IPE201

User Manual

Version: 1.4
Date: 08/03/2017

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Revision Overview

Date	Revision	Change(s)
18.06.2013	1.0	First version
04.07.2013	1.1	Addition of Chapter 10.2 Standard delivery configuration
01.08.2013	1.2	Correction relating to Modi-description, Bit-description BiSS, Connector-description Addition of Chapter Software IP201-Monitor
14.10.2013	1.3	Update of chapter 3.4 and picture 5
08/03/2017	1.4	change to new AMAC document layout

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Definitions and Abbreviations

AVSS	–	ground analog (GND)
A	–	square-wave signal A (P = positive; N = negative)
B	–	square-wave signal B (P = positive; N = negative)
BiSS	–	bidirectional synchronous serial interface
Cos	–	cosine signal (P = positive; N = negative)
DNC	–	do not connect
DVDD	–	supply voltage digital (+5V)
DVSS	–	ground digital (GND)
EN	–	error signal negative
EP	–	error signal positive
MA	–	master clock BiSS/SSI (P = positive; N = negative)
REF	–	reference signal (P = positive; N = negative)
RS422	–	EIA-422 (conduction-bound differential serial data transmission)
SENSVDD	–	supply voltage analog (+5V)
Sin	–	sinusoidal signal (P = positive; N = negative)
SLI	–	BiSS data input (P = positive; N = negative)
SLO	–	BiSS/SSI data input (P = positive; N = negative)
SPI	–	serial peripheral interface
SSI	–	synchronous serial interface
TEACH	–	teach-signal of the GC-IP201B
TRG	–	trigger-signal of the GC-IP201B
V0	–	mean voltage
V_{PP}	–	peak-to-peak voltage
Z	–	square-wave signal Z (P = positive; N = negative)
ZER	–	zero-signal of the GC-IP201B

1 Overview

The interpolation unit IPE201 was designed to increase the resolution of incremental position and angular measuring systems with sinusoidal output signals offset by 90°. The IC inside the device divides the signal period up to 256 times. Incremental encoders with voltage interface can be connected directly. The interpolation unit may operate with both single – ended and differential input signals. Configuration of the unit is possible either via USB, via SSI- / BiSS- interface or via the internal EEPROM of GC-IP201B. Optionally, it is possible to order a unit with serial interface (3.3V or 5V system).
Input signals are subject to an AMAC-specific internal gain and offset control. Correction of the phase displacement of the input signals is possible as well. The quality of the signals issued by the sensors is monitored in the internal interpolation circuit GC–IP201B.
The unit can be connected via RS422 to a standard counter or control. Alternatively, it is possible to activate the SSI/BiSS mode via USB and to connect it to a SSI/BiSS master. The internal power supply voltage is 5 VDC.
In addition, several functions of the interpolation circuit GC–IP201B e.g. switchable analog filter or a digital hysteresis make the unit an ideal choice for use in control systems.

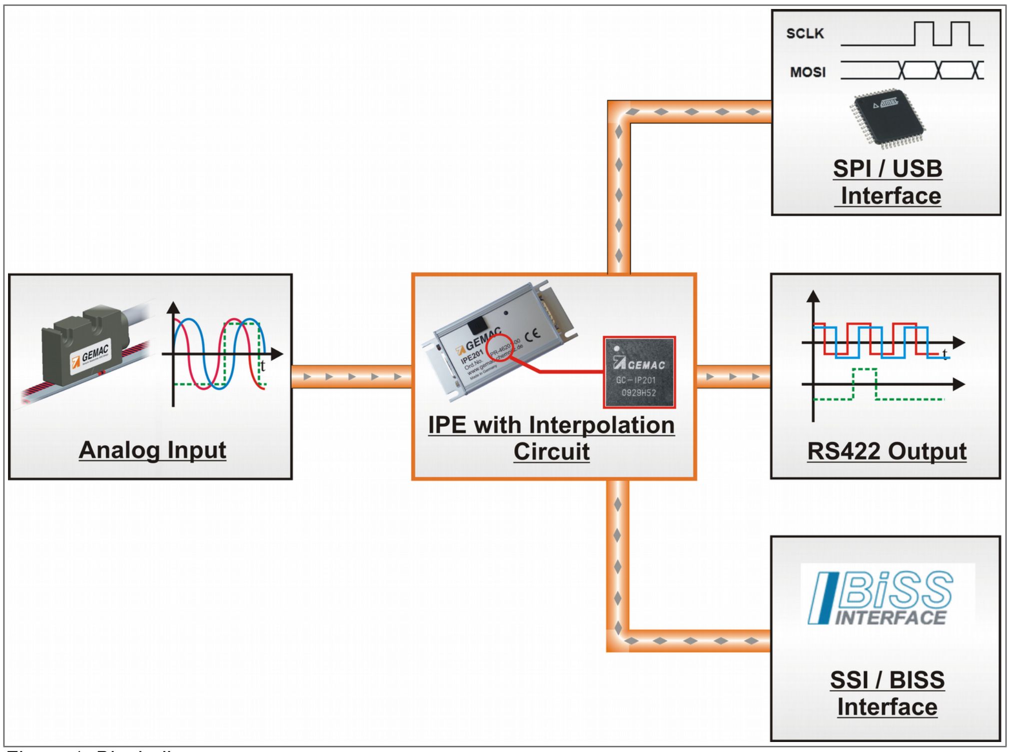

Figure 1: Block diagram

Note:
Detailed description of all functions can be found in the data sheet of GC–IP201B.

2 Features

Table 1: Overview features

Interfaces	
Analog input	- Sine/cosine/reference (index) signals; differential or single ended - Adjustable amplification for 1Vpp/500mVpp/240mVpp/80mVpp - Input frequency max. 440 kHz (SSI/BiSS); max. 140kHz (ABZ) at full interpolation rate - Optionally: active I/U converter to connect current encoders - 3.3V sensor input on request
ABZ	- 90° square wave sequences (A/B/Z) - Adjustable width zero signal Z of ¼ or 1 period A/B - Error signal - Auxiliary signals for sensor adjustment - RS422 interface
SPI[1)]	- 30 bit counter value/16 bit multiturn value - Up to 500,000 measurement values per second - 9 bit for sensor monitoring - Compatible to the standard SPI: 16 bit, MSB first; SPI clock up to 25MHz - Selectable analog noise filter
SSI and BiSS	- 30 bit counter value/16 bit multiturn value - 2 bit sensor monitoring - Graycode/binary code - adjustable timing - SSI ring operation
Additional inputs	- Trigger signal for storing actual measured value in one of the two trigger holding registers - Zero signal and teach signal for adjusting and storing of the zero point of the sensor
Configuration options	- Internal EEPROM - USB - Serial interface (SPI [1)]/SSI/BiSS)
Interpolation / signal handling	
Interpolation rate	256, 200, 160, 128, 100, 80, 64, (50)[2)], 40, 32, (25)[2)], 20
Signal correction	- AMAC-specific digital controller for the offset, control range ±10% of standard amplitude - AMAC-specific digital controller for the amplitude, control range factor 60% ... 120% of nominal amplitude - Digital potentiometer with 15 steps for phase correction; selectable range ±5° or ±10° - Behaviour of IC in case of sensor error can be programmed - LED control signal
Suppression of disturbances	- adjustable low pass filter 10kHz, 75kHz, 200kHz, 450kHz - Digital hysteresis for suppression of the edge noise at the output - adjustable minimum edge interval of output signals
Reference signal processing	- Adjustable reference mark position in 32 steps 0 … 360° - Optional: alignment of the reference mark position (configuration possible via SPI[1)], USB, BiSS or external signals possible) - Processing of distance coded reference marks - Measured value trigger at the reference mark position
Miscellaneous	- 2 stage measured value trigger - Programmable timer (3.2µs … 420ms) - Constant delay between sampling and measurement value for all resolutions - multiturn counter
Important characteristics	
Supply voltage	5VDC
I/O voltage, digital	3.3VDC or 5VDC
Temperature range	-40°C … +85°C
Max. interface clock	SPI[1)] 25MHz, 15MHz USB, BiSS 10MHz, SSI 5MHz
[1)] If ordered with SPI option	
[2)] Interpolation rates 50 and 25 may only be used in counter mode; in this case the ABZ-signals are not valid	

3 Input Signals

The input signals of the IPE201 are analog voltage signals (sine/cosine), which have a sine shaped dependency on the measured value (position or angle). The phase shift between those two analog voltages is 90°, related to one period of the scale. A third input signal serves as the reference point signal which determines the zero point of the scale. All three input signals are processed as differential or single ended signals.

