GEMAC

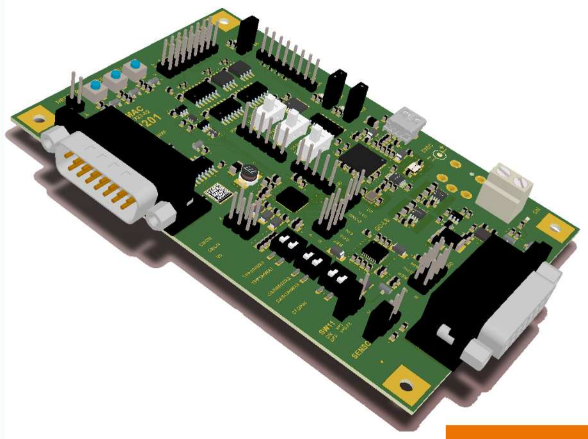
Sensorik. Messtechnik. ASIC-Design.

User Manual

GP-IP201

Version: 1.11

Date: 13.12.2013



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Revision History

Date	Revision	Change(s)
15.11.12	1.0	First version
05.12.12	1.1	Addition at function description, addition at pin description
06.12.12	1.2	Addition of chapter Software
18.12.12	1.3	Addition of SPI speed over on board USB to SPI converter
18.01.13	1.4	Changes on block diagram, additions at chapter 5 and new chapter 6
13.02.13	1.5	Addition of information about adjusting of sensor signals (chapter 3.1.6 Pin assignment Sub-D X6)
06.03.13	1.6	Adaption to new hardware revision
15.03.13	1.7	Addition of chapter 7 Start up behaviour
14.05.13	1.8	Correction of pin description X6 (3V3 / 5V Pin 4)
04.06.13	1.9	Upgrade of software description
25.09.12	1.10	Adaption to new hardware revision
13.12.13	1.11	Addition to chapter 3.1.11 configuration of V0, changes in chapter 7.3

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1 Overview

The evaluation board GP-IP201 serves to demonstrate and evaluate the functionality of GEMAC interpolation circuits GC-IP201 & GC-IP201B. Several configuration options and connectors can be used to easily adapt the GC-IP201(B) to a wide range of customer applications.

It is possible to increase the resolution for incremental position and angular measuring systems with sinusoidal output signals offset by 90°. The GC-IP201(B) on board divides the signal period up to 256 times. Incremental encoders with voltage interface, encoders with current interface, photo diode arrays as well as measuring bridges can be connected directly. The evaluation board may operate with both single-ended and differential input signals.

The configuration & evaluation of the GC-IP201(B) is possible either via USB, SPI or SSI/BiSS interface. Therefore the software “IP201-Monitor” is available. The board can be connected via RS422 to a standard counter or controller as well as via fast serial interface (SPI) to any microcontroller or FPGA.

The internal power supply voltage for GP-IP201 is 5 VDC. Supply via USB interface, connectors X13 or X15.

The desired interface (USB, SPI or SSI/BiSS) can be selected by way of the appropriate jumper (J1, J2 or J3).

The external sensor supply voltage of 3.3 V or 5 V can be selected via jumper J4.

