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Ultrasonic-Flow-Converter

Data Sheet

GP22-EVA-KIT

Evaluation System for TDC-GP22
Time-to-Digital Converter

15th July 2013
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1 Introduction

1.1 General

The GP22-EVA-KIT evaluation system is designed as a platform for a quick and easy start-up and evaluation of the TDC-GP22 Time-to-Digital Converter. The EVA-Kit offers user-friendly configuration and extensive testing of the TDC-GP22.

For a proper use of the evaluation system, we strongly recommended to refer to the current TDC-GP22 datasheet. You can download this datasheet from www.acam.de/download-center/time-to-digital-converters.

1.2 System Overview

The GP22-EVA-KIT is a full featured evaluation system for the TDC-GP22 Time to digital converter. It serves as

- System for evaluating ultrasonic time-of-flight measurement applications
- Evaluation Kit for TDC-GP22 time interval measurements

Features

- PC supported system with USB communication interface
- Easy to use evaluation and measurement software
- Different power options, selectable by jumpers
- Three reference clock sources for alternate clock options
- Pt1000 Temperature measurement with on board reference, hardware option for Pt500 sensors (sensors n.c.)
- Internal / external comparator for temperature measurement
- Easy connection of external microcontroller boards
- Data collection to ASCII text files
- Built-in display of measurement results

1.3 System Components

The GP22-EVA-KIT includes the following components:

- GP22-EVAL: Evaluation board for TDC-GP22 Time-to-Digital Converter
- PICOPROG V2.0: USB-to-SPI communication interface

- High density DSUB15 cable: For connecting the evaluation system to the PICOPROG V2.0 communication interface
- USB cable: For connecting the PICOPROG communication Interface to the local PC
- CD-ROM: Contains software, drivers, examples and technical documentation

PC connection

The GP22-EVAL board is connected to the PC via PicoProg 2.0 device. The PicoProg 2.0 acts as USB to SPI communication interface and provides the power supply of the board. Figure 1.1 on the following page gives an overview. The 15 pin DSUB high density cable connects the GP22-EVAL hardware to the PicoProg 2.0. Additionally, a USB cable is delivered to connect the PicoProg 2.0 with a free USB port of the local PC.

