Space: <b>23552 Bytes</b>	WLAN SSID: <b>211AP1431002147</b>
Actual Record Address: <b>0x8002780</b>	Serial number: <b>1431002147</b>
Power on time: <b>49:20:00</b>	
Type code: <b>2444KZPG5N150-</b>	
Serial number: <b>1428002690</b>	
Spindle: <b>1428002690</b>	
<b>Temperature peaks</b>	
Highest: <b>31.2°</b>	
Lowest: <b>28.4°</b>	
<b>Reset temperatures</b>	

*(Last update = PC system time)*

## 6 Error table

Example:



No.	Error message	Cause	Remedy
E0001	The signal vector generated from the sinusoidal and cosinusoidal signals is too small.	Air gap too big/small	Adjust air gap
E0002	The A/D converter for the cosinusoidal signal is overdriven.	Air gap too small	Increase air gap
E0004	The A/D converter for the sinusoidal signal is overdriven.		
E0008	The input frequency is so high that no A/B signals can be generated or the direction can no longer be detected. <sup>(1)</sup>	Target wheel over-speed	Decrease speed of target wheel
E0010	The signals A, B and Z are invalid. <sup>(1)</sup>	MiniCODER not ready	Turn the target wheel
E0020	The gain controller for the cosinusoidal signal has reached its limit.	Air gap too big	Decrease air gap
E0040	The gain controller for the sinusoidal signal has reached its limit.		
E0080	The offset controller for the cosinusoidal signal has reached its limit.	Air gap too big/small	Adjust air gap as per specification
E0100	The offset controller for the sinusoidal signal has reached its limit.		
E0200	The spin direction has been changed during the analysis.		Do not change target wheel spin direction while analysis is running
E0401	Timeout – No spin detected.	<ul style="list-style-type: none"> <li>– No MiniCODER connected</li> <li>– Target wheel does not turn</li> <li>– Faulty reference signal</li> </ul>	Check/correct measuring set-up, retry analysis