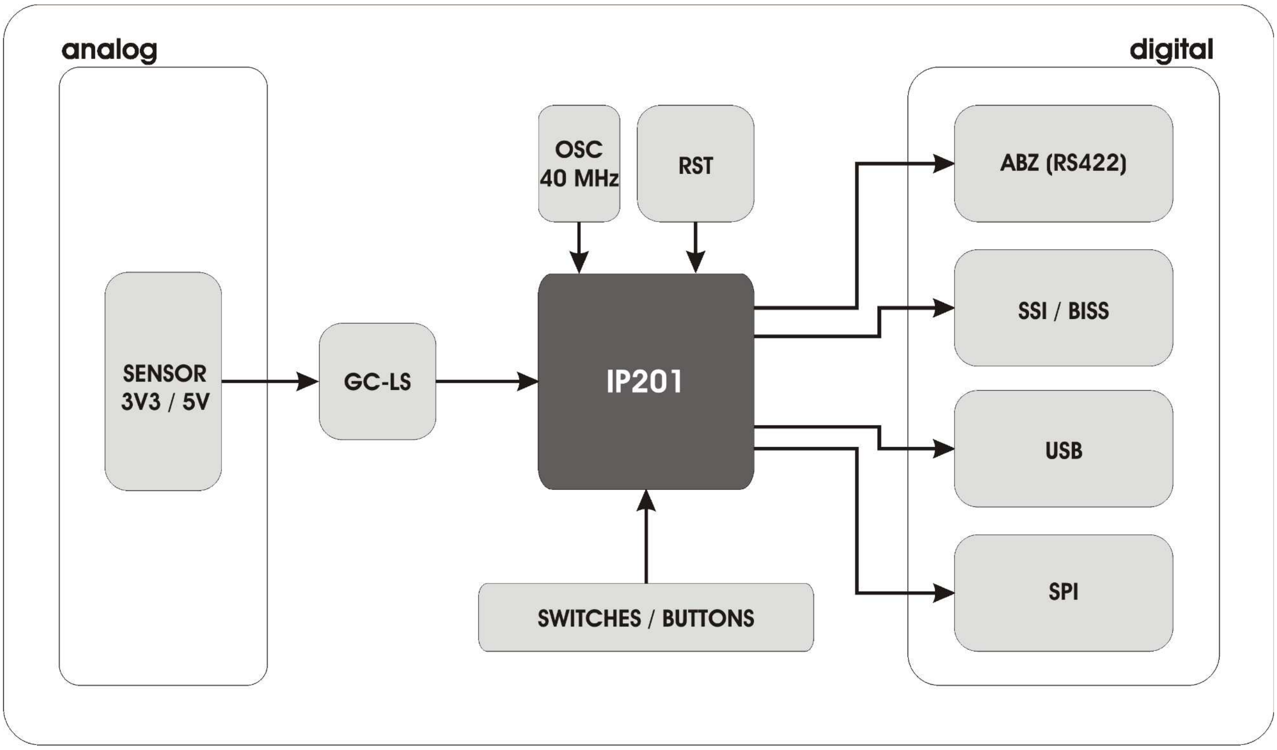

Figure 1: Block diagram

2 Features

Interfaces	
Analog input	■ Sine- / Cosine- / Reference signal; differential or single-ended* ■ Nominal amplitude configurable to 660mVpp / 330mV$_{pp}$ / 160mV$_{pp}$ / 50mV$_{pp}$ (corresponds 1V$_{pp}$ / 500mV$_{pp}$ / 240mV$_{pp}$ / 80mV$_{pp}$ at 5 V systems) ■ Maximum input frequency 440 kHz for all resolutions
ABZ	■ 90°-square wave sequences (A/B/Z) ■ Adjustable width of the index signal Z of ¼ or 1 period A/B ■ Error signal ■ Interrupt signal for µC ■ Additional signals for sensor adjustment
SPI	■ 30 Bit counting value / 16 Bit multi-turn value ■ Data rate up to 500 000 measuring values/s ■ 9 Bit signal monitoring ■ Standard SPI compatible: 16 Bit, MSB first, up to 25 MHz ■ Signal filter for noise suppression
SSI and BiSS	■ Up to 30 Bit counting value / 16 Bit multi-turn value ■ 2 Bit signal monitoring ■ Gray code / binary code ■ Adjustable timing ■ SSI ring mode
Further inputs	■ Trigger signal for measured value storage ■ Zero-signal and Teach-signal for adjusting and storage of the sensor zero position
Configuration options	■ Internal EEPROM ■ Configuration inputs ■ Serial interface (SPI/BiSS)
* external modulation necessary (negative inputs SINN, COSN, REFN to mid-voltage V0)	
Interpolation / Signal Processing	
Interpolation rates	■ 256, 200, 160, 128, 100, 80, 64, (50), 40, 32, (25), 20
Signal correction	■ Patented digital offset regulation, regulation range ±10% of the nominal amplitude ■ Patented digital amplitude regulation, regulation range factor 60% ... 120% nominal amplitude ■ Digital 15 step potentiometer for phase correction; adjusting range ±5° or ±10° ■ Monitoring and evaluation of the input signal quality ■ Programmable reaction to sensor errors
Suppression of disturbances	■ Adjustable low pass filter 10 kHz, 75 kHz, 200 kHz, 450 kHz ■ Digital hysteresis for edge noise suppression at the output (0 … 7) ■ Adjustable minimum edge distance (band width limitation) at the output
Reference signal processing	■ Adjustable reference point position 32 steps 0° … 360° ■ Identification of the optimum reference position via SPI/BiSS or additional signals ■ Processing of distance coded reference marks ■ Measured value trigger at reference point position
Others	■ 2-step measured value trigger ■ Programmable timer (3.2µs … 420ms) ■ Delay time between sampling and measured value constant 2.3µs for all resolutions ■ Multi-turn counter
Main Features	
Package	■ QFN40 (6 mm x 6 mm)
Power supply voltage	■ 3.3 V
Temperature range	■ -40°C … 150°C
Interface frequency	■ SPI 25 MHz, BiSS 10 MHz, SSI 5 MHz

Table 1: Features

A detailed description of all functions can be found in the data sheet of GC-IP201(B).

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3 Hardware

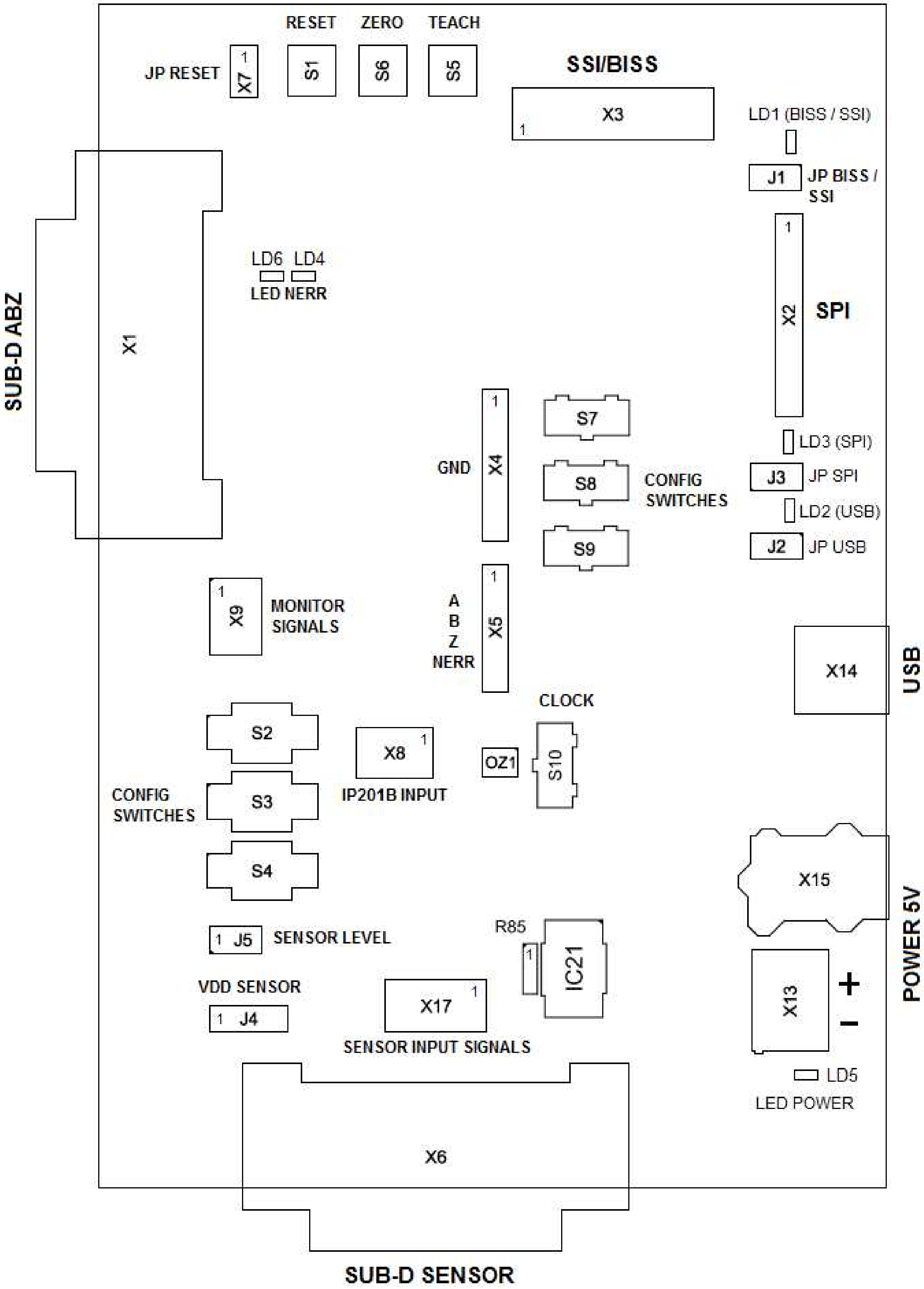

Figure 2: Demoboard GP-IP201, component places

3.1 *Connectors*

3.1.1 Pin Assignment SUB-D X1 (ABZ – RS422)

Pin	Name	Meaning
1	AP	Square wave output A positive
2	GND	Ground
3	BP	Square wave output B positive
4	+ 5V	Unit power supply 5 VDC / 3.3 VDC
5	ZP	Square wave output Z positive
6	-	-
7	EN	Error output NERR negative
8	TRIG	Trigger signal
9	AN	Square wave output A negative
10	GND	Ground
11	BN	Square wave output B negative
12	+ 5V	Unit power supply 5 VDC / 3.3 VDC
13	ZN	Square wave output Z negative
14	EP	Error output NERR positive
15	-	-