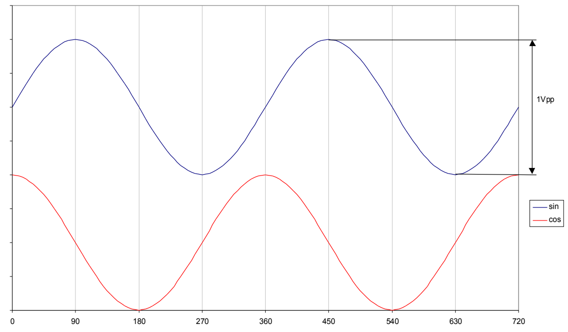

Figure 2: Input signals single ended

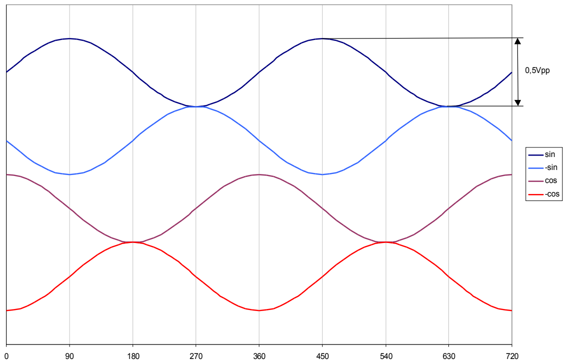

Figure 3: Differential input signals

3.1 Connection of a Measuring System

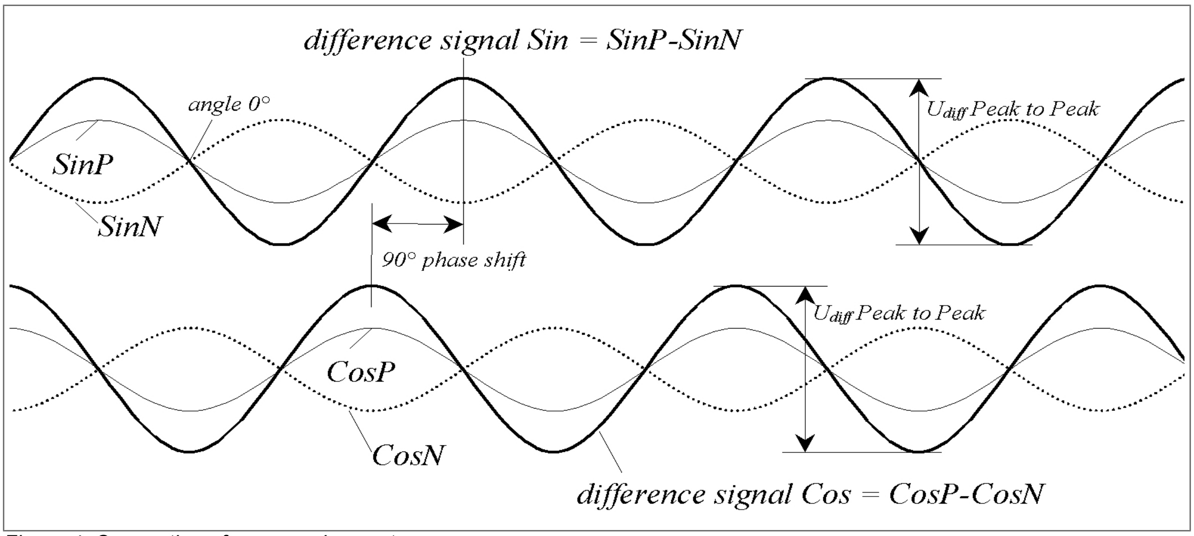

Figure 4: Connection of a measuring system

3.2 Description of the Input Amplifier

The gain can be set through the CFG1 – register. (also see data sheet of GC–IP201B)

Table 2: Description of the input amplifier

Description	Parameters			
Configuration bits CFG1 – GAIN (1:0)	00	01	10	11
Gain factor (nominal)	1	2	4	12,5
Input voltage for differential supply (mV_{pp}) 1)	500	250	120	40
Input voltage U_{Diff} nominal (mV_{pp})	1000	500	240	80
Input voltage range for U_{Diff} (mV_{pp})	600 – 1200	300 – 600	150 – 300	45 – 90
Hysteresis reference comparator, nominal (mV)	150	75	36	12
Bit CFG1 / LPF	recommended	recommended	recommended	**necessary**
1) at each of the inputs SINP, SINN, COSP, COSN				

3.3 Signal Correction

Input signals are subject to an AMAC-specific internal gain and offset control. The amplitudes are controlled in the range between 60% and 120% of the standard amplitude. Control range for the offset of the two signals is max. ±10% of the nominal amplitude. The phase shift of the input signals can be adjusted statically by the internal potentiometer in the range of ±5° or ±10°.
There are two measuring points for testing the signals: X2 Pin 1 (SMON) and X2 Pin 2 (CMON).

Table 3: Signal correction

Parameters	as a percentage referred to the nominal amplitude (PEAK – PEAK)	as a percentage referred to the ADC maximum (PEAK – PEAK)	in mV referred to the standard signal ($1V_{pp}$)	in V the pin SMON or CMON
Maximal value at the input	150	100	1500	1.91
Nominal value of the input signal	100	66.7	1000	1.27
Guaranteed control range for the amplitude	60 … 120	40 … 80	600 … 1200	0.76 … 1.52
Setting range of the amplitude controller	56 … 168 1)	38 … 112 1)	560 … 1680 1)	0.71 … 2.13 1)
Vector monitoring 2)	30	20	300	0.38
Guaranteed control range for the offset (sensor)	± 15	± 10	± 100	± 0.133
Setting range of the offset controller	± 25	± 17	± 250	± 0.315

1) The setting range for the amplitude is greater than the control range of the ADC. Therefore, the upper limit of the setting range cannot be fully utilised for the analogue signals.
2) An aggregate signal from sine and cosine is monitored.

3.4 Reference Signal

The reference signal of measuring systems is typically called REF, index point or zero point signal. The reference signal is detected if the voltage on input pin REFP is bigger than voltage on input pin REFN.

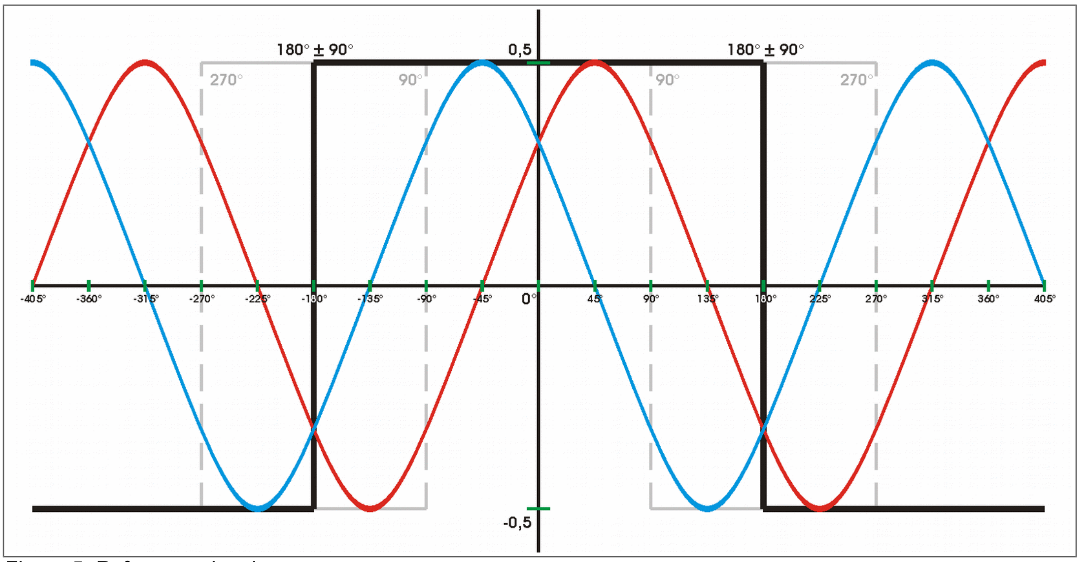

Figure 5: Reference signal

Note:
The reference point processing in the IPE201 can be deactivated in the internal configuration if no detection of the reference signal is needed.

Table 4: Reference signal internal

Register value CFG3 / DISZ	Meaning
0	Reference signal at the output active
1	Reference signal at the output inactive

Note:
The shape of the Z signal on the output of IPE201 can be adapted for different applications by configuring the interpolation circuit. If one increment is selected for the width of the Z signal, the Z impulse on the output corresponds exactly to one quarter of the period duration of the signals A and B. The Z impulse extends over a whole period if four increments are selected.

Table 5: Configuration of the reference point

Register value CFG1 / Z4	Meaning
0	1 increment = ¼ period
1	4 increments = 1 period

4 Input/Output Signals

It is possible to run the IPE201 in two different modes. The mode ABZ is the normal counter mode with the ABZ signals on the output (standard mode at delivery). At SSI/BiSS mode it is possible to configure the IPE201 or to read out measured values via the SSI/BiSS master. The running mode is also configurable by USB.