<sup>(1)</sup> A: SIN; B: COS; Z: REF

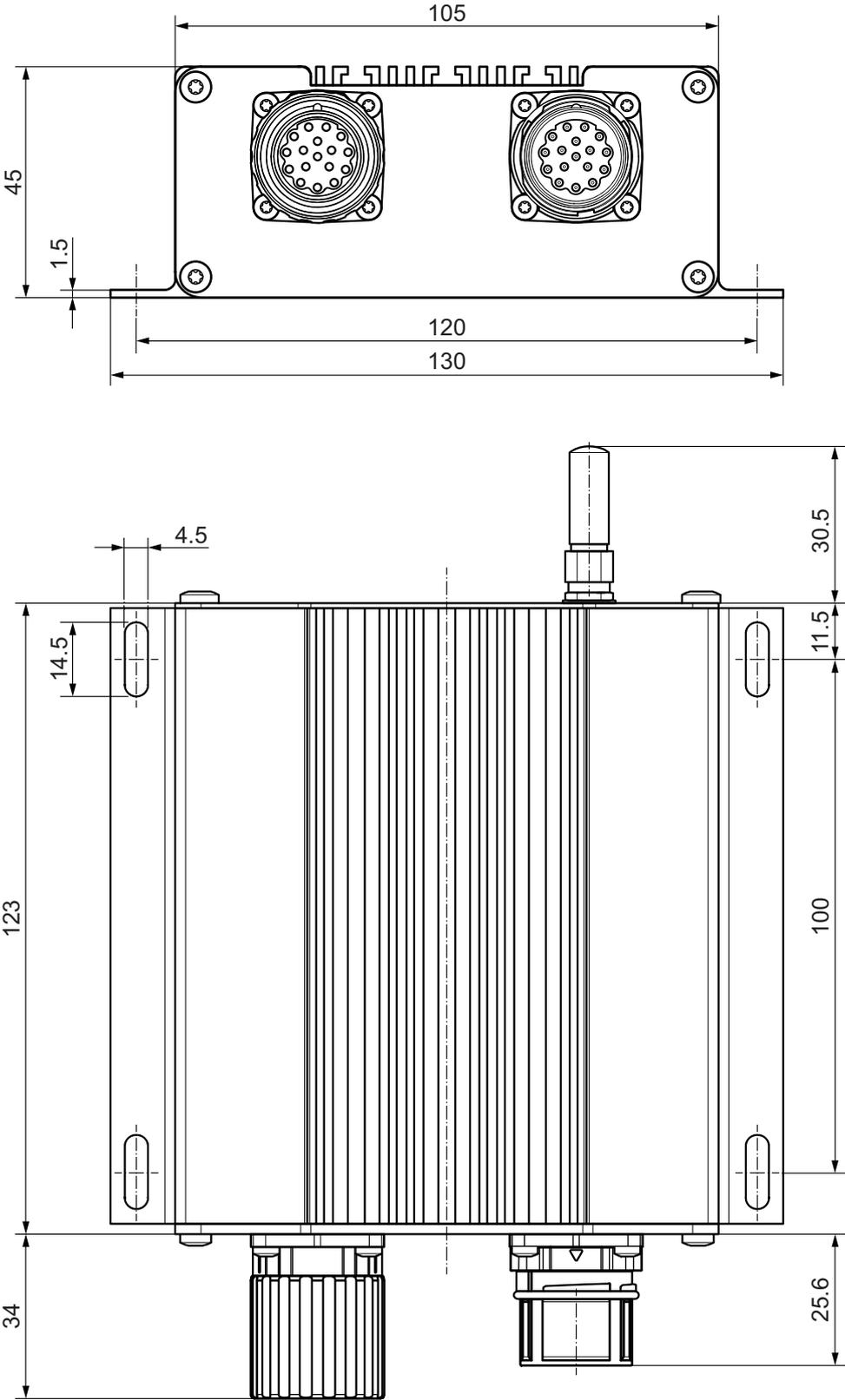
No.	Error message	Cause	Remedy
E0403	File system error	Memory error	Repair necessary, send device back to factory
E0404	Memory overflow: Too many samples. The target wheel spin was too slow.	Speed of target wheel too low	Increase speed of target wheel
E0405	Memory underrun: Too few samples. The target wheel spin was too fast.	Speed of target wheel too high	Decrease speed of target wheel

## 7 Technical data

### 7.1 Specifications

<b>Electrical data</b>	
Supply voltage	5 V DC
Current consumption via USB port	≤ 500 mA
Connections	Micro-USB (type B) Signal output: M23 female connector, 17-pin; Signal input: M23 male connector, 17-pin
Data transmission	WLAN Report files: WLAN or USB
WLAN module approvals	FCC ID: YOPGS1011MEE IC ID: 9154A-GS1011MEE
<b>Mechanical data</b>	
Housing material	Anodised aluminium, black
Weight	Approx. 0.5 kg
<b>Ambient data</b>	
Operating temperature range	0 °C ... +70 °C
Storage temperature range	-20 °C ... 85 °C
Protection class	IP 20
Maximum relative humidity of air	80%
Condensation	Not permitted

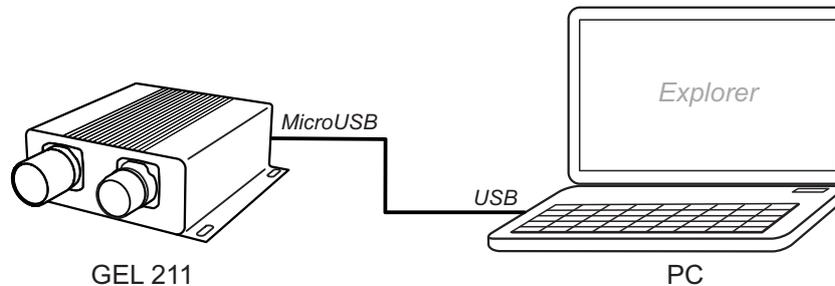
7.2 Dimensional drawing



## 8 Annex: Changing operation mode

If the testing and programming unit is not operated as a WLAN access point, but is to be integrated into an existing wireless network, or default settings are to be changed (e.g. WLAN password), it must be configured accordingly using a PC. For this purpose the following procedure is recommended:

- ▶ Connect the unit to a spare USB port on a Windows PC.