Table 2: Pin assignment SUB-D X1

3.1.2 Pin Assignment X2 (SPI)

Pin	Name	Meaning
1	+ 5V	Power supply 5 VDC / 3.3 VDC
2	SCK	SPI Clock
3	MISO	SPI MISO
4	MOSI	SPI MOSI
5	SEN_SPI	SPI enable
6	ZERO	ZERO-pin GC-IP201(B)
7	TRG	Trigger-pin GC-IP201(B)
8	GND	GND

Table 3: Pin assignment X2 (SPI)

3.1.3 Pin Assignment X3 (BiSS / SSI)

Pin	Name	Meaning
1	+ 5V	Power supply 5 VDC / 3.3 VDC
2	+ 5V	Power supply 5 VDC / 3.3 VDC
3	MA_P	SSI / BiSS MA positive
4	MA_N	SSI / BiSS MA negative
5	SLO_P	SSI / BiSS SLO positive
6	SLO_N	SSI / BiSS SLO negative
7	SLI_P	SSI / BiSS SLI positive
8	SLI_N	SSI / BiSS SLI negative
9	SEN_SSI/BiSS_P	SSI / BiSS enable positive
10	SEN_SSI/BiSS_N	SSI / BiSS enable negative
11	ZERO	ZERO-pin GC-IP201(B)
12	TEACH	TEACH-pin GC-IP201(B)
13	TRG	Trigger-pin GC-IP201(B)
14	-	-
15	GND	Ground
16	GND	Ground

Table 4: Pin assignment X3 (BiSS/SSI)

3.1.4 Pin Assignment X4 (GND)

Pin	Name	Meaning
1 – 6	GND	AGND GC-IP201(B) (analog ground)

Table 5: Pin assignment X4 (GND)

3.1.5 Pin Assignment X5 (ABZ)

Pin	Name	Meaning
1	A	Square wave output A directly at GC-IP201(B)
2	B	Square wave output B directly at GC-IP201(B)
3	Z	Square wave output Z directly at GC-IP201(B)
4	NERR	Error output NERR directly at GC-IP201(B)
5	GND	DGND GC-IP201(B) (digital ground)

Table 6: Pin assignment X5 (ABZ)

3.1.6 Pin Assignment SUB-D X6 (Sensor)

Pin	Name	Meaning
1	SINP	Encoder signal sine positive
2	GND	AGND GC-IP201(B) (analog ground)
3	COSP	Encoder signal cosine positive
4	3V3 / 5V	Encoder power supply 5 VDC / 3.3 VDC
5	-	-
6	-	-
7	REFN	Encoder signal reference negative
8	-	-
9	SINN	Encoder signal sine negative
10	GND	AGND GC-IP201(B) (analog ground)
11	COSN	Encoder signal cosine negative
12	3V3 / 5V	Encoder power supply 5 VDC / 3.3 VDC
13	V0	Mid voltage output 1.1 V (just for 3.3 V sensor systems!)
14	REFP	Encoder signal reference negative
15	-	-

Table 7: Pin assignment SUB-D X6 (sensor)

<u>Information for adjustment of sensor signals</u>

Adjustment for single-ended encoder signals (SINN to common mode level V0):

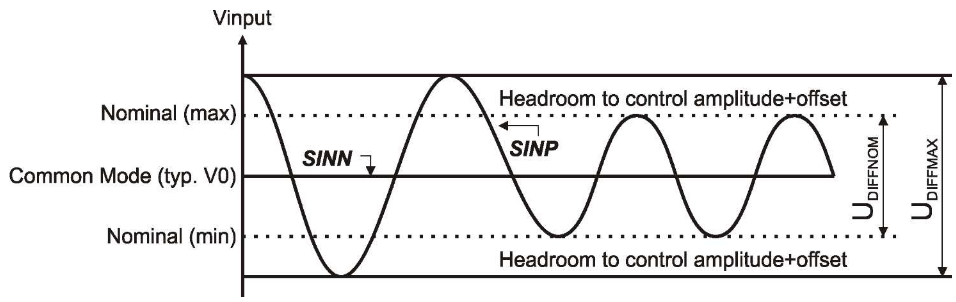

Figure 3: Adjustment single-ended input signals

Adjustment for differential encoder signals

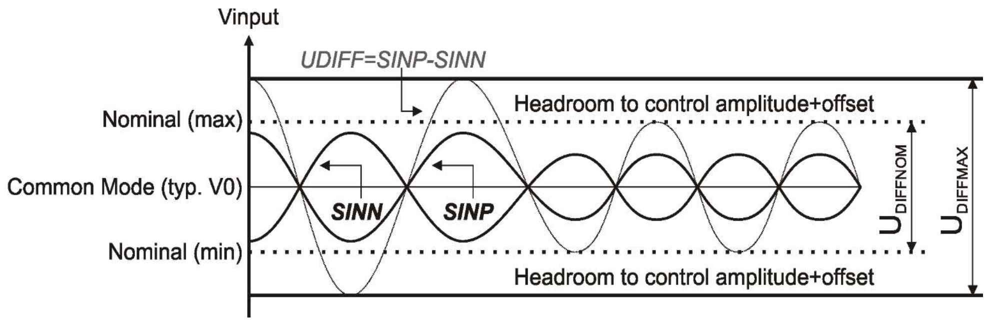

Figure 4: Adjustment differential input signals

For detailed description please see data sheet of GC-IP201(B), Chapter 7.1 Input amplifier / Low pass filter

3.1.7 Jumper X7 (NRES)

Pin	Name	Meaning
1	NRES	Open→ reset not active Closed → reset active
2	GND	

Table 8: Jumper X7 (NRES)

3.1.8 Pin Assignment X8 (Input Signals at GC-IP201(B))

Pin	Name	Meaning
1	SINP	Positive sine signal directly at GC-IP201(B)
2	SINN	Negative sine signal directly at GC-IP201(B)
3	COSP	Positive cosine signal directly at GC-IP201(B)
4	COSN	Negative cosine signal directly at GC-IP201(B)
5	REFP	Positive reference signal directly at GC-IP201(B)
6	REFN	Negative reference signal directly at GC-IP201(B)

Table 9: Pin assignment X8 (input signals at GC-IP201(B))

3.1.9 Monitoring Signals X9

Pin	Name	Meaning
1	CMON	Cosine-monitoring signal at GC-IP201(B)
2	AGND	AGND GC-IP201(B) (analog ground)
3	SMON	Sine-monitoring signal at GC-IP201(B)
4	AGND	AGND GC-IP201(B) (analog ground)
5	V0	Mid-voltage monitoring signal at GC-IP201(B)
6	AGND	AGND GC-IP201(B) (analog ground)

Table10: Monitoring signals X9

3.1.10 Pin Assignment X13, X14, X15 (Power, USB)

Connector	Name	Meaning
X13	Input 1 → GND Input 2 → + 5VDC	Ground Power supply 5 VDC / 3.3 VDC
X14	USB	Mini-USB
X15	Female DC connector 5.0 x 2.1 mm	Power supply 5 VDC / 3.3 VDC

Table 11: Pin assignment X13, X14, X15 (Power, USB)