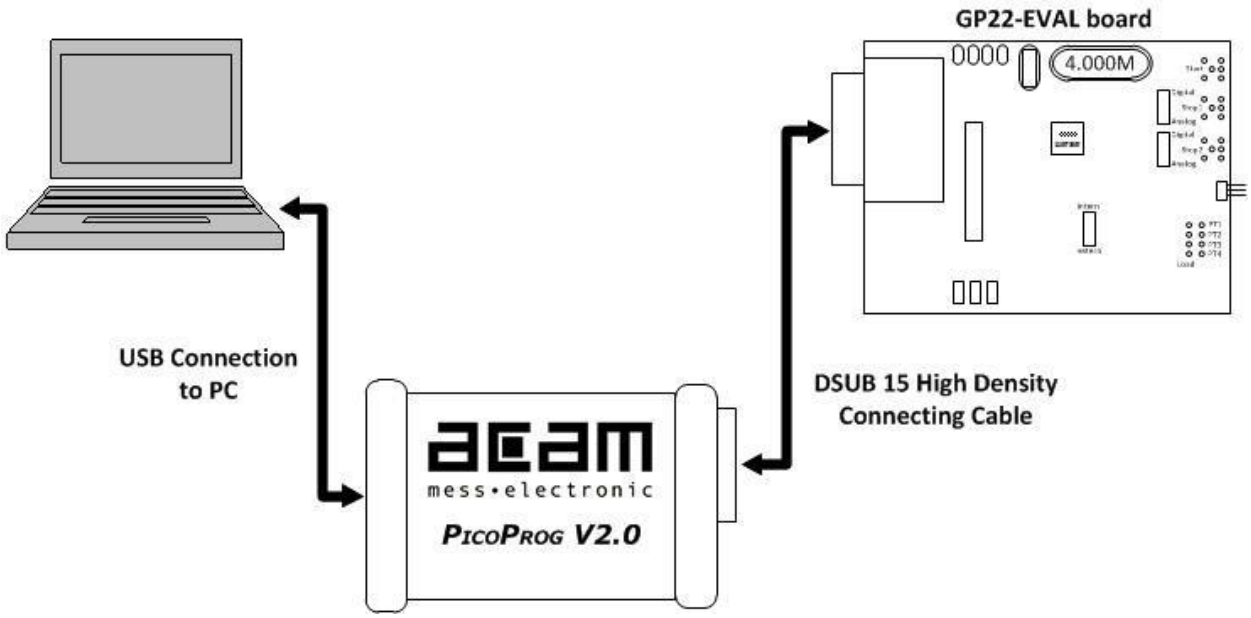


Figure1.1 System Block diagram

2 Hardware Description

2.1 Introduction

The GP22-EVA-KIT, shown in figure 2.1, is an evaluation system for the TDC-GP22 Time-to-Digital Converter. It offers full access to the TDC-GP22 in order to test and evaluate this device for your application.