4.1 Output Signals RS422

The output signals are phase shifted square wave sequences (as common for incremental measuring transducers) which are counted in single or quadruple evaluation mode. A synchronous Z impulse will be generated when the angle of 0° (refer also to Figure 4) is passed through and the analog differential input voltage between **REFP** and **REFN** exceeds the positive comparator hysteresis level. If the differential input voltage is permanently above this level, the reference pulse will be generated once during every signal period. The output signals are differential AP – AN, BP – BN, ZP – ZN.

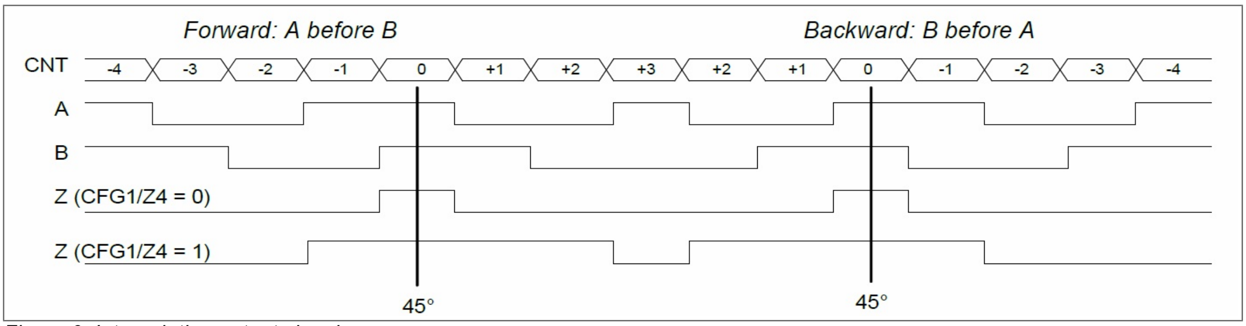

Figure 6: Interpolation output signals

Note:
The Signals A, B and Z are offset in time by 1 increment if the digital hysteresis is activated.

4.2 Input and Output Signals RS485 Mode SSI / BiSS

It is possible to read out measured values or to configure the IPE201via the SSI or the BiSS interface. The selection of the interface (SSI or BiSS) is done by the modification of the bit SSI at the register CFG3 of the GC-IP201B. Once the IPE201 is connected to the PC via the USB interface, the SSI/BiSS interface is inactive!

4.2.1 BiSS-Interface

The BiSS C-mode interface of the IPE201 will be activated if the bit SSI at register CFG3 is cleared. For use of the BiSS interface, the integrated EEPROM must contain a valid configuration, because essential operating parameters are stored in EEPROM. The configuration bits `BISSTO` and `READ32` in register `CFGBISS` can be used to adapt the interface to the system's parameters. The Single Cycle Data (SCD) transferred in BiSS C mode contains the actual position value from register `POSIT` (see datasheet of GC-IP201) with an overall length of 40 bit. This includes the 32 bit position, two bits of error information (error and warning bit) and the CRC check sum (6 bit, inverted). Since the higher-ranking interface master can usually only handle binary resolution it is vital that - in case of the use of the multi-turn counter – one of the following interpolation rates should is set: 256, 128, 64, or 32.

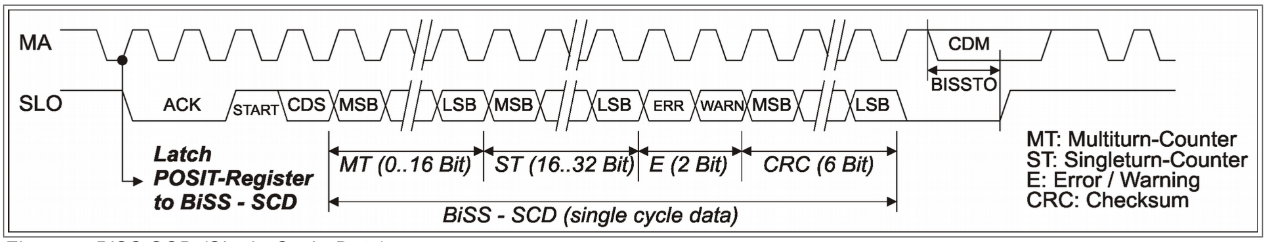

Figure 7: BiSS SCD (Single-Cycle-Data)

Via access to the BiSS register, all further IC registers are reachable. In case of reading the 32 bit data registers the bit READ32 in the register CFGBISS has to be set. Register read accesses via BiSS occur in 32 bit format. Four consecutive addresses always starting with the least significant one (divisible by 4) are read by the BiSS master. Additionally, the advices for setting the bits SYNC(4:0)in register CFG2 have to be considered as well (see datasheet of the GC-IP201B).

Table 6: Register CFGBISS (BiSS-Mode)

Bit	Meaning	Vendor configuration
BISSTO	BiSS-Timeout	25.6µs at 40MHz
READ32	Data format read access	Reading of configuration registers

Table 7: Default values BiSS register

Register	Vendor configuration
BiSS serial number	0x00
BiSS Vendor ID	0x47 0x43 („GC“)
BiSS Device ID	0x51 0x01 0x1E 0x00
BiSS-Profile + Electronic data sheet (EDS)	unused

Further specification of the BiSS interface, signal waveforms, register description as well as information regarding the electronic datasheet (EDS) can be found on the website *www.biss-interface.com*.

4.2.2 SSI-interface

The SSI interface of the IPE201 will be activated if the bit `SSI` at register `CFG3` is set to '1'. For use of the SSI interface, the integrated EEPROM must contain a valid configuration, because essential operating parameters are stored in EEPROM. The bits `BISSTO` and `RING` in register `CFGBISS` are initialised in the EEPROM by the end user based on system parameters. The SSI data output contains the position value (register `POSIT`, see datasheet GC-IP201B) with an overall length of 13 or 25 bit. The data contains the interpolation counter value (= single turn counter) and the multi turn counter value. Additionally, a bit for the error information is reserved. Since the higher-ranking interface master can usually only handle binary resolution it is vital that - in case of the use of the multi-turn counter – one of the following interpolation rates is set: 256, 128, 64, or 32. If the bit `RING` in the register `CFGBISS` is set, the SSI master will be able to enforce a repeatable data transmission of the same value by continuous clock (SSI ring mode).

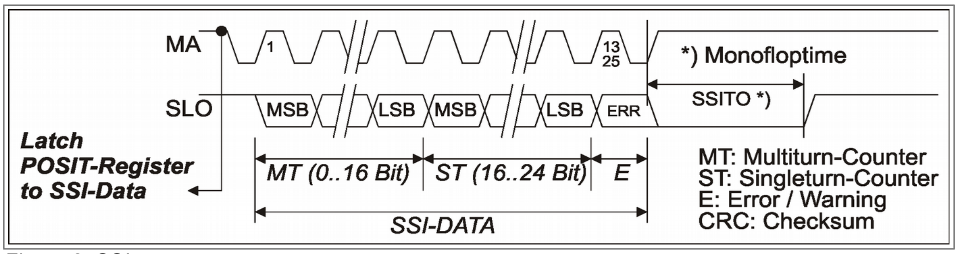

Figure 8: SSI

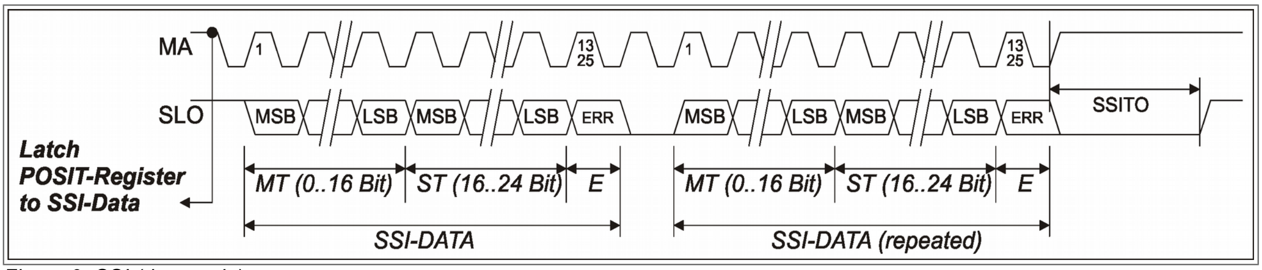

Figure 9: SSI (ring mode)

Table 8: Register CFGBISS (SSI-Mode)

Bit	Meaning	Vendor configuration
RING	SSI ring mode	Ring mode
SSI13	Output data length	13 bit

4.3 Error Signal

An error signal will be generated if the input signals are no longer plausible. The error signal will also be generated if the input frequency is so high that the square wave signals are unable to follow, and/or when the maximum input frequency is exceeded. It is recommended to use the error signal for data processing.

Note:
If the error signal was detected, the current measuring results and the following results should be discarded. Following elimination of the cause of the error and a reset of the error bit, the reference point has to be passed by for absolute value measurements once again!

4.4 Trigger Signal

The current counter value is shifted to one of the trigger holding registers by a signal edge at the trigger input of X1. The active trigger edge is set with the bit TRGSLP in the register CFG1.