If a USB hub is used, the hub must be an active hub, as the unit is supplied with power via the USB connection.

After plugging in, several devices are detected:

- Mass storage medium (disk drive, available directly)
- Libusb device (driver may not be installed, see below)

### 8.1 Mass storage

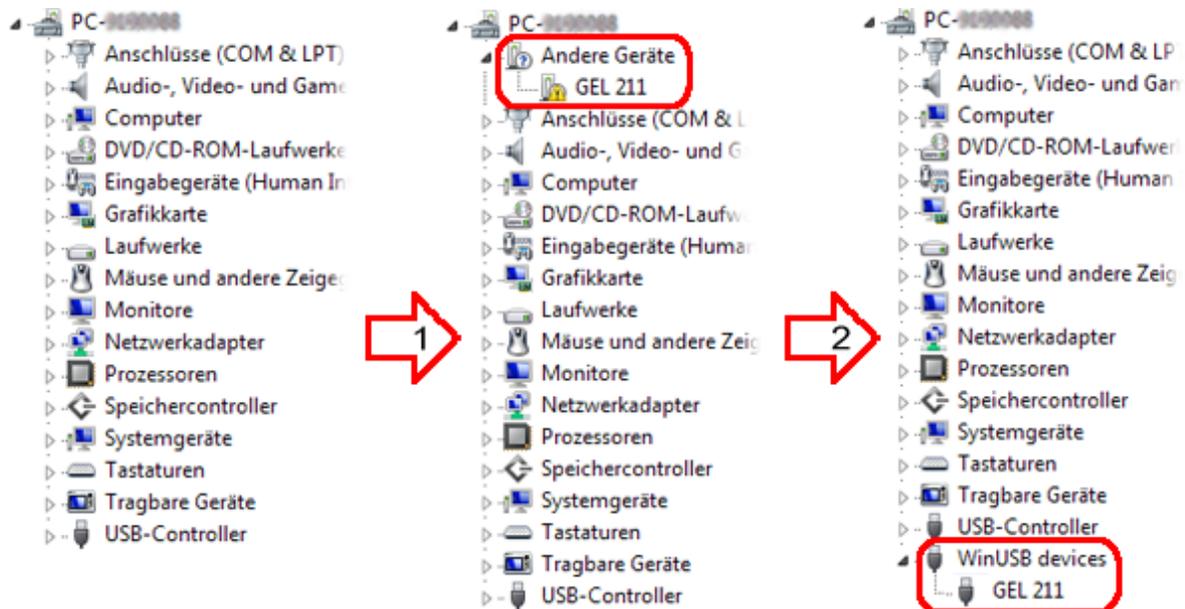
There are the following folders and files here:

data	Contains saved reports with measurement results (file type *.json)
driver	Contains the driver files necessary for the operation of the unit
firmware\gel211	Is the temporary storage location for a firmware update (→ <a href="#">page 43</a> )
ReportViewer	Contains a tool that must be installed to view report data saved externally (→ <a href="#">page 43</a> )
setup	Contains the configuration tool for the unit (GEL211Configure.exe)
web	Contains the source files for the web interface for the unit (used internally)
changelog.txt	Contains an overview of changes made to the firmware
datafiles.json	Contains a list of saved reports (used internally)

- ❗ It is strongly recommended not to make changes to the files, or to delete or move individual files. In the worst case this action could render the unit unusable.

## 8.2 Libusb USB driver

The Libusb driver may need to be installed. You will find the related files on the newly detected mass storage device in the folder driver). The unit is then displayed in the Windows Device Manager as a WinUSB device.