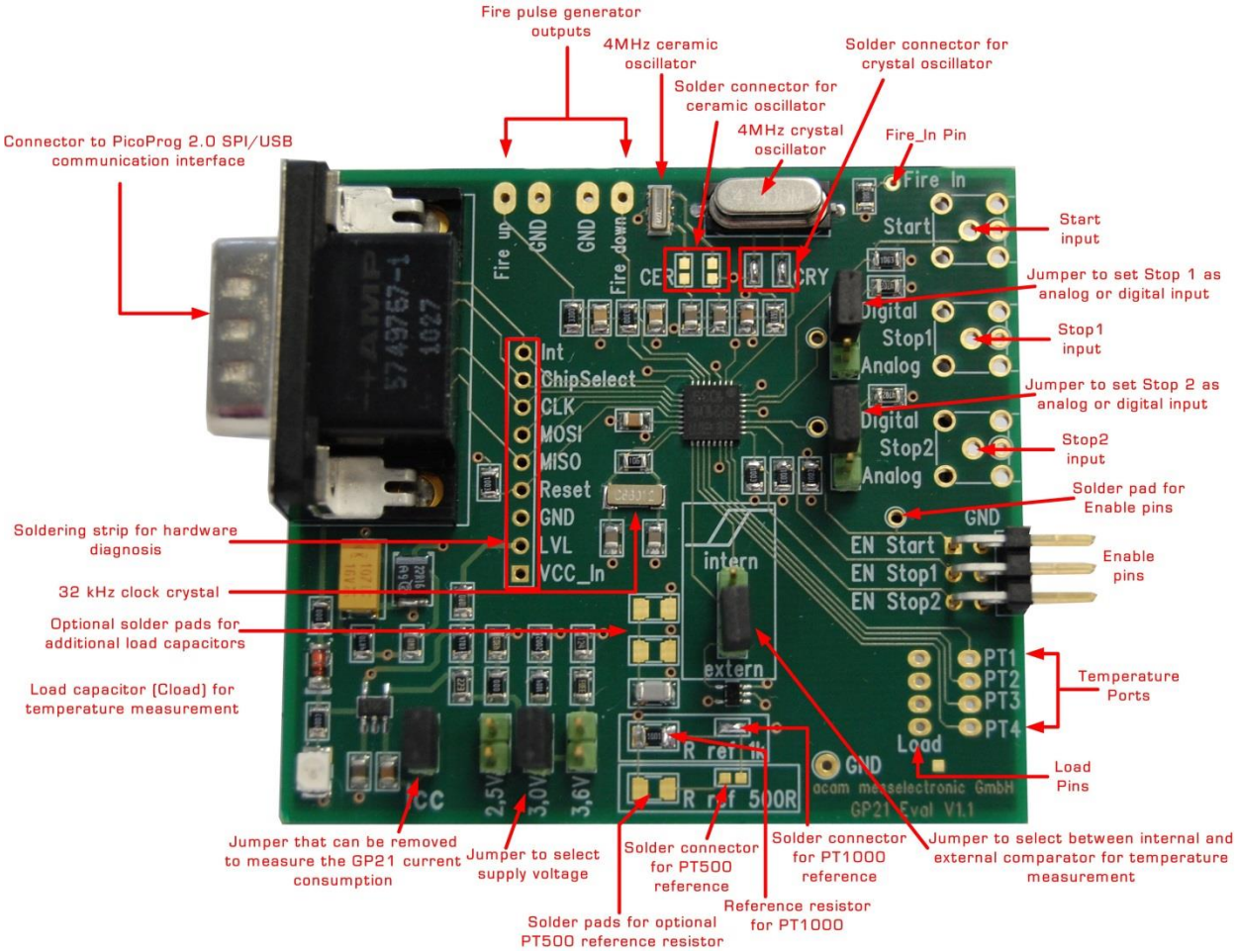


Figure 2.1 GP22-EVA-KIT Hardware

2.2 Clock sources

Besides the 32,768 Hz quartz, the GP22-EVA-KIT includes two high speed clock sources, a 4 MHz crystal and a 4 MHz ceramic oscillator. The high speed clock source can be selected by closing the appropriate solder connectors (LJ1 to LJ4). By default LJ3 and LJ4 are closed so the 4 MHz crystal operates as the system's high speed clock source.

Solder connector LJ1, LJ2 closed → Ceramic oscillator (CER) selected

Solder connector LJ3, LJ4 closed → Crystal Oscillator (CRY) selected (Default)

Figure 2.2 High speed clock sources and solder connectors

2.3 Power Supply and Current Consumption

The GP22-EVA-KIT hardware is powered via USB by the PicoProg 2.0 communication interface. The supply voltage is provided through the 15-pin VGA connector (J1) and can be adjusted by setting the appropriate jumper. Closing J2, J3 or J4 selects the corresponding supply voltage. In figure 2.4 the supply voltage is adjusted to 3.0 V.

Figure 2.3: 15-pin VGA connector for power supply

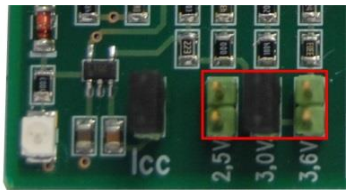


Figure 2.4 Jumpers to select the supply voltage

J2 closed: 2.5 V
J3 closed: 3.0 V (Default)
J4 closed: 3.6 V

In some cases it might be useful to operate the GP22-EVA-KIT without the PicoProg2.0 device, e. g. if the hardware is connected to a microcontroller developers kit. Then the supply voltage can be fed to Vcc and GND pins of the J19 solder strip. Even in this case

the supply voltage can be adjusted by setting the jumper J2, J3 or J4, as described above.

GND: Ground Connection

VCC_In: Supply voltage

Figure 2.5 External power supply via J19

Current Consumption

Portable or battery driven systems like e. g. heat meters demand for energy efficient design. To measure the current consumption of the system, Jumper J5 can be left open and connected to an ampere meter.

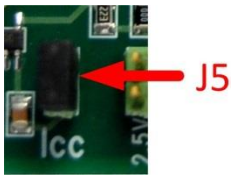


Figure 2.6: Measure power consumption

2.4 Communication Interface

2.4.1 VGA Connector

In combination with the PICOPROG 2.0 device the 15-pin VGA-connector shown below is also used for SPI data communication. The PICOPROG 2.0 then provides the USB to SPI conversion for data transfer with the PC based measurement and configuration software.

Figure 2.7: 15-pin VGA connector for power supply and data communication via PICOPROG 2.0

2.4.2 Interfacing an external Microcontroller

Alternative to the VGA connector soldering strip J 19 offers easy access to the SPI data communication and to signals that are useful for system diagnosis. This is useful when external hardware like a microcontroller development board should be connected to the GP22-EVAL board.

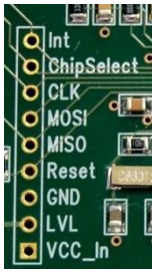


Figure 2.8: SPI interface for external hardware

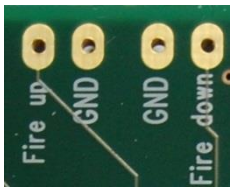
Table 2.1 Signal Description

Terminal	Description
Int	GP22 Interrupt pin
ChipSelect	SPI Chipselect line (SSN – Slave Select)
CLK	SPI Clock (Clock Serial Interface)
MOSI	SPI serial data in (Master Out Slave In)
MISO	SPI serial data out (Master In Slave Out)
Reset	GP22 Reset line (low active)
GND	Ground Connection
LVL	Supply voltage for PicoProg 2.0 internal level shifters
Vcc In	Optional Power supply, can be used if the system shall be powered without using the PicoProg 2.0 communication interface

2.5 TDC - Interfaces

2.5.1 Fire Pulse Generator Outputs

The fire pulse generator's outputs (J11 to J14) offer direct connection of the piezo ceramic transducers for up and down measurement, as it is typical in time-of-flight applications, like ultrasonic flow- or heat meters.