4.5 Teach Signal

By using the signal teach it is possible to store a reference mark in the EEPROM of GC-IP201B. Therefore, it is necessary to set the bit TEAEN in register CFG1.

4.6 Zero Signal

By using the signal zero it is possible to reset the internal counter of GC-IP201B and, if occurred, reset the corresponding error bit. After the rectification of the error cause and resetting of the error bits it is imperative to pass through the reference point to be able to perform further absolute measurements.

5 Interpolation Rate

Possible interpolation rates (IRATE) which can be selected are 256, 200, 160, 128, 100, 80, 64, 50, 40, 32, 25, 20. The term 'interpolation rate' is here understood as the number of increments into which the sinusoidal/cosinusoidal period of the input signals is divided.

Table 9: Configuration of the interpolation rate

Interpolation rate	CFG1 – IR(3:0)
200	0000 (0)
100	0001 (1)
50	0010 (2)
25	0011 (3)
160	0100 (4)
80	0101 (5)
40	0110 (6)
20	0111 (7)
256	1000 (8)
128	1001 (9)
64	1010 (10)
32	1011 (11)

Note:
The interpolation rates 50 and 25 should only be configured if the internal counter is used (mode SSI/BiSS). In this case the ABZ signals are not valid.

5.1 Edge Interval Setting for ABZ Signals

The minimum time interval t_{pp} at which the output signals A,B and Z may switch can be adjusted in binary steps between $1/f_{OSZ}$ and $128/f_{OSZ}$. This function can be used to restrict the bandwidth of the IPE201 for slow RS422 counters.

Table 10: Minimum edge interval

Min. edge interval tpp	Register CFG1 – TPP(2:0)
1/fosz	000 (0)
2/fosz	001 (1)
4/fosz	010 (2)
8/fosz	011 (3)
16/fosz	100 (4)
32/fosz	101 (5)
64/fosz	110 (6)
128/fosz	111 (7)

5.2 Digital Hysteresis for ABZ Signals

To suppress the edge noise of the output signals at low input frequencies and standstill, a digital hysteresis can be activated for the signals A, B and Z by set/reset the bit `DH0` in register `CFG1`. This prevents switching off of the outputs when static input signals occur. In this case, all output signals are delayed by one increment.

Table 11: Configuration of the hysteresis

CFG1 – DH0	Digital hysteresis
0	deactivated
1	activated

6 Specifications

Table 12: Specifications

Recommended Operating Conditions	Min.	Nom.	Max.	Unit
Supply voltage	4.75	5.0	5.5	V
Supply current		110	230	mA
Internal interface voltage		3.3 / 5.0		V
Mid – voltage V_{0BUF}	2.1	2.25	2.4	V
Output current on V_{0BUF}			30	mA
Operating temperature	- 40		+85	°C
Analog input specifications	**Min.**	**Nom.**	**Max.**	**Unit**
Input frequency			440	kHz
Phase offset between SIN and COS		90		°
Peak to Peak input voltage SINN ⇔ SINP / COSN ⇔ COSP	0.08	1.0	1.2	V_{pp}
Phase deviation	4.5 / 9	5 / 10	9 / 11	°
Oscillator frequency		40		MHz
Interpolation	**Min.**	**Nom.**	**Max.**	**Unit**
Interpolation rates	20 / 25 / 32 / 40 / 50 / 64 / 80 / 100 / 128 / 160 / 200 / 256			
Minimum interval time A / B signals	1 / f_{OSZ}		128 / f_{OSZ}	ns
Interpolation accuracy		± 0.7 n		
Propagation delay square wave outputs (A / B / Z)	155 / f_{OSZ}		187 / f_{OSZ}	ns
Other characteristics	**Extruded aluminium housing**			
Degree of protection	IP20			
Connector	SUB–D, 15pin			
Dimensions	55mm x 80mm x 20mm			

7 Configuration of the Connectors

7.1 Signal output X1, mode ABZ

Table 13: Signal output SUB – D 15-pin; ABZ

Pin	Name	Direction	Meaning
1	AP	Output	Square wave Output A positive
2	VSS	Input	Unit power supply ground
3	BP	Output	Square wave Output B positive
4	VDD	Input	Unit power supply 5V
5	EP	Output	Error Output E positive
6	nTEACH	Input with pullup	Teach signal input; falling edge active
7	ZN	Output	Square wave Output Z negative
8	nTRGIN	Input with pullup	Trigger signal input; falling edge active
9	AN	Output	Square wave Output A negative
10	VSS	Input	Unit power supply ground
11	BN	Output	Square wave Output B negative
12	VDD	Input	Unit power supply 5V
13	nZERO	Input with pullup	Zero signal input; falling edge active
14	ZP	Output	Square wave Output Z positive
15	EN	Output	Error Output E negative

7.2 Signal output X1, mode SSI / BiSS

Table 14: Signal output SUB – D 15-pin; SSI / BiSS

Pin	Name	Direction	Meaning
1	SLOP	Output	Signal SLO positive
2	VSS	Input	Unit power supply ground
3	SLIP	Input	Signal SLI positive
4	VDD	Input	Unit power supply 5V
5	SENN	Input	Signal SEN negative [1)]
6	nTEACH	Input with pullup	Teach signal input; falling edge active
7	MAN	Input	Signal MA negative
8	nTRIG	Input with pullup	Trigger signal input; falling edge active
9	SLON	Output	Signal SLO negative
10	VSS	Input	Unit power supply ground
11	SLIN	Input	Signal SLI negative
12	VDD	Input	Unit power supply 5V
13	nZERO	Input with pullup	Zero signal input; falling edge active
14	MAP	Input	Signal MA positive
15	SENP	Input	Signal SEN negative [1)]
[1)] Signals could be left open. Interface configuration is done internally.			

7.3 Analog Output Header X2

Table 15: Analog test signal sine/cosine

Pin	Name	Direction	Meaning
1	SMON	Output	analog test signal sine
2	CMON	Output	analog test signal cosine
3	GND	Input	analog ground for measuring

7.4 USB Interface X4

Table 16: USB interface X4

Pin	Name	Meaning
1	+ USB	+ 5 V
2	USBD -	Data -
3	USBD +	Data +
4	ID	–
5	- USB	GND

7.5 Signal Input X6, Female

Table 17: Signal input SUB – D 15-pin; female

Pin	Name	Direction	Meaning
1	SINP	Input	Encoder signal sine positive
2	AVSS	Output	Encoder ground
3	COSP	Input	Encoder signal cosine positive
4	SENSVDD	Output	Encoder power supply 5V
5	–	–	–
6	–	–	–
7	REFN	Input	Encoder signal reference negative
8	–	–	–
9	SINN	Input	Encoder signal sine negative
10	AVSS	Output	Encoder ground
11	COSN	Input	Encoder signal cosine negative
12	SENSVDD	Output	Encoder power supply 5V
13	DNC	–	Do not connect
14	REFP	Input	Encoder signal reference positive
15	–	–	–

7.6 LED

Table 18: LED

LED	Value	Meaning
Sensor monitor LD4 LD6	red (LD6 off)	Sensor adjustment necessary / sensor not connected
	green (LD4 off)	Sensor signals valid
Power LED LD3	Off	IPE201 not working
	green	IPE201 working

8 Configuration of the GC-IP201B

8.1 Configuration Process

After the reset of the IC GC–IP201B, all registers are initialised with their default values. Subsequently, the configuration register can be modified via USB or SSI/BiSS. Therefore, program ip201-Monitor.exe should be used which is downloadable from our website at www.amac-chemnitz.de . With this program it is also possible to select the active interface on X1.

Attention:

To avoid communication problems with the PC, the hardware address of the IPE201 should always be 0x00. IPE201 cannot be used with another hardware address in combination with the IP201-Monitor.exe.

9 Software – IP201 Monitor

9.1 Overview

To control and set up parameters and values of GC-IP201B our "***IP201-Monitor***" software is recommended. This software is developed for windows based pc systems. GC-IP201B has to be connected via USB cable to the pc system. (USB port pc → X4)

Optionally: Configuration is also possible using BiSS adapter (iC-MB4U) and software.

9.2 System Requirements

To ensure the correct working of the software the following requirements are recommended.

- **Hardware:**
  - Processor: 2GHz or more (recommended: multi-core)
  - Min. 512MB main memory
  - Min. 1GB mass storage (for measuring values)
  - Graphic card with 24Bit shade (recommended: 32 Bit)
  - Resolution: 1024x768 pixel or more
  - USB – port

- **Operating Systems[1]:**
  - Microsoft Windows® 2000
  - Microsoft Windows® XP
  - Microsoft Windows® Server 2003
  - Microsoft Windows® Vista
  - Microsoft Windows® 7 and higher

[1] Microsoft and Windows® are registered trademarks of Microsoft Corporation in the U.S. and other countries.

9.3 Installation

The software and USB driver are installed via 44025-SW-x-x-IP201-Monitor Setup.exe file.

