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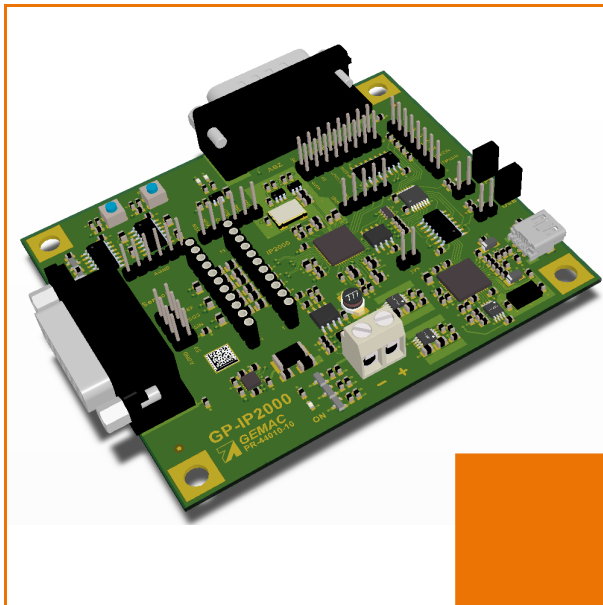
Sensorik. Messtechnik. ASIC-Design.

User Manual

GP-IP2000

Version: 1.0

Date: 17.09.2014



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Revision Overview

Date	Revision	Change(s)
17.09.14	1.0	First version

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1 Overview

The demo board GP-IP2000 serves to demonstrate and evaluate the functionality of the GEMAC interpolation circuit GC-IP2000. Several configuration options and connectors can be used to easily adapt the GC-IP2000 to a wide range of customers applications.

With the GC-IP2000 integrated circuits, analog sinusoidal and cosinusoidal input signals can be divided into small digital increments with an interpolation rate up to 2048. The GP-IP2000 is designed to connect analog encoders with voltage or current interface as well as photo diode arrays and several measuring bridges directly to the board. The demo board may operate with both single-ended and differential input signals.

The configuration & evaluation of the GC-IP2000 is possible either via USB- or SPI- interface. Therefore the software “IP2k-Monitor” is available. The digital RS422 output interface is suitable for any fast digital counter and quadrature encoder interfaces. A dedicated SPI interface gives the user full access to the internal measurement and configuration registers.

The demo board can be powered with the operating voltage via USB, a power adapter (screw clamp) or the connected SPI interface.

The desired interface (USB or SPI) can be selected by way of the appropriate jumper.

The supply voltage for the connected sensor is 5V.