3.1.11 Solder Configuration of Resistor R85 for Selection of V0 at X6

Pin	V0	Meaning
1 – 2	2.5V	Mid-voltage for 5V-Sensors
2 – 3	1.1V	Mid-voltage for 3.3V-Sensors
Open	Depends on sensor	Mid-voltage from external source → 2.5 V for 5V-Sensors → 1.1 V for 3.3V-Sensors

Table 12: Selection of V0 at X6 with resistor R85

3.1.12 Pin Assignment X17 (Sensor)

Pin	Name	Meaning
1	3V3 / 5V	Power supply 5 VDC / 3.3 VDC
2	GND	AGND GC-IP201(B) (analog ground)
3	SINP	Encoder signal sine positive
4	SINN	Encoder signal sine negative
5	COSP	Encoder signal cosine positive
6	COSN	Encoder signal cosine negative
7	REFP	Encoder reference signal positive
8	REFN	Encoder reference signal positive

Table 13: Pin assignment X17 (Sensor)

3.1.13 Jumper J1 – J5

Jumper	Name	Meaning
J1	Pin 1 → BiSS / SSI (ENABLE) Pin 2 → GND	Open → BiSS / SSI not active Closed → BiSS / SSI active (LD1 active)
J2	Pin 1 → USB (ENABLE) Pin 2 → GND	Open → USB not active Closed → USB active (LD2 active)
J3	Pin 1 → GND Pin 2 → SPI (ENABLE)	Open → SPI not active Closed → SPI active (LD3 active)
J4	Pin 1 → 5V Pin 2 → SVCC Pin 3 → 3V3V	Pin 1 – Pin 2 → 5VDC power supply on X6 Pin 2 – Pin 3 → 3.3VDC power supply on X6
J5	Pin 1 → 5 VDC Pin 2 → LSB	Open → for 5 VDC sensor systems (amplification factor 0,66) Closed → for 3.3 VDC sensor systems (amplification factor 1)

Table 14: Jumper J1 – J5

3.2 Switches and Buttons

Switches	Function	Meaning
S1	Button Reset → reset demoboard	Initialisation of GC-IP201(B) and selected interfaces
S2	Switch 1 → TPP(0) / HWA(0) Switch 2 → TPP(1) / HWA(1)	Configuration edge interval / hardware address Configuration edge interval / hardware address
S3	Switch 1 → GAIN(0) / HWA(2) Switch 2 → GAIN(1) / HWA(3)	Configuration ABZ mode / pulse to reset counter Configuration ABZ mode / pulse to reset counter
S4	Switch 1 → CFGPIN Switch 2 → –	Choice between EEPROM or Pin config → off = configuration via EEPROM (CFGPIN = low)
S5	Button Teach	Current counter value is stored for zero value
S6	Button Zero	Reset counter value
S7	CFGDH/TRG	Digital hysteresis – Bit 0 / trigger signal
S8	CFGMODE0/TEACH	ABZ mode – Bit 0 / pulse to store the counter value
S9	CFGMODE1/ZERO	ABZ mode – Bit 1 / pulse to store the counter value
S10	CLKSEL / CLK	Selection between internal / external clock

Table 15: Switches and buttons

<u>Information for configuration of switches S7 – S9:</u>

To transmit pulses like TRG, TEACH and ZERO the position of the switches has to be correct to there appendent PCB label. If these switches are in AGND position the appendent pin has a low level signal.

3.3 LEDs

LED	Value	Meaning
LD1		LED off → BiSS / SSI not active LED on (yellow) → BiSS / SSI active
LD2		LED off → USB not active LED on (yellow) → USB active
LD3		LED off → SPI not active LED on (yellow) → SPI active
LD4		LED off → no error signal at NERROR LED on (red) → error signal at NERROR → error has accord
LD5		LED off → no supply voltage LED on (green) → supply voltage ok
LD6		LED off → error signal at NERROR → error has accord LED on (green) → no error signal at NERROR

Table 16: LEDs

4 Characteristic Values

Characteristic values	Min.	Typ.	Max.	Unit
Supply voltage	4.75	5.0	5.5	VDC
Supply voltages (internal)		3.3 / 5.0		VDC
Encoder voltages I/O		3.3 / 5.0		V
Current consumption		92*		mA
Operating temperature	0		70	°C
Frequency (internal)	35	40	45	MHz
Frequency (external)	4		40	MHz
Mid-voltage V0 of GC-IP201(B)	1.08	1.1	1.12	V
* Power supply over external adapter with 5 V sensor system!				

Table 17: Characteristic values

5 Software – IP201-Monitor

5.1 Overview

The software "***IP201-Monitor***" is used to control and visualize all parameters and values of GC-IP201(B) and was developed for Windows based PC systems. The GP-IP201 has to be connected via USB cable to the PC. (USB port pc → X14)

Optionally the configuration using the software is also possible via the BiSS interface with an appropriate BiSS adapter (iC-MB4U).

5.2 System Requirements

To ensure that the software is running smoothly the following system 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

5.3 Installation

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

5.4 Program Structure

The graphical interface of the configuration program is divided into a dialog bar, a status bar, and the two areas for the display of the measured values. The dialog bar is located directly below the toolbar. In this area, the interface SPI or BISS is selected. Furthermore, a measurement can be started here and the time for the interrogation interval can be selected; it is also possible to trigger commands (for example to reset the counters). The measured values and status information of the GC-IP201(B) 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. Once the hardware is detected according to the selected interface, its identifier is displayed in the status bar. If the demo board is properly connected and enabled, the status bar additionally displays the circuit name (eg: "IC: GC-IP201"). If no IC was detected, "unknown" appears.

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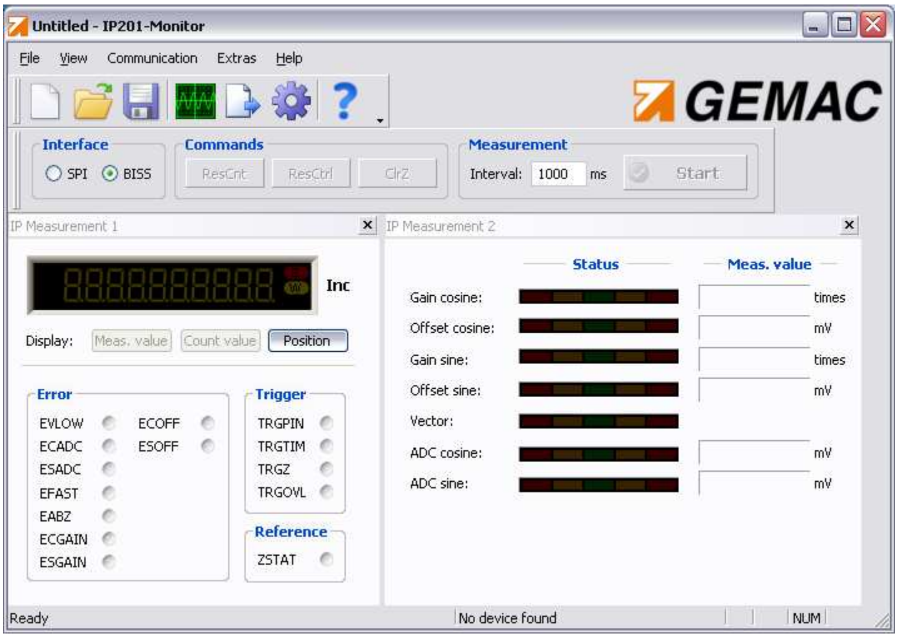
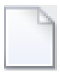
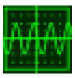


Figure 5: IP201-Monitor – start window

When using the BiSS interface, it is necessary that the connections between circuit and interface and between the interface and PC exist to enable the software to find the hardware during the scan for new devices. It may be necessary to change the interface selection after connecting the hardware to restart the device scan.