9.4 Program Structure

The graphical interface of the configuration program is divided into a dialog bar, a status bar and two areas for the display of the measured values. The dialog bar is located directly below the toolbar. In this area, the interface SPI (via USB) or BiSS can be selected. In addition, a measurement is started, the time interval, for the query can be chosen and commands for resetting e.g. counters can be triggered. The measured values and status information of the GC-IP201B are shown in measurement windows 1 & 2. The update of the measurement values is specified by the time interval.

After starting the application as shown in Figure 5 the software checks for the presence of the hardware. If a hardware is detected according to the selected interfaces, the name of the hardware will be displayed in the status bar. If the IPE201 is properly connected and enabled the status bar additionally displays the circuit name (eg: "IC: GC-IP201"). If no circuit can be detected, "unknown" appears.

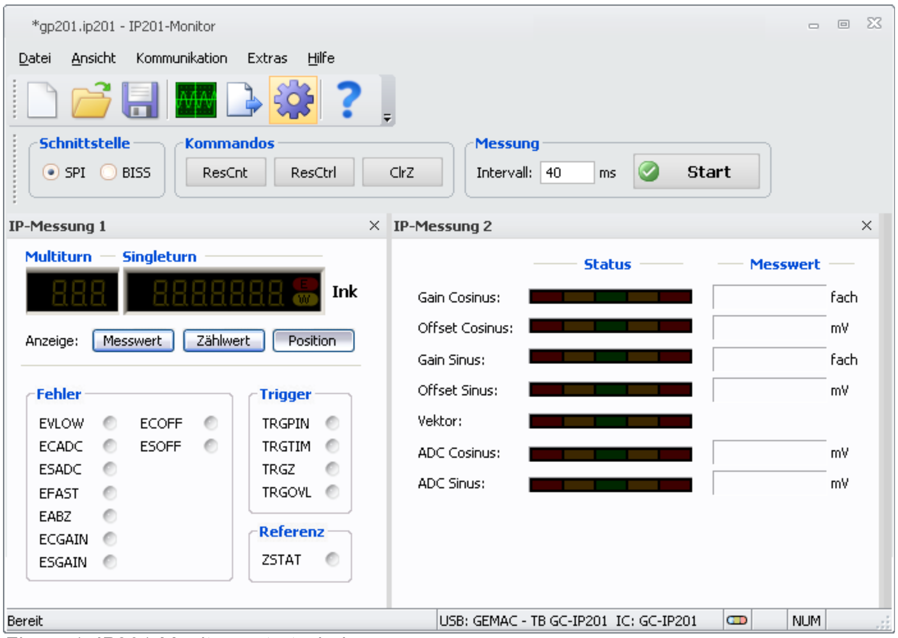

Figure 1: IP201-Monitor – start window

When using the BiSS interface it is necessary that the connections between circuit and interface and between the interface and PC exist. This enables the software to scan and define the hardware and interface. It may be necessary to change the interface selection after connecting the hardware. The scan of the device will then be restarted.

9.5 Menu

New document	Create a new configuration file.
Open document	Open and read a file with configuration details.
Store document	Store configuration details into a document.
Oscilloscope	Open the oscilloscope view for sensor signals. (chapter 9.9)
Export	Export of measurement values into file.
Configuration	Open the configuration menu. (chapter 9.7.2)
Information	Details to software, firmware and hardware.

9.6 Assistance

During the development of the configuration program special attention was paid to clear design and a self-explanatory graphical interface. Many elements of the user interface display detailed explanations once the mouse is moved over it (tooltip or status text).

9.7 Measurement

Once the IPE201 is connected to a PC and has been detected by the software a live-measurement can be started by pressing button "Start". The displays in both windows will be updated depending on the chosen interval time. The selected measurement interval is only a target value. The real measurement interval depends on software configuration and interface as well as PC capability and workload.

9.7.1 IP-Measurement 1

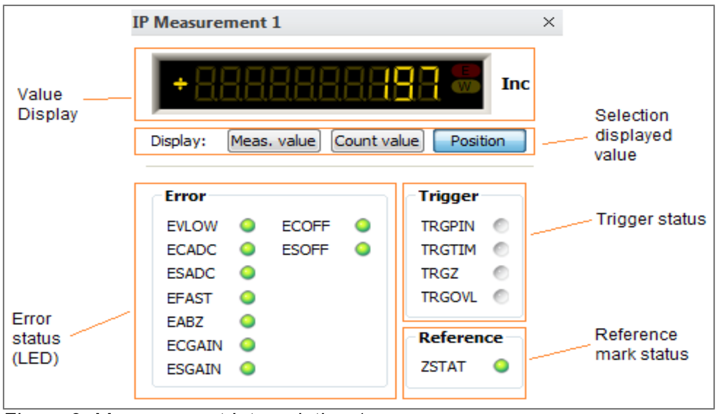

Figure 2: Measurement Interpolation 1

If a measurement is started, the actual counter value is displayed in window IP-Measurement 1. A selection between measured value (register MVAL of GC-IP201B), counter value (register CNT) and position (register POSIT, see register description at the datasheet of GC-IP201B) is possible. By choosing the position single and multiturn information can be displayed according to the circuit configuration (registers CFGBISS/MTBIT, CFGBISS/STBIT).
The display of the error-LEDs also depends on the circuit configuration. Every single error can be activated, deactivated or stored in the configuration register CFG1. According to this the behaviour of the LEDs is

adapted. The LEDs for error, trigger and state of the reference mark correspond to the information at the status register STAT of GC-IP201B. The meaning of the Error LEDs is shown in table 19. The status LEDs are described in table 20.

Table 19: Error LEDs

LED	Meaning
EVLOW	green: No vector error red: The signal vector generated from the sinusoidal and cosinusoidal signals is too small. Usually, the cause is a partly or completely disconnected sensor. Another cause are input signals with a very large offset and a low amplitude occuring at the same time.
ECADC	green: No ADC-error at cosinusodial signal red: The AD converter for the cosinussodial signal is overdriven. The cause is that the signal amplitude is too high. Another cause are input signals with a very large offset and a high amplitude at the same time.
ESADC	green: No ADC-error at sinusodial signal red: The AD converter for the sinussodial signal is overdriven. The cause is that the signal amplitude is too high. Another cause are input signals with a very large offset and a high amplitude at the same time.
EFAST	green: No speed error. Red: The input frequency is so high that no A/B signals can be generated or the direction can no longer be detected. The monitored frequency is different depending on whether an internal counter or the square wave outputs A/B/Z are used.
EABZ	green: No error on A,B,Z. red: The signals A, B, and Z are invalid. The cause is an excessive input frequency. The monitored frequency depends on the set minimum edge interval t_{PP}. This error bit will also appear, if the interpolation rate or the minimum edge interval t_{PP} is changed. Detection of this error has to be deactivated when using the GC-IP201B with an internal counter only (`MABZ` = 0).
ECGAIN	green: No amplitude error at cosinussodial signal. red: The gain controller for the cosinussodial signal has reached its limit. The cause is either that the signal amplitude is too low or the sensor is partly or fully disconnected.
ESGAIN	green: No amplitude error at sinussodial signal. red: The gain controller for the sinussodial signal has reached its limit. The cause is either that the signal amplitude is too low or the sensor is partly or fully disconnected.
ECOFF	green: No offset error at cosinussodial signal. red: The offset controller for the cosinussodial signal has reached its limit. The cause is an excessive signal offset, a partly or fully disconnected sensor or an invalid value for the initialisation of the offset controller.
ESOFF	green: No offset error at sinussodial signal. red: The offset controller for the sinussodial signal has reached its limit. The cause is an excessive signal offset, a partly or fully disconnected sensor or an invalid value for the initialisation of the offset controller.

Table 20: Status LEDs

LED	Meaning
TRGPIN	Trigger status (pin) active: The next value at register `MVAL` was triggered by the Pin TRG. inactive: The register `MVAL` contains the actual measured position value (register POSIT).
TRGTIM	Trigger status (timer) active: The next value at register `MVAL` was triggered by the timer. inactive: The register `MVAL` contains the actual measured position value (register POSIT).
TRGZ	Trigger status (reference mark) active: The next value at register `MVAL` was triggered by the reference mark signal. inactive: The register `MVAL` contains the actual measured position value (register POSIT).
TRGOVL	Trigger overflow active: Overflow of trigger holding register. A trigger event was lost. inactive: No overflow of the trigger holding registers. Max. two trigger events will be stored.
ZSTAT	Reference mark status active: The reference mark of the scale was passed. GC-IP201B and scale work synchronously. inactive: The reference mark of the scale has not been passed yet or the relation between counter value and reference mark was lost due to an error.

9.7.2 IP-Measurement 2

The quality of the sensor signals is displayed in window IP-Measurement 2 in form of LED bars according to the regulator parameters. In addition, the input amplitude on the A/D converters are monitored, so that an eventually occurring overload on the ADC can be displayed in the software.