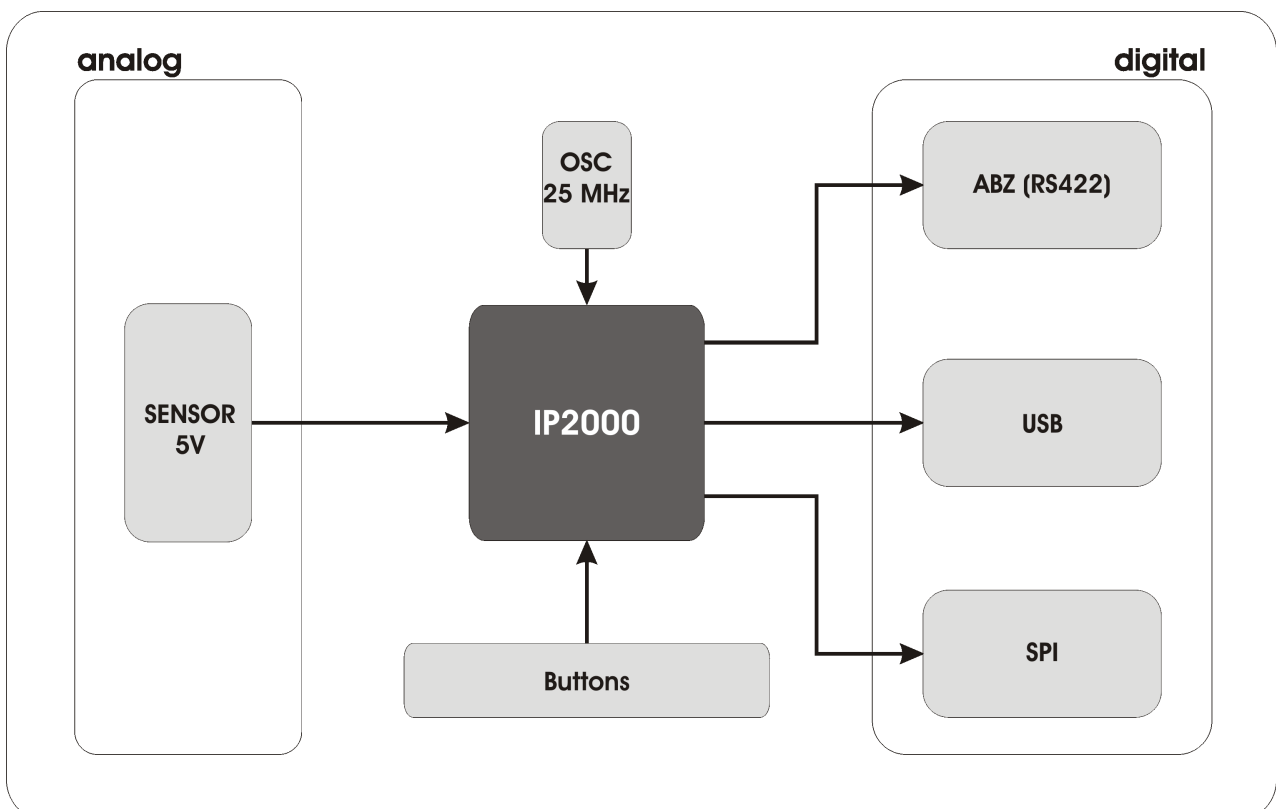


Figure 1: Block diagramm

2 Features

Interfaces	
Analog input	Sine- / Cosine- / Reference signal; differential or single-ended* Nominal amplitude configurable to 1 Vpp / 500 mVpp / 250 mVpp / 75 mVpp Maximum input frequency 260 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 Data rate up to 500.000 measuring values/s Standard SPI compatible: 16 Bit, MSB first, up to 25MHz 5V oder 3,3V interface
Further inputs	Trigger signal for measured value storage Reset signal for the reset of the GC-IP2000
Configuration options	Internal EEPROM Serial interface (SPI)
* external modulation necessary (negative inputs SINN, COSN, REFN to mid-voltage V0)	
Interpolation / Signal processing	
Interpolation rates	100 / 128 / 200 / 256 / 400 / 500 / 512 / 800 / 1000 / 1024 / 1600 / 2000 / 2048
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 40 step potentiometer for phase correction; adjusting range ±5° or ±10° Monitoring and evaluation of the input signal quality Programmable reaction to sensor errors LED control signal
Suppression of disturbances	Adjustable low pass filter Digital hysteresis for edge noise suppression at the output
Others	2-step measured value trigger Programmable timer Delay time between sampling and measured value constant 5 µs for all resolutions
Main Features	
Power supply voltage	5 VDC
I/O voltage, digital	3,3 VDC or 5 VDC
Temperature range	0 ... 70°C
Dimensions GP-IP2000	PCB 80 mm x 95 mm
Interface frequency	SPI 25 MHz (15 MHz via on-board USB SPI converter)

Table 1: Features

Detailed description of all functions of the circuit GC-IP2000 can be found in the datasheet, as download available on our Website www.gemac-chemnitz.de/en/products/interpolation.