5.5 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 5.9)
	Export	Export of measurement values into file.
	Configuration	Open the configuration menu. (chapter 5.8)
	Information	Details to software, firmware and hardware.

5.6 Assistance

During development of the configuration program special attention was paid to a clear and self-explanatory graphical user interface. Many elements of the user interface show detailed explanations once you position the mouse pointer on them (tooltip or status text).

The settings made in the program can be saved in a setup document with the extension “.ip201” and restored if necessary.

5.7 Measurement

Once the GC-IP201(B) is connected to a PC and has been detected by the software, a live-measurement can be started by pressing button “Start”. This will also refresh the displays in both windows 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.

5.7.1 IP-Measurement 1

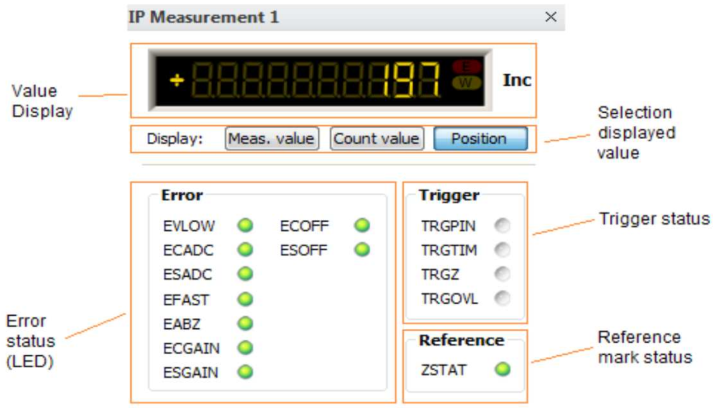


Figure 6: Measurement Interpolation 1

If a measurement is started, the actual counter value is displayed in the window IP-Measurement 1. A selection between measured value (register `MVAL` of the GC-IP201(B)), counter value (register `CNT`) and position (register `POSIT`, see register description in the data sheet of GC-IP201(B)) can be made. If the option position is selected, the single and multiturn information is displayed according to the circuit configuration (registers `CFGBISS/MTBIT`, `CFGBISS/STBIT`).

The presentation 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 in the status register `STAT` of the GC-IP201(B). The meaning of the LEDs is shown in table 18. The status-LEDs are described in table 19.

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 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 be also set, if the interpolation rate or the minimum edge interval t_{PP} is changed. Detection of this error has to be deactivated for using the GC-IP201(B) 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 18: Error 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 became 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-IP201(B) and scale work synchronous. Inactive: The reference mark of the scale was not passed yet or the relation between counter value and reference mark was lost due to an error.

Table 19: Status LEDs

5.7.2 IP-Measurement 2

At window IP-Measurement 2 the quality of the sensor signals is displayed at the "LED-bars" according to the regulator parameters. Also the input amplitude on the A/D-converters are monitored, so that an eventually occurring overload on the ADC could be displayed in the software.

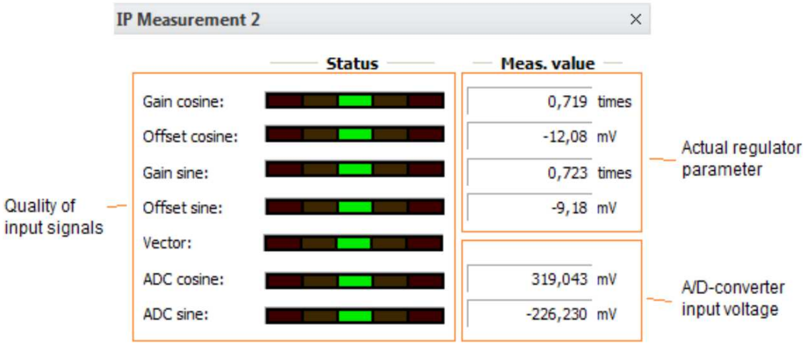


Figure 7: Measurement Interpolation 2

The meaning of the display elements is described in table 20 and 21.

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 20: 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

Table 21: Range for sensor monitoring

5.8 Configuration

Once the circuit GC-IP201(B) has 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).

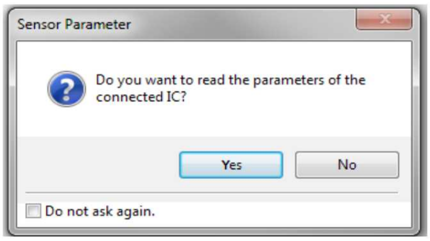


Figure 8: Read configuration

5.8.1 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 makes it possible to switch the basic functions of the GC-IP201(B) without much effort.

The settings selected for the EEPROM of the GC-IP201(B) are saved by clicking on the "Program" button. The "Verify" button can be used for comparison of the data displayed in software and the data in the EEP-ROM of the GC-IP201(B). If any differences are detected, it is possible to read out the EEPROM values by clicking on the "Read" button.

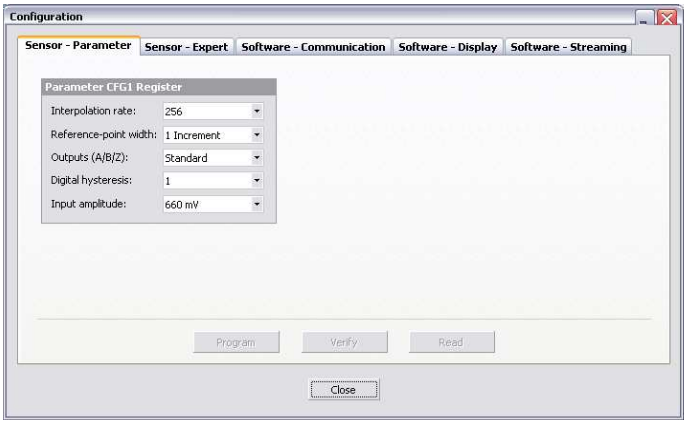


Figure 9: Sensor Parameter

For further configuration of GC-IP201(B) the tab "Sensor - Expert" is designed. This is directly based on the definitions in the configuration registers CFG1-3 and CFGBiSS, which can also be programmed individually. A detailed description and explanation of each parameter can be found in the data sheet of GC-IP201(B). Reading, programming and verifying the parameters can be carried out analogously to the procedure of sensor parameter tab.