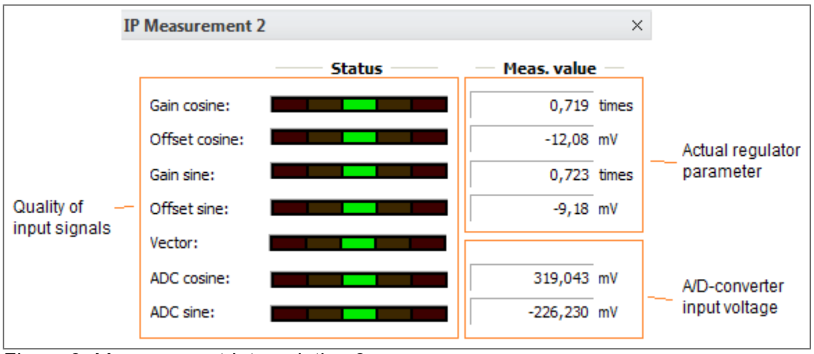

Figure 3: Measurement Interpolation 2

The meaning of the display elements is described in table 21 and 22.

Table 21: Sensor monitoring

Name	Type	Meaning
Gain cosine Gain sine	LED-bar	Regulator value for signal amplitude.
	Measured value	Regulator value for amplification of the input signal.
Offset cosine Offset sine	LED-bar	Regulator offset correction value.
	Measured value	Actual regulator value for offset correction.
Vector	LED-bar	Vector magnitude of the input signals.
ADC-cosine ADC-sine	LED-bar	Range of the AD-converter.
	Measured value	Actual input voltage at the A/D-converter.

Table 22: Range for sensor monitoring

Display	Meaning
LED-bar green yellow left yellow right red left red right	Value ... ... lies at the allowed range ... is too small, sensor signal should be aligned ... is too big, sensor signal should be aligned ... is too small, measured value is incorrect ... is too big, measured value is incorrect

9.8 Configuration

After the IPE201 and circuit GC-IP201B have successfully been detected, the software tries to read the current configuration. The user has the opportunity to confirm this or to create a new configuration (File -> New; symbol "white sheet"). In addition, a previously saved configuration with the extension *. IP201 can be loaded. (File -> Open folder icon).

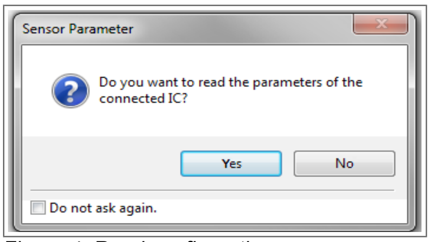

Figure 4: Read configuration

9.8.1 Sensor Parameter / Expert

In the first tab “Sensor – Parameter” of the sensor configuration menu basic settings such as interpolation rate and input amplitude can be adjusted. This allows switching between the basic functions of the GC-IP201B without much effort.
The saving of the selected parameters into the EEPROM of GC-IP201B is done using the "Program" button. The button "Verify" is used to compare the data between software and EEPROM and finishes by delivering the result of this comparison. If differences are observed the button "Read" is used to read the values of the EEPROM and to show them in the display of the software.

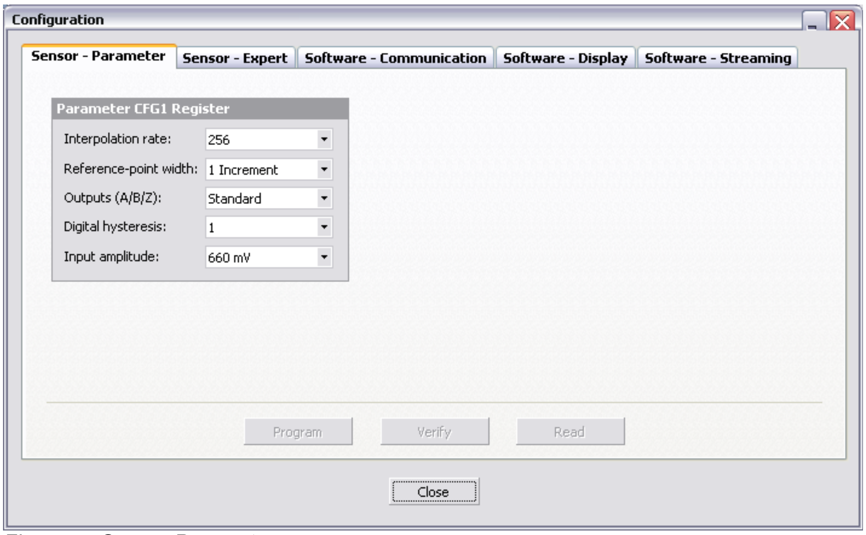

Figure 5: Sensor Parameter

For further configuration of GC-IP201B the tab Sensor-Expert has been designed. This is directly based on the definitions in the configuration register CFG1-3 and CFGBiSS, which can also be programmed individually. The detailed description and explanation of each parameter can be found in the data sheet of GC-IP201B. Reading, programming and verifying the parameters follows the same procedure as the Sensor-Parameter tab.