3 Hardware

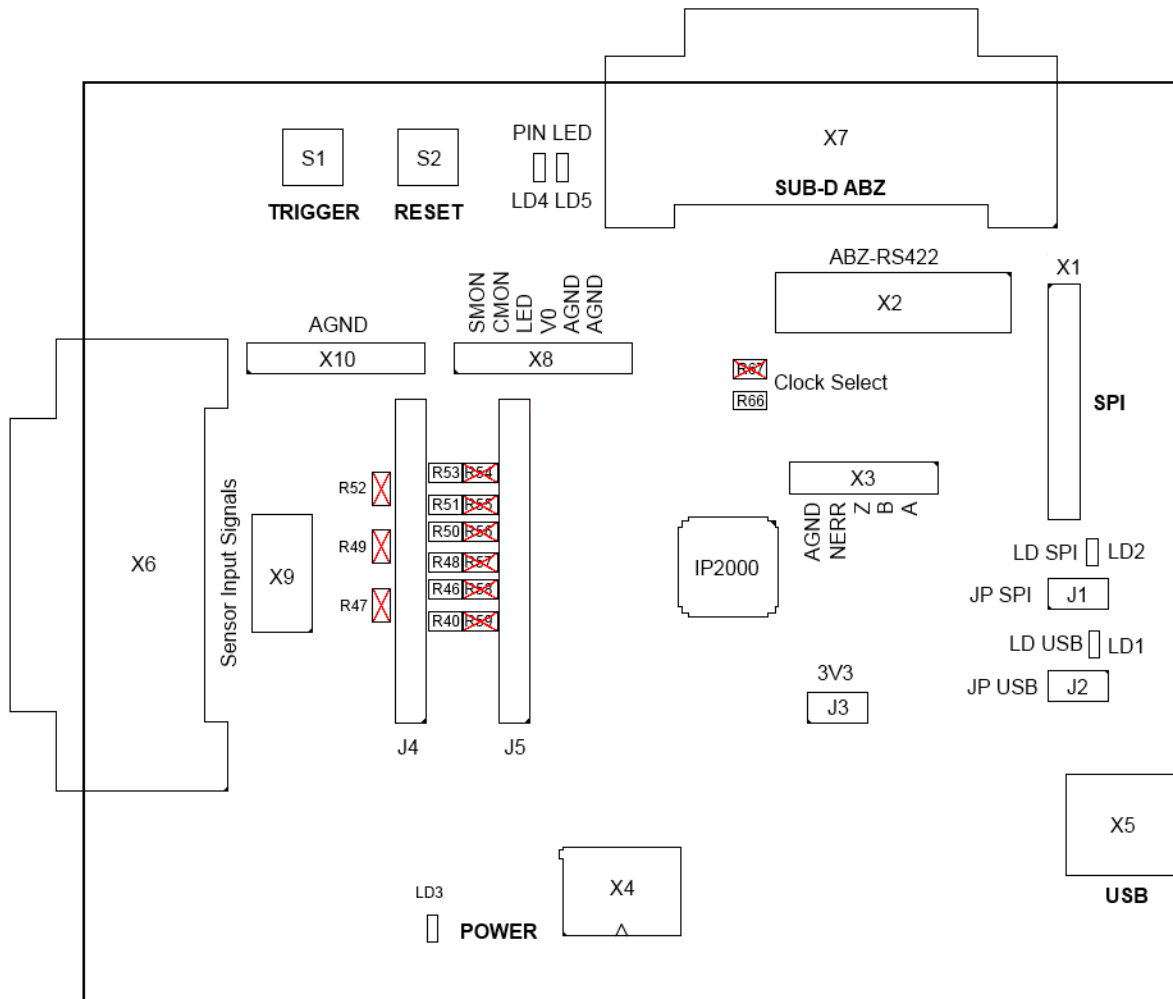


Figure 2: Demoboard GP-IP2000

3.1 Connections

3.1.1 Pin assignment X1 (SPI)

Pin	Name	Meaning
1	5V	Unit power supply 5 VDC / 3,3 VDC
2	SCK	SPI Clock
3	MISO	SPI MISO
4	MOSI	SPI MOSI
5	SEN	SPI Enable
6	NRESIN	Reset-Pin GC-IP2000
7	NTRIGIN	Trigger-Pin GC-IP2000
8	GND	Ground

Table 2: Pin assignment SUB-D X1 (SPI)

3.1.2 Pin assignment X2 (ABZ-RS422, Control, Clock)

Pin	Name	Meaning
1	AP	Square wave output A positive
2	AN	Square wave output A negative
3	BP	Square wave output B positive
4	BN	Square wave output B negative
5	ZP	Square wave output Z positive
6	ZN	Square wave output Z negative
7	EP	Error output NERR positive
8	EN	Error output NERR negative
9	NTRIGIN	Pin for Trigger signal to GC-IP2000
10	NRESIN	Pin for reset signal to GC-IP2000
11	CLKIN	Optional for applying an external clock signal
12	CLKOUT	Actual clock signal source of the GC-IP2000
13	5V	Unit power supply 5 VDC / 3.3VDC
14	5V	Unit power supply 5 VDC / 3,3 VDC
15	GND	Ground
16	GND	Ground

Table 3: Pin assignment X2 (ABZ-RS422, Control, Clock)