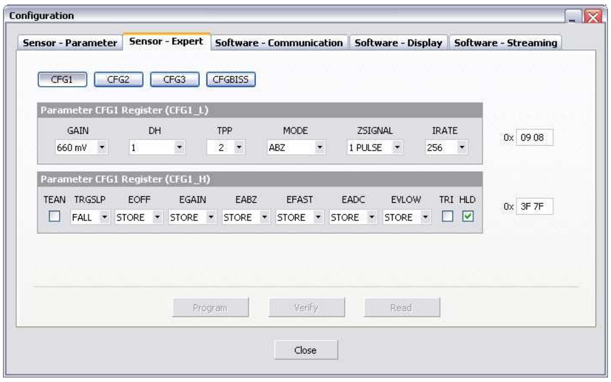


Figure 10: Sensor-Expert - CFG1

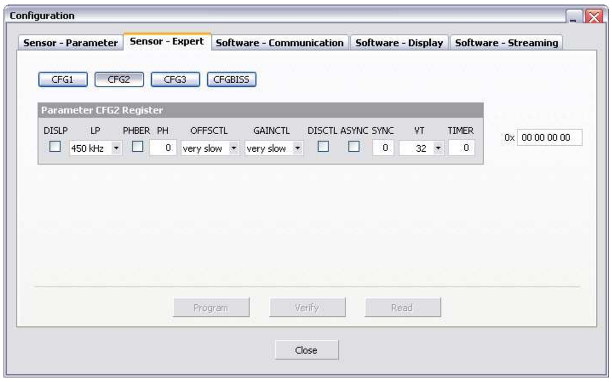


Figure 11: Sensor-Expert - CFG2

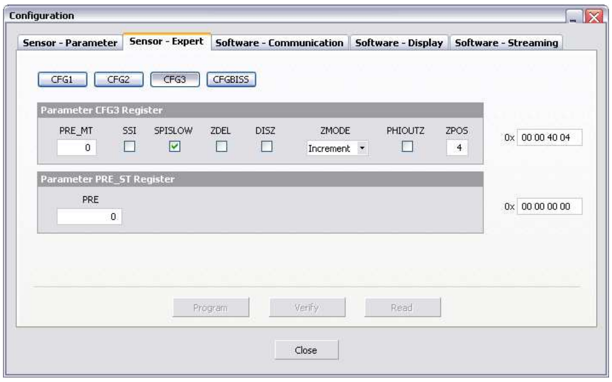


Figure 12: Sensor-Expert - CFG3

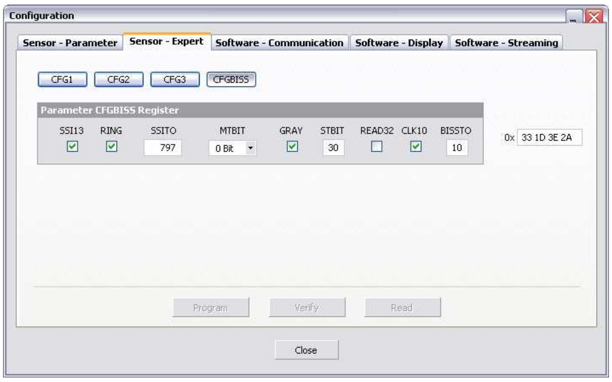


Figure 13: Sensor-Expert - CFGBiSS

5.8.2 Software – Communication

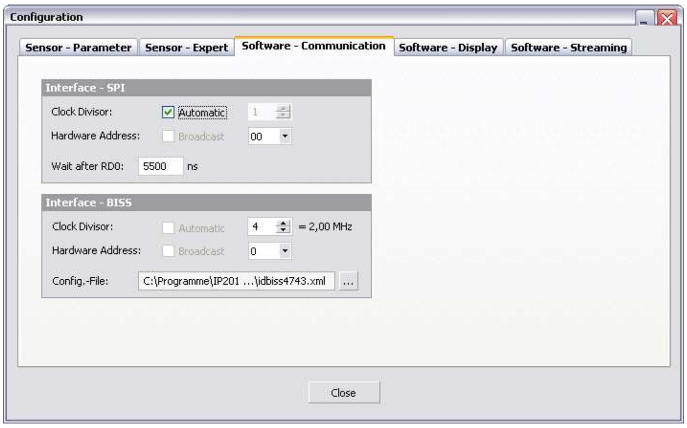


Figure 14: Software - Communication

This tab is used to adjust the settings for the communication interfaces SPI and BiSS. In addition to the clock setting for the interface, it is also possible to enter the hardware address for the use of several slaves on the bus.

It is also possible to specify the waiting time after read access for the SPI interface (for further information refer to the data sheet of GC-IP201(B)).

In the area for BiSS interface, the XML configuration file (idbiss4743.xml) must be specified to enable the software to identify the IC and configure the BiSS master.

5.8.3 Software – Display

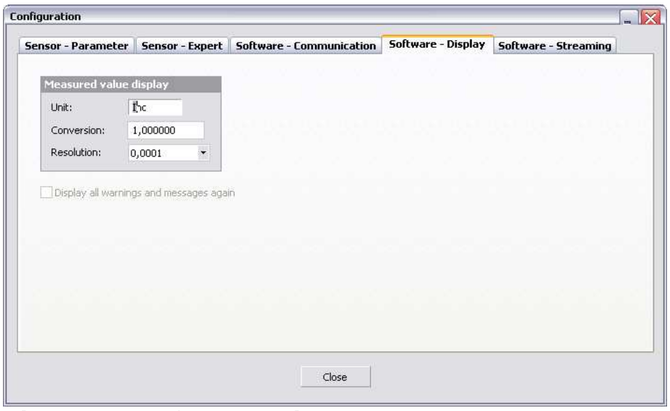


Figure 15: Software - Display

The tab "Software - Display" is used to set a user defined conversion factor and unit for the displayed measurement value (IP Measurement 1).

Furthermore, any warning and information dialogs which were possibly hidden by the user can be reactivated here.

5.8.4 Software - Streaming

The Streaming tab offers the possibility to set parameters for recording the measurement values of GC-IP201(B) such as corrected and uncorrected ADC values, PHI and BQ. The data is recorded by starting a measurement in the main window. The data can then be exported using the export feature (Tools -> Export).

Thus, it is possible to evaluate, edit and document the data later. The recorded data can be visualized simultaneously in the oscilloscope view.

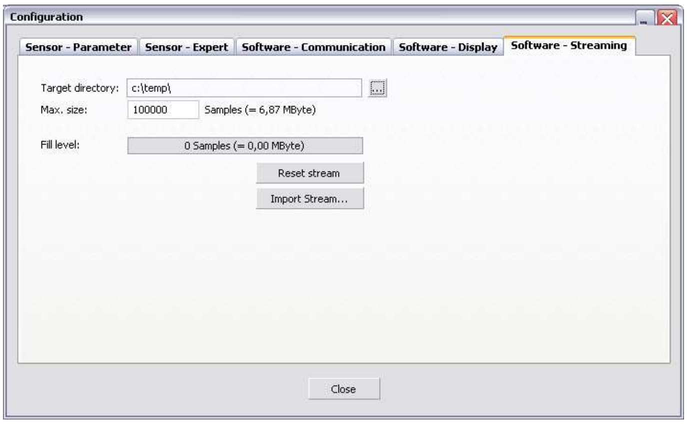


Figure 16: Software Streaming

5.9 Oscilloscope

The software also provides the ability to show signals and parameters of the GC-IP201(B) like ADC values graphically. Generally, it is possible to switch between the time-based mode and the XY representation.