### Using Device Manager

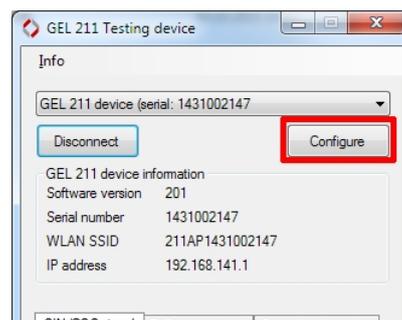
- 1 Search for new hardware
- 2 Update driver software (GEL 211), select driver folder on the mass storage device and install software

- ▶ Start the commissioning wizard GEL211Configure.exe in the folder Setup.

The GEL 211 unit connected via USB is detected and displayed in the list above.

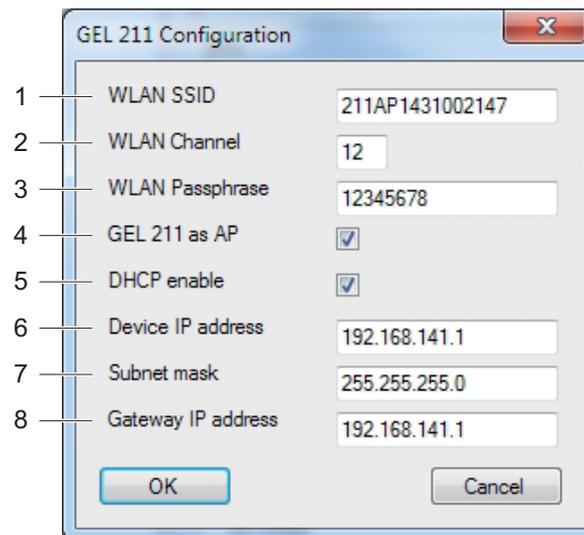


Connecting GEL 211



Configuring GEL 211

- ▶ Connect the unit (or another unit from the list) using the Connect button to undertake configuration
- ▶ Click the Configure button to configure the unit for the application.



Configuration window with the parameters set in the factory

Explanations on the figure:

- 1 The network identification can be modified to suit your specific needs (access point) or is to be set to suit the existing network; the default SSID is given on the rating plate on the GEL 211
  - 2 The WLAN channel can be modified to suit the specific local conditions (only on usage as an access point; otherwise the wireless channel will be set automatically)
    - i** In certain countries that may be regulatory restrictions that prohibit the usage of certain channels. A list sorted by regions is available in the Internet at [http://en.wikipedia.org/wiki/List\\_of\\_WLAN\\_channels](http://en.wikipedia.org/wiki/List_of_WLAN_channels).
  - 3 The WPA2 network password can be modified to suit your specific needs (access point) or is to be set to suit the existing network
  - 4 Selected: operation as access point
  - 5 Selected: automatic assignment of IP addresses by the GEL 211 as an access point ⇒ No manual configuration necessary on the client side; on integration in an existing network the IP address for the GEL 211 is assigned by the DHCP server in the WLAN network
  - 6 Address for the GEL 211, using which the web interface can be opened; on integration in an existing network only used if DHCP enable is not selected
  - 7 The subnet mask should only be changed in special cases
  - 8 The gateway address is only provided for special cases
- Define the mode of operation for the GEL 211:
- Unit is acting as an **access point** (default) with the specific WLAN SSID
    - For this purpose the GEL 211 as AP check box must be selected (default; item 4 further up in the figure). Changes can be made in the following fields:
      - WLAN SSID (item 1)
      - WLAN Channel (see also the note on item 2)

- WLAN Passphrase (item 3)
- DHCP enable (item 5)
- Device IP address (item 6)
- Unit is acting as a **client** in an existing wireless network  
For this purpose the GEL 211 as AP check box must be cleared (item 4 further up in the figure). Then the following entries must be changed to suit:
  - WLAN SSID (item 1)
  - WLAN Passphrase (item 3)
  - DHCP enable (item 5)
  - [Device IP address] (item 6)

### 8.3 Firmware update

Lenord + Bauer will provide a ZIP file to update the GEL 211 operating system.