3.1.3 Pin assignment X3 (ABZ GC-IP2000)

Pin	Name	Meaning
1	A	Square wave output A directly at GC-IP2000
2	B	Square wave output B directly at GC-IP2000
3	Z	Square wave output Z directly at GC-IP2000
4	NERR	Square wave output NERR directly at GC-IP2000
5	AGND	Ground

Table 4: Pin assignment X3 (ABZ GC-IP2000)

3.1.4 Pin assignment X4 (Power)

Pin	Name	Meaning
1 (-)	GND	Ground connecting power supply
2 (+)	5V	Connection for power supply 5 VDC / 3,3 VDC

Table 5: Pin assignment X4 (Power)

3.1.5 Pin assignment SUB-D X6 (Sensor)

Pin	Name	Meaning
1	SINP	Encoder signal sine positive
2	GND	Ground
3	COSP	Encoder signal cosine positive
4	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	Ground
11	COSN	Encoder signal cosine negative
12	5V	Encoder power supply 5 VDC / 3,3 VDC
13	-	-
14	REFP	Encoder signal reference positive
15	-	-

Table 6: Pin assignment SUB-D X6 (Sensor)

Instructions for adjusting the sensor encoder signals:

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

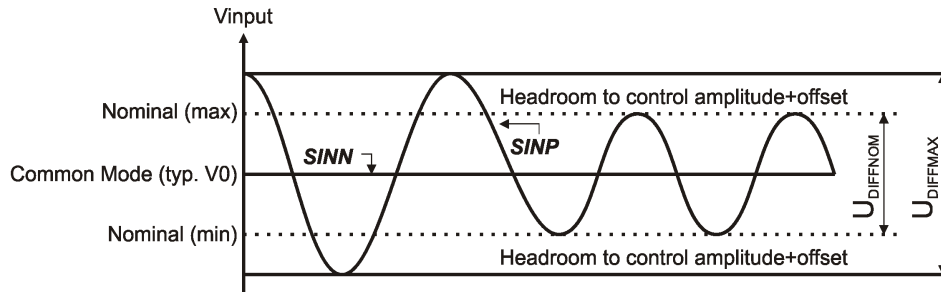


Figure 3: Adjustment single-ended input signals

Adjustment for differential encoder signals:

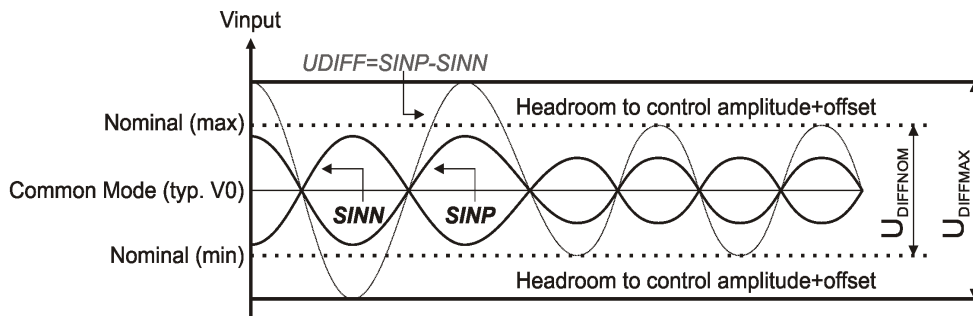


Figure 4: Adjustment differential input signals

Detailed description at data sheet GC-IP2000, chapter 6.1 Input amplifier.

3.1.6 Assignment SUB-D X7 (ABZ)

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	NTRIGIN	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 7: Pin assignment SUB-D X7 (ABZ)

3.1.7 Pin X8 (Monitoring signals)

Pin	Name	Meaning
1	SMON	Monitoring point for sine-monitoring signal at GC-IP2000
2	CMON	Monitoring point for cosine-monitoring signal at GC-IP2000
3	LED	LED-Pin of GC-IP2000
4	V0	Mid-voltage monitoring signal at GC-IP2000
5	AGND	Ground
6	AGND	Ground

Table 8: Pin X8 (Monitoring signals GC-IP2000)

3.1.8 Pin X9 (input signals at GC-IP2000)

Pin	Name	Meaning
1	5V	5V supply (Output)
2	AGND	Ground
3	SINP	Sine signal positive at GC-IP2000-input
4	SINN	Sine signal negative at GC-IP2000-input
5	COSP	Cosine signal positive at GC-IP2000-input
6	COSN	Cosine signal negative at GC-IP2000-input
7	REFP	Reference signal positive at GC-IP2000-input
8	REFN	Reference signal negative at GC-IP2000-input