Note:

When operating using the BiSS interface only the position data (single-turn, multi-turn and error bits) are read from the circuit during the measurement. Therefore, the indicators for input signal control in the main window are not displayed in the BiSS mode, nor can the signals be tracked in the oscilloscope view.

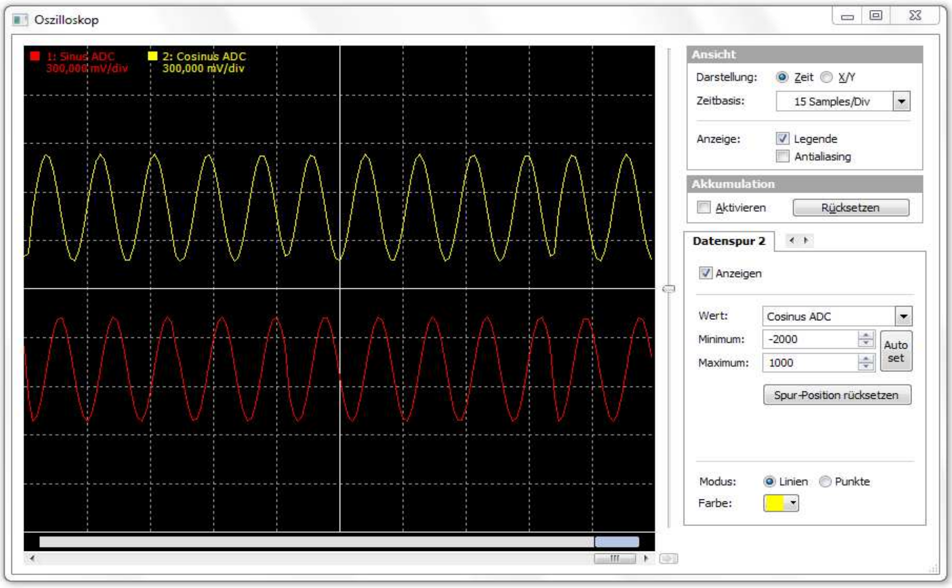


Figure 17: Oscilloscope - time graphic

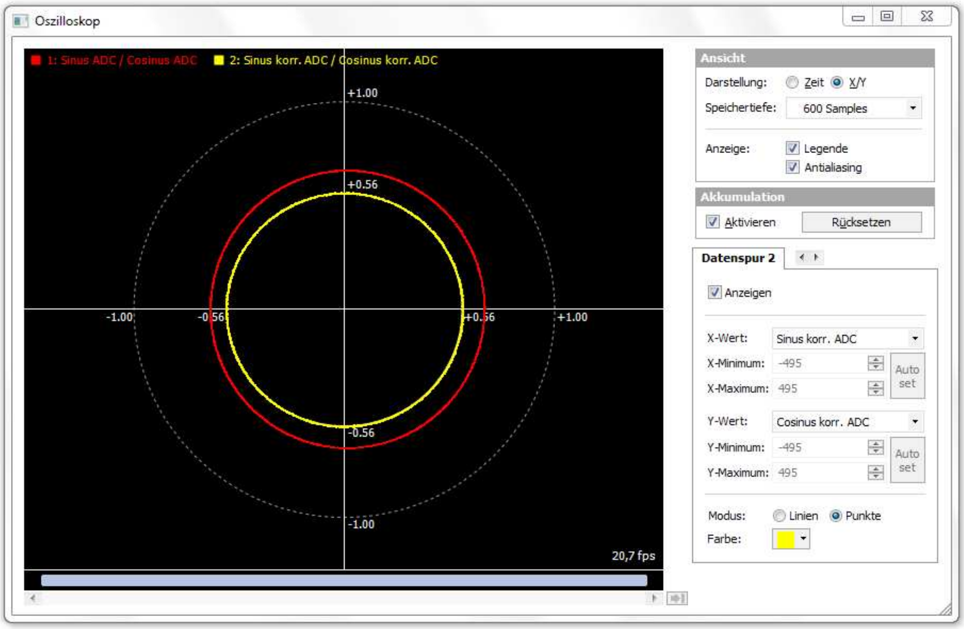


Figure 18: Oscilloscope - XY graphic

6 Quick start

Quick start initial configuration:

- Power supply for demoboard via USB
- Sensor with 5 VDC supply voltage
- Sensor with differential signals (Figure 19)
- Internal clock of GC-IP201(B) is used
- The starting configuration is read from the internal EEPROM of the GC-IP201(B)
- Installation of the software as described in point 5.3
- Additional configuration and data acquisition via USB and software

Board-Configuration:

Jumper J1 open → SSI/BiSS interface inactive
Jumper J2 closed → USB interface active (LD2 lights)
Jumper J3 open → SPI interface inactive
Jumper J4 open 1–2 → sensor power supply with 5 V
Jumper J5 open → amplification of GC-LS is 0.66
Jumper X7 open → GC-IP201(B) is not in reset
Jumper X12 open 1–2 → Internal clock of GC-IP201(B) is used
Switch S2 and S3 at off → hardware address 0
Switch S4 (CFGPIN) at off → configuration from EEPROM
Switch S7, S8 and S9 settings at TRG, TEACH, ZERO
Sensor connected at SubD - connector X6

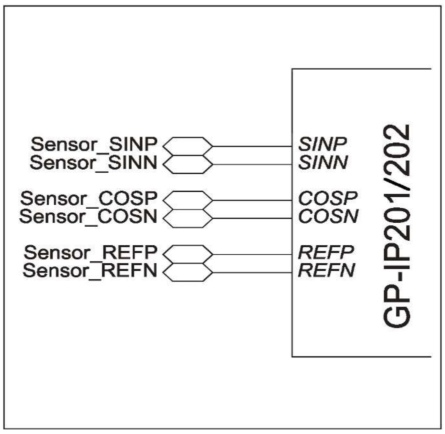


Figure 19: Differential input signals

7 Start up Behaviour

The demo board GP-IP201 is immediately ready for operation after connecting the power supply and the GC-IP201(B) is initialized with the default settings from the internal EEPROM or by way of the configuration pins. The description of the configuration from the EEPROM is explained in detail in the data sheet of GC-IP201(B).

7.1 Power Supply

The demo board is powered by connecting a 5 V DC voltage to X15 or X13. When using the USB interface at X14, power is supplied directly via USB.

7.2 Interface Selection

The serial interfaces USB, SPI or BiSS can be selected on the demo board via J1, J2 and J3 (Table 14).

7.3 Input Signals

The connection of the sine, cosine and reference signals to the GP-IP201 is possible via the 15-pin SUB-D connector X6 (Table 7) or on the pin strip X17 (Table 13).