The packed file contains the firmware update as a binary file and, if necessary, new drivers and/or updates for the web interface.

- ▶ Connect the GEL 211 to the PC via USB

Windows notifies you that there is a new mass storage device.

- ▶ Select the ZIP file in Explorer

- ▶ Unpack the file in the root of the GEL 211 mass storage device

During this process the individual files are copied to the related sub-folders; accept prompts to overwrite existing data.

- ▶ Eject the medium (mass storage device GEL 211) on the PC and disconnect from the USB port (GEL 211 is switched off)

- ▶ Supply the unit with power again

The firmware update is now loaded; during this process the Power LED flashes. Then the GEL 211 can be operated normally.

- ! Do not interrupt the supply of power during the loading process.

### 8.4 ReportViewer

To install and use the tool proceed as follows:

- ▶ Connect the GEL 211 to the PC via USB port
- ▶ Open the file explorer and open the folder ReportViewer on the GEL 211 (removable storage device)
- ▶ Unpack there the file GEL211ReportViewerSetup.zip to any folder on a local data carrier, e.g. to the desktop

A folder with the name ReportViewerSetup is created.

- ▶ Run there the application GEL211ReportViewer.exe

- ▶ The first time the program starts, click the Open report path button and select the local folder that contains the downloaded GEL 211 reports of type *.json* (in general the default download folder)
- ▶ If necessary, define the language for displaying the reports using the Report language button
- ▶ In the list window, select the file required and click View Report

The default browser opens with the report view.

-  Using the preferences icon at the top right in the ReportViewer you can define whether new entries for the report header can be defined and saved before the report is displayed.

The Back and Download buttons shown in the browser are of course irrelevant here and should not be clicked.

## Glossary

### SIN/COS signals

#### *What are the SIN/COS signals?*

Every MiniCODER provides two analogue signals with 90° phase offset: sine and cosine. They represent the main signals for speed and incremental position regulation. It is also possible to determine the direction of rotation using the two signals.

Each SIN/COS period represents exactly one tooth on the measuring scale with the maximum voltage at the tip of the tooth and the minimum voltage in the gap between the teeth.

#### *What should the SIN/COS signals look like?*

Ideal SIN/COS signals have an amplitude of  $V_{pp} = 1$  V (peak-peak value). The amplitude synchronism is a further quality criterion. This value represents the amplitude difference between the SIN and COS signal and should be kept as low as possible:  $\Delta V_{pp} \approx 0$  V.

Along with the amplitude, the offset on the SIN/COS signals is important. An ideal system has an offset of almost 0 V.

The final quality criterion is the phase error between the two signals. It should be as low as possible:  $\Delta\varphi \approx 0^\circ$ .

All the parameters listed here represent idealised values. Real applications will always vary from these idealised values – however the differences should be kept as low as possible to obtain good signal quality.

#### *What affects the SIN/COS signals?*

The signals are primarily affected by the distance from the MiniCODER to the target wheel (air gap): larger distances result in a lower differential amplitude and vice versa. Minor deviations on the MiniCODER plus can be compensated using the GEL 211. All MiniCODERs are calibrated at Lenord + Bauer to the module-specific nominal distance.

A further factor that affects the signal quality is the quality of the measuring scale (target wheel). Messy or inaccurate teeth as well as a concentricity error will result in a low quality signal, especially in relation to the parameter  $V_{pp}$ .

The position of the sensor in relation to the target wheel (alignment) also affects the SIN/COS signals. It must be ensured that the sensor is aligned correctly in relation to the target wheel both horizontally and tangentially. Mounting inaccuracies in this area will primarily result in zero offsets (offset errors).

### Reference signal

#### *What is the reference signal?*

Along with the SIN/COS signals, an appropriately equipped MiniCODER will output a reference signal once per turn.