Table 9: Input signals X9

3.1.9 Pin X10 (AGND)

Pin	Name	Meaning
1 - 6	AGND	Ground

Table 10: Pin X10 (AGND)

3.1.10 Jumper

Jumper	Name	Meaning
J1	Pin 1 → SPI (ENABLE) Pin 2 → 3V3	Open → SPI not active Closed → SPI active (LD2 active)
J2	Pin 1 → USB (ENABLE) Pin 2 → DGND	Open → USB not active Closed → USB active (LD1 active)
J3	Pin 1 + 2	3,3V supply (Output)
J4 + J5	Pin 1 + 2 → 5V supply (Output) Pin 3 → V0 Pin 4 → SINP Pin 5 → SINN Pin 6 → COSP Pin 7 → COSN Pin 8 → REFP Pin 9 → REFN Pin 10 + 11 → analog ground	Slot for additional module

Table 11: Jumper

3.2 Switches and LEDs

3.2.1 Switches

Switch	Name	Meaning
S1	TRIGGER	Trigger signal to the GC-IP2000
S2	RESET	Reset signal to GC-IP2000

Table 12: Switches

3.2.2 LEDs

LED	Value	Meaning
LD1		LED off → USB not active LED on (yellow) → USB active
LD2		LED off → SPI not active LED on (yellow) → SPI active
LD3		LED off → no operating voltage supply LED on (green) → operating voltage supply ok
LD4 + LD5		Status LED-Pin of GC-IP2000* red LED on → low level at LED-Pin green LED on → high level at LED-Pin

* For further details about LED-Pin see data sheet GC-IP2000, chapter 6.5.3

Table 13: LEDs

3.3 Resistor configuration

3.3.1 Adjustment of sensor connection

On the demo board, it is possible to adjust the input circuit of the GC-IP2000 to the output signals of the connected sensor. The required configurations can be set by the resistors R40 and R46 - R59. At the references R47, R49 and R52, terminating impedances can be soldered optionally. The position of the individual components is displayed in Figure 2.