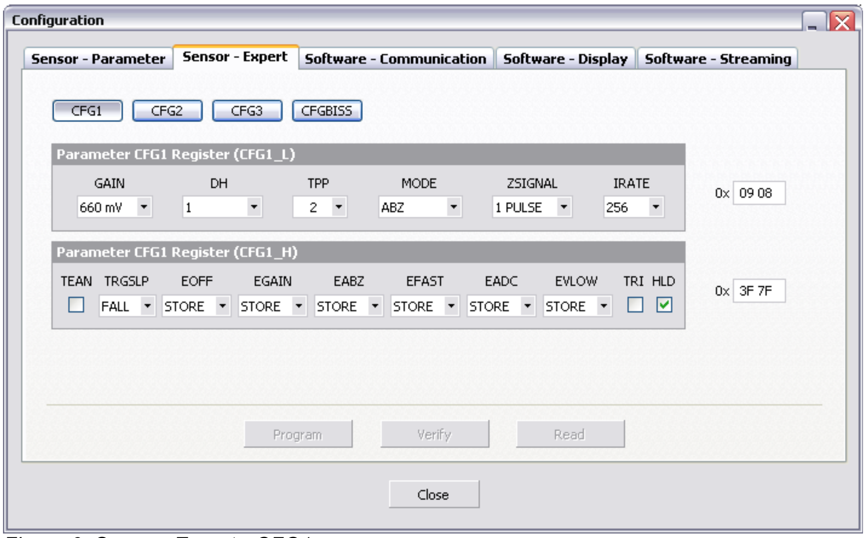

Figure 6: Sensor–Expert - CFG1

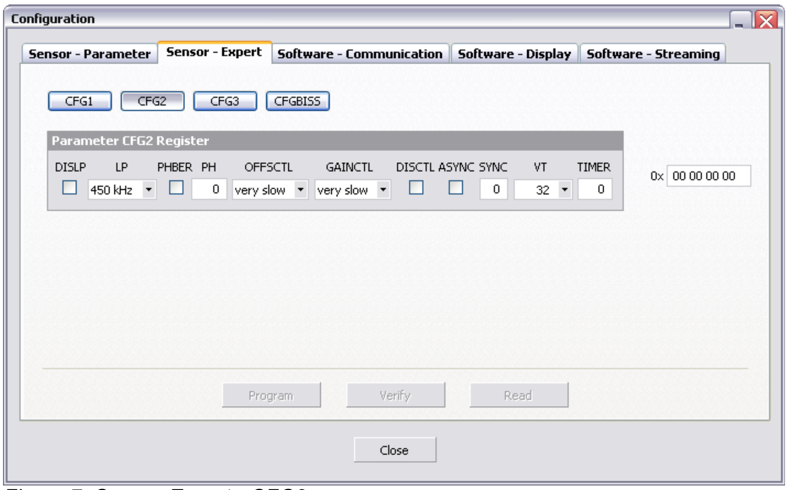

Figure 7: Sensor-Expert - CFG2

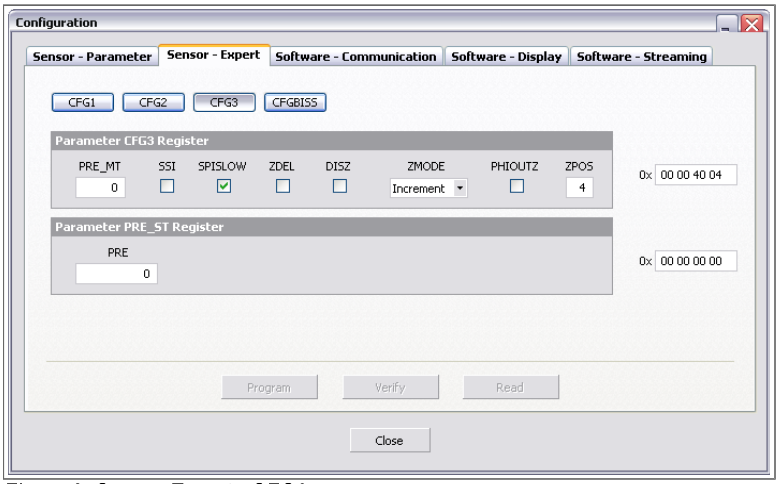

Figure 8: Sensor-Expert - CFG3

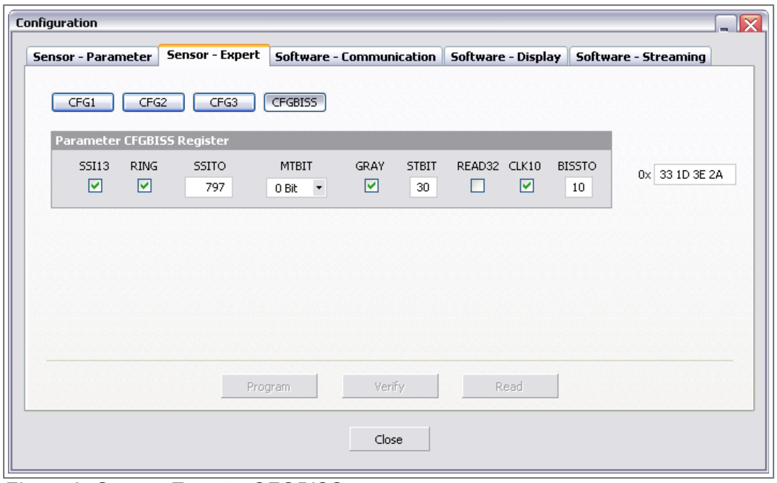

Figure 9: Sensor-Expert - CFGBiSS

9.8.2 Software – Communication

The settings for the clock divisor for communication via the interfaces SPI (via USB) or BiSS are made in this tab. The waiting time for the SPI interface after a read access can also be set (for more information see data sheet of GC-IP201B). In the area for BiSS interface, a configuration file (BiSS xml file) can be loaded for the configuration of a BiSS master. At the area “Config. Output” it is possible to choose the actual interface on X1. Attention: The BiSS-interface is only active if the IPE201 is not connected via USB!

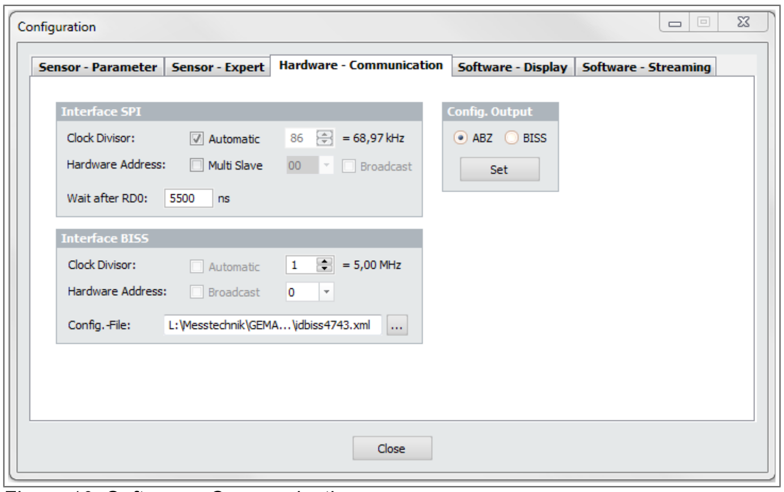

Figure 10: Software - Communication

9.8.3 Software – Display

In the tab Software-Display the measuring unit and scaling factor for the display of the measured values in the software (IP Measurement 1) can be programmed. It is also possible to enable or disable user warnings and information dialogs.

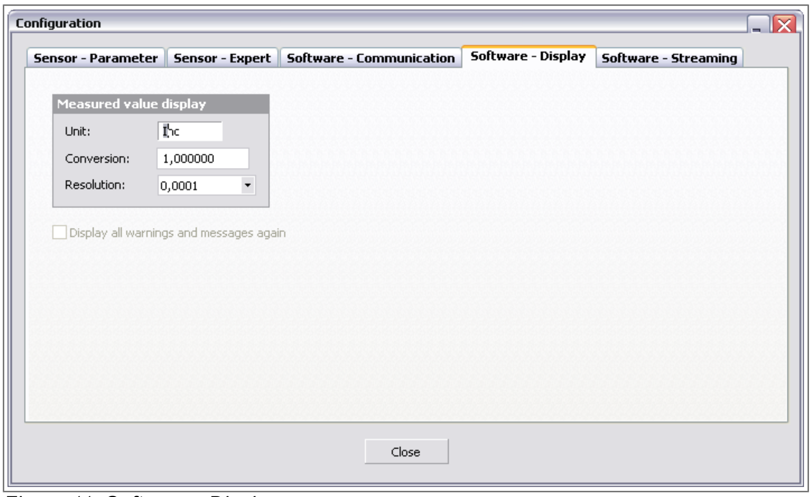

Figure 11: Software - Display

9.8.4 Software – Streaming

The Streaming tab offers the possibility to continuously record the parameters of GC-IP201B such as corrected and uncorrected ADC values, PHI or BQ. The data can then be exported as measurement data or raw data as CSV or Matlab data using the export feature (Tools->Export). Thus providing the base for a subsequent analysis and processing of data and documentation.

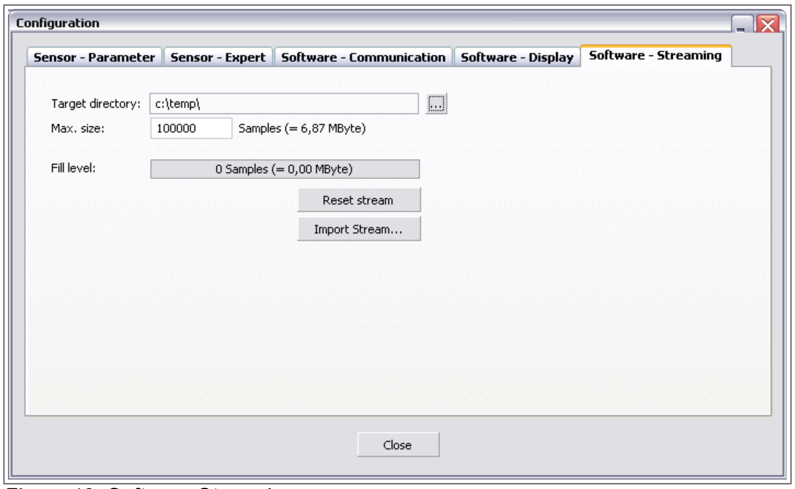

Figure 12: Software Streaming

9.9 Oscilloscope

The software also provides the ability to show signals and parameters of the GC-IP201B e.g. ADC values graphically. The user can choose between the mode with time reference and XY display.

Note:
When using the BiSS interface only the position data (single-turn, multi-turn and error bits) are read from the circuit during the measurement. Therefore, neither the indicators for input signal control in the main window are displayed in the BiSS mode, nor can the signals in the oscilloscope be tracked.