Using this signal a control system is able to determine the absolute angular position of the measuring scale after the first turn, without the need to undertake a reference search routine.

*What should the reference signal look like?*

The reference signal can be a square wave or sine wave. An ideal reference signal has a signal width of  $270^\circ$  within one tooth period. The middle point is close to  $135^\circ$  at the position where the SIN and COS signal cross. The deviation from this ideal position is termed the signal deviation.

Two further significant points are determined starting from the middle point. The first point is the point at which the reference signal crosses the x axis on the rising edge, which should be at around  $-135^\circ$ . The second point is the point at which the reference signal crosses the x axis on the falling edge; this point should be at around  $+135^\circ$ .

Along with the position of the signal, the amplitude is important. Lower amplitudes will not generate a valid reference signal, while excessively high amplitudes will result in so-called "clipping" (truncation of the signal). An ideal amplitude ( $V_p$ ) is around 500 mV with an offset of around -350 mV.

*What affects the reference signal?*

Like the SIN/COS signals the reference signal is primarily affected by imprecise mounting in relation to the target wheel or an imprecisely manufactured target wheel. While mounting inaccuracies primarily generate amplitude errors, defects on the gear wheel are primarily apparent as phase errors.

**Gear wheel analysis***What does the gear wheel analysis produce?*

During the gear wheel analysis the sine signal is evaluated once per turn (from reference pulse to reference pulse).

Manufacturing and mounting inaccuracies on the target wheel limit the overall accuracy of the angle measuring system. To be able to make a quantitative statement here, a so-called BQ value (evaluation quotient) is determined that represents a measure of the precision of the overall angle measuring system.

In an ideal measuring system the fluctuation on the BQ value is zero, i.e. there are no deviations around the average value. In practice, this situation however is not achieved.

If the standard deviation and the maximum swings ( $\Delta BQ$ ) are now evaluated once per turn, a meaningful evaluation criterion for the accuracy of the angle measuring system is obtained. In this way the quality of the target wheel used and the installation situation can be evaluated, documented and compared.

The limits for BQ standard deviations and  $\Delta BQ$  depend on numerous factors: number of teeth, quality of the teeth, shape of the teeth, concentricity, bearing play etc.

The following values are determined:

**BQ value** This value is determined from a simulated amplification (positive/negative) of the amplitude from tooth to tooth that would be necessary to achieve a constant sine signal for each tooth. The internal controller module would compensate for mechanical irregularities in the teeth in this way. This is actually the case on MiniCODERs with integrated am-

plitude control, which is why a gear wheel analysis does not make any sense on this type. The values are displayed as a curve (in magenta).

The BQ value is dependent on the amplitude and offset on the sine signal. For this reason, calibration of the MiniCODER **prior** to the gear wheel analysis is imperative.

Vpp curve	This curve (in blue) shows the change in the amplitude of the sine signal from tooth to tooth. From this information it is possible, e.g., to derive the concentricity of the gear wheel: smaller amplitude → larger air gap and vice versa. In the ideal case there would be a straight line at the height of the zero line. However, in practice the curve is mostly like a sine wave; the term “fluctuation” in the sine signal amplitude is also used.
$\Delta V_{pp}$	This value defines the difference between the maximum and the minimum amplitude for one turn of the gear wheel.
Standard deviation	This value represents a statistical distribution of the BQ values over one turn of the gear wheel. A theoretical treatise on this value is not given here. Based on experience, values between 0 and 10 are acceptable.
$\Delta BQ$	Difference between the extreme BQ values (to be seen as “peaks” on the BQ value curve)

#### *What affects the error signals?*

In general the factors are the same as for the SIN/COS signals: the distance between the sensor and the target wheel, the size of the gear wheel/the module and the position (alignment) of the sensor in relation to the gear wheel. Other factors that have a major effect on the signals are the quality of the gear wheel (concentricity) and the edges on the teeth.