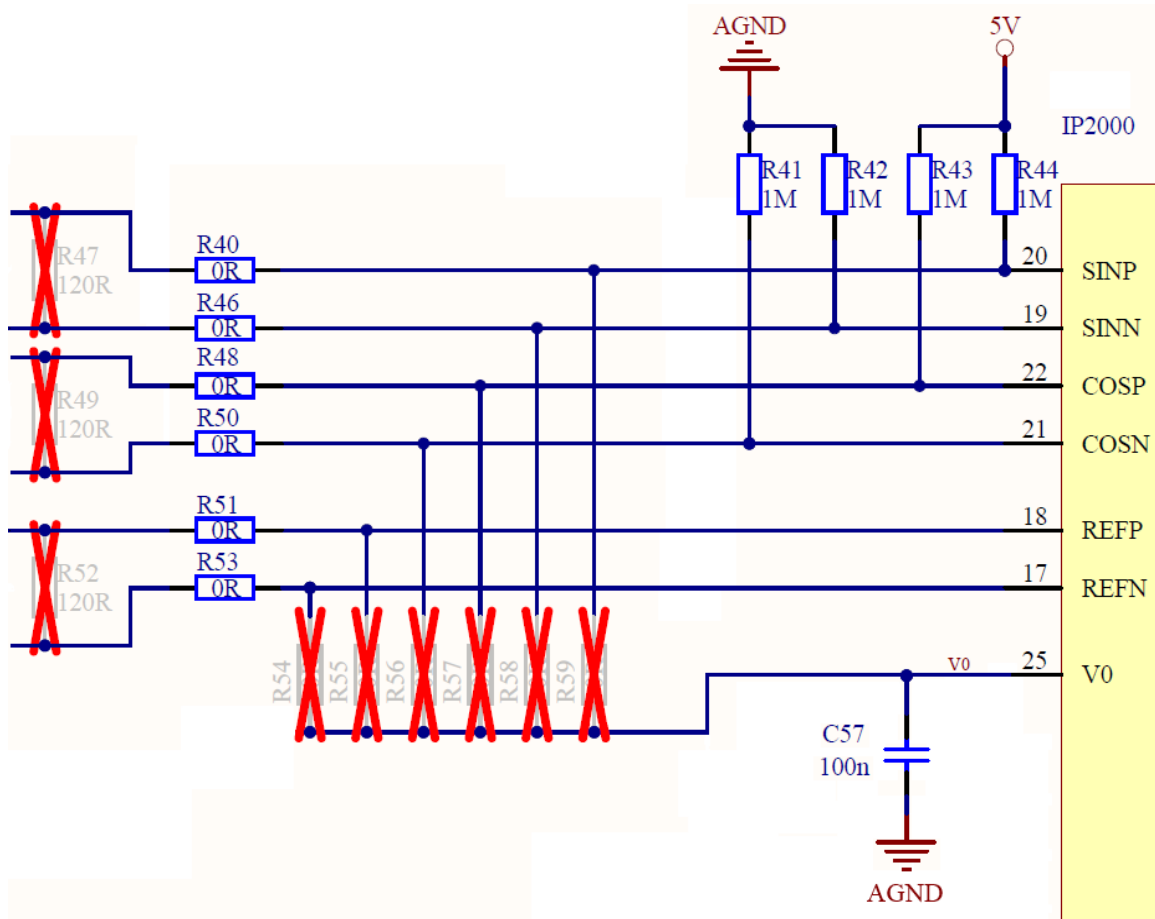


Figure 5: Resistor configuration input

3.3.2 Configuration of clock source

The demo board allows to operate the GC-IP2000 with either the on-board oscillator (25MHz) or use an external clock source. To set the particular configuration, the two resistors R66 and R67 can be fitted depending on the desired clock source. The position of the two resistors is displayed in Figure 2.

5 Software - IP2k-Monitor

5.1 Overview

The control and visualization of the parameters and characteristics of the GC-IP2000 is realized via the IP2k monitor software. The software is designed for Windows operating systems and communicates directly via USB (by the on-board USB to SPI converter) to the circuit.

5.2 System requirements

In order to ensure the proper execution of the program, your PC or Notebook should not fall below the minimum hardware requirements and have one of the listed operating systems:

■ Hardware requirements

- Processor: 2 GHz or higher (recommended: multi-core system)
- min. 512 MB RAM
- min. 1 GB free hard disc space (for measurement data)
- Graphic card with 24 bit colour depth (recommended: 32 bit)
- Resolution: 1024x768 Pixel or higher
- free USB-port

■ Compatible operating systems¹:

- Microsoft Windows® 2000
- Microsoft Windows® XP
- Microsoft Windows® Server 2003
- Microsoft Windows® Vista
- Microsoft Windows® 7
- Microsoft Windows® 8

5.3 Installation

The installation of the software and the required USB drivers of the demo board is carried out via the executable file (installer): 44025-SW-XX-IP2k monitor Setup.exe (see www.gemac-chemnitz.de/en/products/interpolation)

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

6 Quickstart

Quick start initial configuration:

- Power supply for demoboard via USB
- Sensor with 5VDC supply voltage
- Sensor with differential output signals (Figure 7)
- Onboard clock of GC-IP2000 is used
- The starting configuration is read as standard configuration from the EEPROM
- PC-Software installation as explained in point 5.3
- Additional configuration and data acquisition via USB and software

Board-Configuration:

Jumper J1 open → SPI interface inactive, Jumper J2 closed → USB interface active (LD1 lights when demo board is detected by software) Sensor is connected to SubD-Connector X6

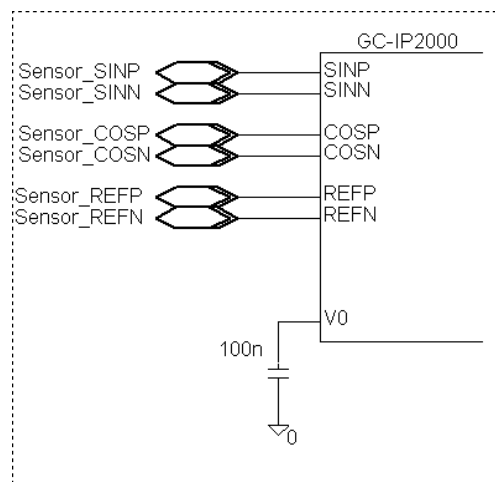


Figure 7: Differential input signals

7 Start up procedure

The demo board GP-IP2000 is prepared to be ready for operation after connecting the power supply and the GC-IP2000 is initialized with the default settings from the external EEPROM. The description of the configuration from the EEPROM is explained in detail in the data sheet.