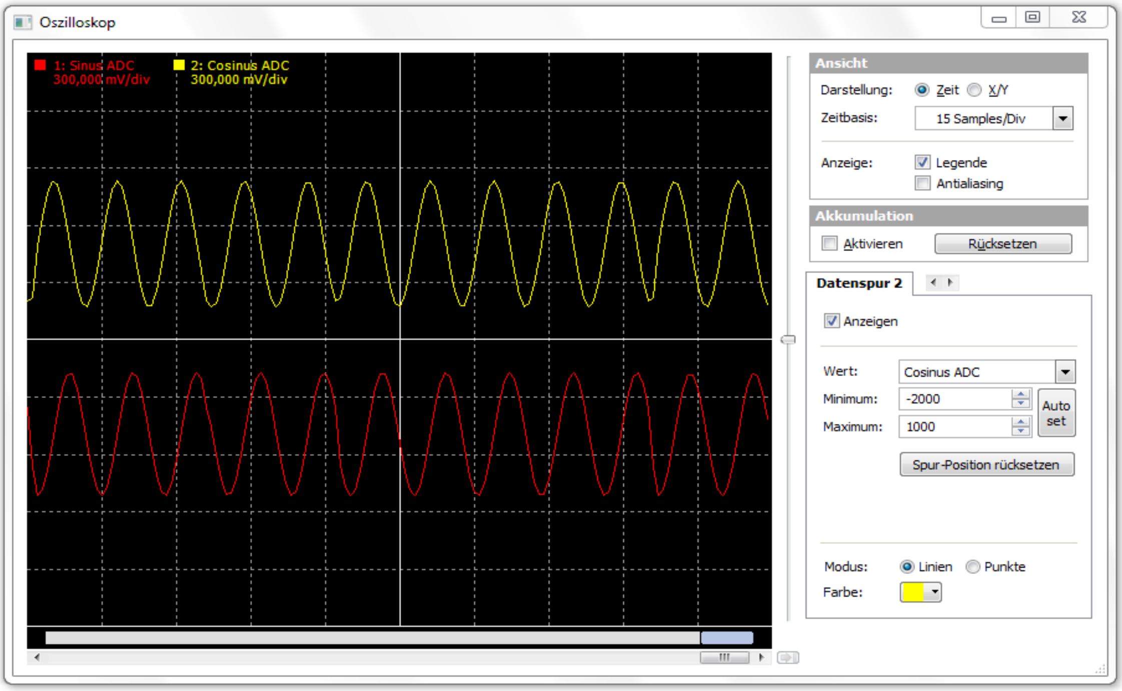

Figure 13: Oscilloscope – time graphic

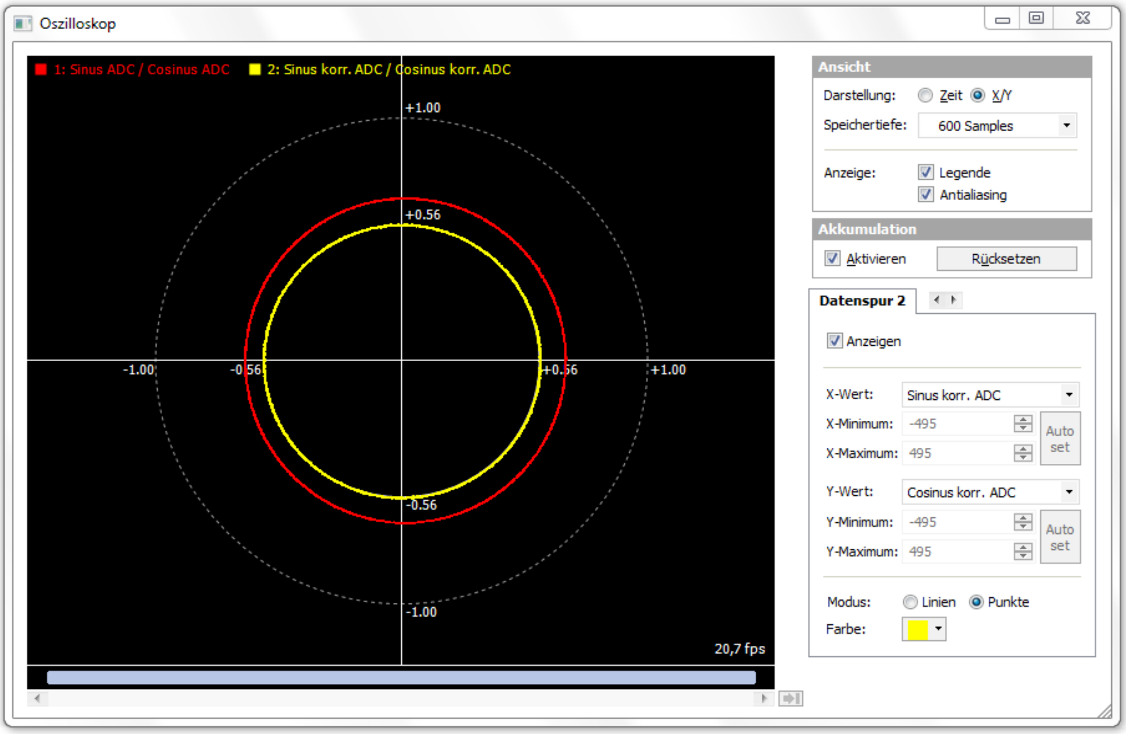

Figure 14: Oscilloscope - XY graphic

10 Ordering Information

Table 23: Ordering Information

Product Type	Description	Article Number
IPE201	Interpolation Unit with GC-IP201B (standard configuration ABZ)	PR-46201-00

10.1 Standard Delivery Configuration

Table 24: Hardware delivery configuration

Interface	Description
Sensor input	Differential input signals with $1V_{SS}$ amplitude
Digital output	ABZ signals

Table 25: GC-IP201B delivery configuration

Parameter	Configuration
Interpolation rate	256
Reference point detection	Active
Reference point width	1 Increment
Output signals	ABZ
Digital hysteresis	Active
Low pass at input	Active, f_g = 450kHz
Error signals	Active, errors will not be stored (bit `HLD` at register `CFG1` of the IP201B is not set)
SPI	Filter of SPI input signals → used for USB communication (bit `SPISLOW` at register `CFG3` of the GC-IP201B) not active

11 Component Mounting Diagram

11.1 Connectors and Test Points

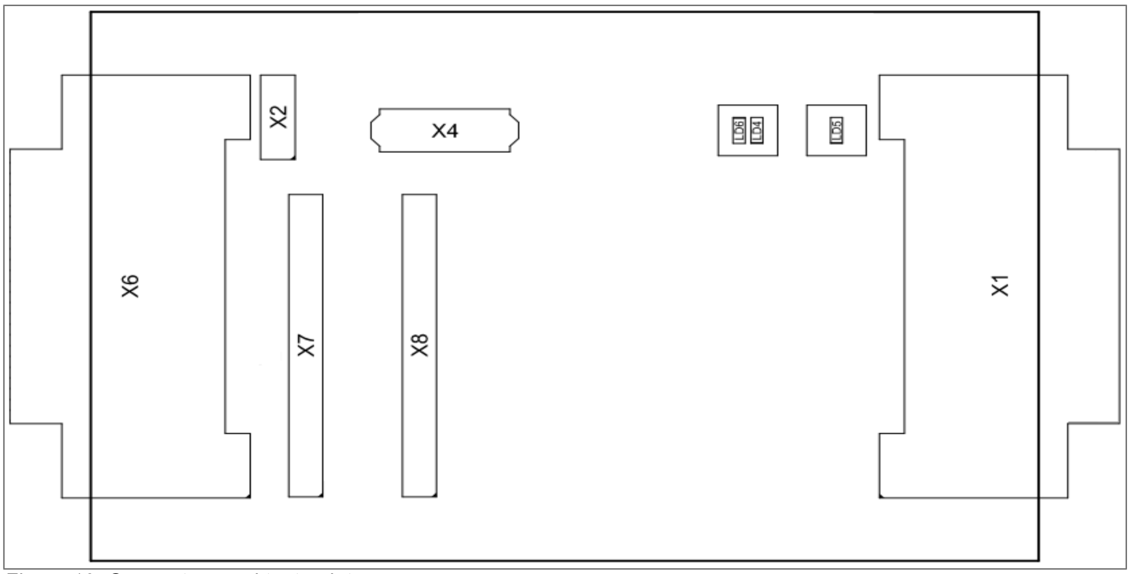

Figure 10: Connectors and test points

11.2 Dimensions

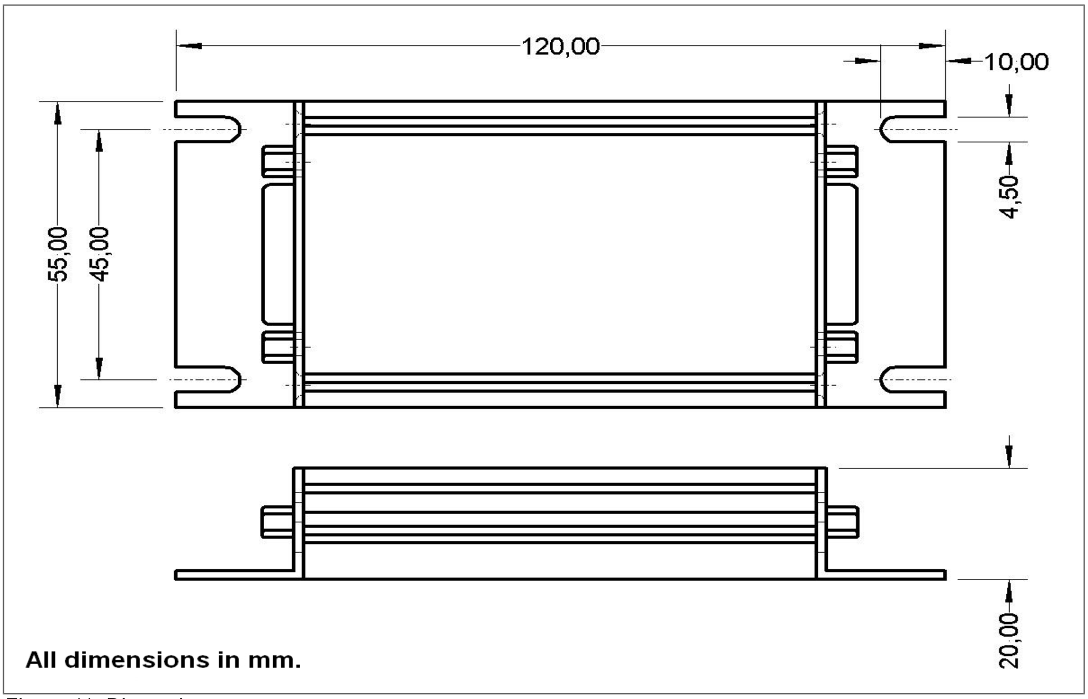

Figure 11: Dimensions

12 Notes