On the demo board sensors with 5 V or 3.3 V supply voltage can be connected directly. Both single-ended and differential sensor signals can be processed. The following figures show an example of the connection of different sensor types (see also section 3.1.6).

Sensor with differential output signals

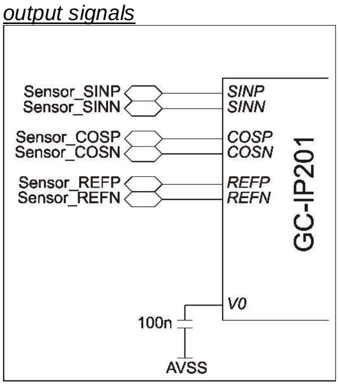


Figure 20: Sensor connection (1)

- The amplitude of the sensor and the gain factor of GC-IP201(B) are adapted by configuration bits GAIN(1:0).
- Reference level V0 is generated internally.

Sensor with single-ended output signals (1)

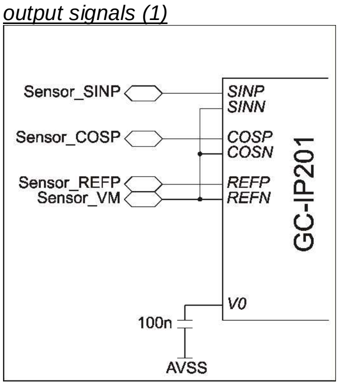


Figure 21: Sensor connection (2)

- The amplitude of the sensor and the gain factor of GC-IP201(B) are adapted by configuration bits GAIN(1:0).
- Reference level V0 is provided by the sensor.

Sensor with single-ended output signals (2)

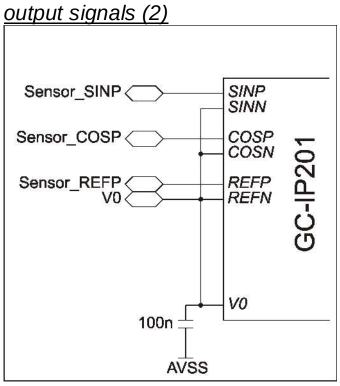


Figure 22: Sensor connection (3)

- The amplitude of the sensor and the gain factor of GC-IP201(B) are adapted by configuration bits GAIN(1:0)
- Reference level V0 is generated internally and connected to the sensor.

A detailed description can be found in the data sheet of GC-IP201(B).

7.4 Sensor Connection

7.4.1 Supply Voltage

Before connecting a sensor to the demo board, the GP-IP201 supply voltage for the sensor based on jumper J4 is set. A distinction is made between 5 V and 3.3 V types:

Sensor power suply	Configuration jumper J4	Meaning
5 VDC	Pin 1 – Pin 2	5 VDC power supply on X6 and X17
3.3 VDC	Pin 2 – Pin 3	3.3 VDC power supply on X6 and X17

Table 22: Sensor connection

7.4.2 Configuration of the Nominal Amplitude / Gain Setting

For the adjustment of the analog input stage of the amplitude of the input signals, the gain setting of the GC-IP201(B) must be made. 5 V systems typically operate with higher signal amplitude compared to 3.3 V systems. The level converter circuit GC-LS on the demo board allows adjusting the amplitude of the input stage of the GC-IP201(B). For this, the gain of the GC-LS can be switched from 1 to 0.66 by jumper J5. The following table shows the configuration of the GC-LS and the gain setting for the GC-IP201(B) for different input signals.

Input voltage $U_{DiffNom}$ nominal (mVpp)	Sensor supply voltage (typical)	GC-LS		Gain-adjustment	
		Amplification	Jumper J4	GAIN1	GAIN0
1000	5V	0.66	OFF	0	0
660	3.3V	1	ON	0	0
500	5V	0.66	OFF	0	1
330	3.3V	1	ON	0	1
240	5V	0.66	OFF	1	0
160	3.3V	1	ON	1	0
80	5V	0.66	OFF	1	1
50	3.3V	1	ON	1	1

Table 23: Configuration for different input amplitudes

7.5 GC-IP201(B) - Circuit Configuration

For the configuration of the circuit GC-IP201(B) it is helpful to distinguish between the initialization via internal EEPROM and the pin configuration. The selection is made via the switch CFGPIN (S4).

CFGPIN (S4)	Voltage level at Pin CFGPIN	Meaning
ON	VDD	The initialization of the circuit is based on the configuration pins. For the rest of the configuration, the default settings are used.
OFF	VSS	The configuration of the circuit is made from the internal EEPROM.

Table 24: Configuration source selection

During the initialization of GC-IP201(B) from the EEPROM (CFGPIN = 0) the hardware address for the SPI communication can be set using the switches S2 and S3. Thus, several ICs can be connected to a SPI interface. For configuring via pins (CFGPIN = 1) the GC-IP201(B) uses always the hardware address '0000 '. Detailed register description of the internal EEPROM in data sheet of GC-IP201(B)

The following settings are available for the pin configuration:

Adjustment	Switch
Mode	S8, S9
Signal amplitude nominal	S3
Minimum edge distance t_{pp}	S2
Digital hysteresis	S7

Table 25: Adjustment for pin configuration

CFGMODE1 (S9)	CFGMODE0 (S8)	Mode	Meaning
0 (AGND)	0 (AGND)	Standard-ABZ	Standard-Mode, ABZ square wave signals at the output
0 (AGND)	1 (TEACH)	Sensor adjustment 1	Reference signal width adjustment, offset adjustment (see data sheet GC-IP201(B))
1 (ZERO)	0 (AGND)	Sensor adjustment 2	Phase & amplitude adjustment (see data sheet GC-IP201(B))
1 (ZERO)	1 (TEACH)	Sensor adjustment Z	Reference signal adjustment (see data sheet GC-IP201(B))

Table 26: Configuration ABZ modes

GAIN1 (S3)	GAIN0 (S3)	Meaning
0 (OFF)	0 (OFF)	Input voltage $U_{DiffNom}$ nominal 660mV_{pp}
0 (OFF)	1 (ON)	Input voltage $U_{DiffNom}$ nominal 330mV_{pp}
1 (ON)	0 (OFF)	Input voltage $U_{DiffNom}$ nominal 160mV_{pp}
1 (ON)	1 (ON)	Input voltage $U_{DiffNom}$ nominal 50mV_{pp}

Table 27: Configuration nominal input amplitude

TPP1 (S2)	TPP0 (S2)	Meaning
0 (OFF)	0 (OFF	Minimum edge distance tpp = 1/f_{OSZ}
0 (OFF	1 (ON)	Minimum edge distance tpp = 2/f_{OSZ}
1 (ON)	0 (OFF	Minimum edge distance tpp = 4/f_{OSZ}
1 (ON)	1 (ON)	Minimum edge distance tpp = 8/f_{OSZ}

Table 28: Configuration minimum edge distance

CFGDH (S7)	Meaning
0 (AGND)	Digital hysteresis inactive
1 (TRG)	Digital hysteresis active

Table 29: Configuration digital hysteresis

8 Notes