7.1 Power supply

The demo board can be powered by connecting a 5V DC voltage on X4. When using the USB interface on X5, power is supplied directly via USB. Alternatively, the supply via the corresponding pins at the interfaces X1, X2 and X7 is possible (see respective pin assignment in chapter 3.1).

7.2 Interface selection

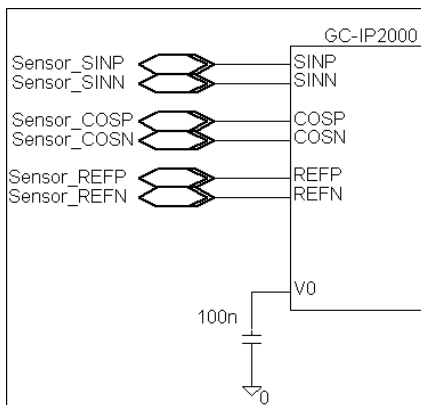
For the serial interfaces on the demo board can be selected between USB or SPI. The selection is based on the jumper J1 and J2 (see 3.1.10).

7.3 Signal input

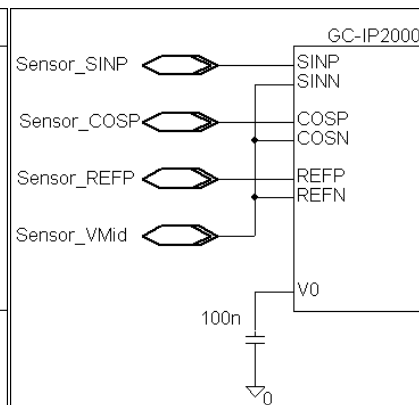
The direct input of the sine, cosine and reference signals to the GP-IP2000 is effected via the 15-pole SUB-D socket X6 (assignment see Table 6) or on the pin X17 (Table 9).

On the demo board sensors with 5V 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 3.1.5).

Sensor with differential output signals



Sensor with single-ended output signals (1)



Sensor with single-ended output signals (2)

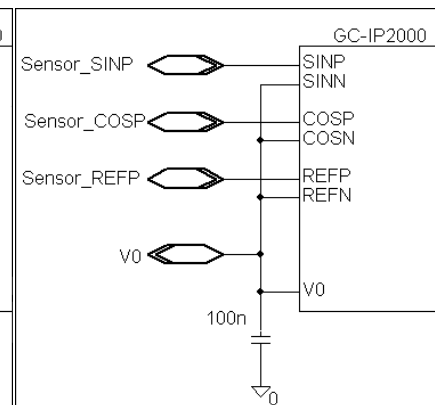


Figure 8: Sensor connection (1) Figure 9: Sensor connection (2) Figure 10: Sensor connection (3)

- The amplitude of the sensor and the gain factor of GC-IP2000 are adapted by configuration bits GAIN(1:0).
- Reference level V0 is generated internally.
- The amplitude of the sensor and the gain factor of GC-IP2000 are adapted by configuration bits GAIN(1:0).
- Reference level V0 is provided by the sensor.
- The amplitude of the sensor and the gain factor of GC-IP2000 are adapted by configuration bits GAIN(1:0).
- Reference level V0 is generated internally and connected to the sensor.

Detailed description and application examples at data sheet of GC-IP2000.

7.4 Sensor connection

7.4.1 Supply voltage

The output supply voltage from the demo board GP-IP2000 for the sensor is 5 VDC. The corresponding pins at the terminal points (X6 or X9) are marked by the designation 5V.

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-IP2000 must be made. The following table shows the gain setting for the GC-IP2000 for different input signals.

Input voltage nominal U_{DNom} (mV _{pp})	Sensor supply voltage (typical)	Gain setting	
		GAIN1	GAIN0
1000	5V	0	0
500	5V	0	1
250	5V	1	0
75	5V	1	1

Table 15: Configuration for different input amplitudes

7.5 Circuit configuration

The configuration of the GC-IP2000 on the demo board is basically effected on the basis of the configuration data in the external EEPROM. A configuration by using the configuration pins is not possible. For the configuration via the external EEPROM, a detailed register description is available at the data sheet of the GC-IP2000.