J11: Fire up

J12, J14: Ground connection

J13: Fire down

Figure 2.9: Fire pulse generator outputs

2.5.2 Fire In

Fire in (J18) is an input that offers the possibility to extend your signals transit time by means of the "sing around method". Using that option, the received echo pulse can directly fed to this input for multiple resend. Additionally, Fire In can act as an output. Here, it offers enhanced functionality for hardware diagnosis, configurable by software via SEL_TSTO1 settings (see also table 3.14 in section 3.2.3.7).

Figure 2.10: Fire in

2.5.3 Start Input

The Start channel (J6) is an LVTTL input that acts as TDC-GP22 start. It triggers the beginning of a time interval measurement. The mounting holes of the start channel offer the possibility to solder an SMB series RF connector (e. g. Bürklin Type JO1160A0231) or a straight dual pin connector, to easily interface with peripheral hardware. Optionally, direct soldering is also possible.

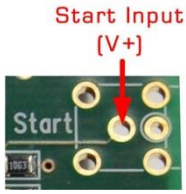


Figure 2.11 Start input channel

Note: If SEL_START_FIRE item is activated by software, the fire out signal of the pulse generator triggers the TDC start. In that case the start input channel is disabled.

2.5.4 Stop Channels

Stop 1 (J7) and Stop 2 (J8) are the Stop inputs for TDC-GP22. They can be interfaced to analog or digital sources. The selection is done by configuration of the 3-pin jumpers J9 and J10. J9 switches STOP1 as analog or digital input, J10 refers to STOP2. Similar to the start channel, the mounting holes of the stop channels offer the possibility to solder an SMB series RF connector (e. g. Bürklin Type JO1160A0231) or a straight dual pin connector, to easily interface with peripheral hardware. Direct soldering is also possible.

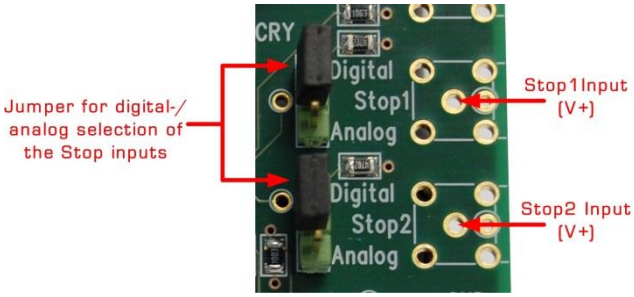


Figure 2.12: Stop channels and the corresponding jumpers to switch over between analog-and digital input mode.

Digital LVTTL input enable

Analog input enable

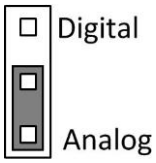


Figure 2.13: Jumper settings for analog/digital enable

2.5.5 Start / Stop Enable Pins

J12 provides the high active enable pins for the TDC-GP22 start and stop channels. Each of the three LVTTL inputs can be used for externally enabling / disabling the corresponding input channel, e. g. by connecting them to your microcontroller's general purpose I/O pins.

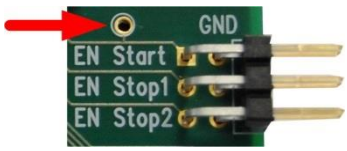


Figure 2.13: Enable pins for Start- / Stop channels

EN_Start: By default, high level on EN _Start enables the GP22 start input. Additionally, it can act as an output. The EN_Start pin then offers enhanced functionality for hardware diagnosis, configurable by setting SEL_TSTO2 (see also table 3.13 in section 3.2.3.7). Easy access to the EN_Start diagnosis signals is provided by an additional soldering pad, as shown in figure 2.13.

EN_Stop1: High level on this pin enables stop 1 input

EN_Stop2: High level on this pin enables stop 2 input

2.6 Temperature Measurement

In some applications, like ultrasonic heat meters, temperature difference measurement is an important feature. Here, the GP22-EVA-KIT offers a fully equipped PICOSTRAIN based temperature measurement interface for PT500 and PT1000 temperature sensors.

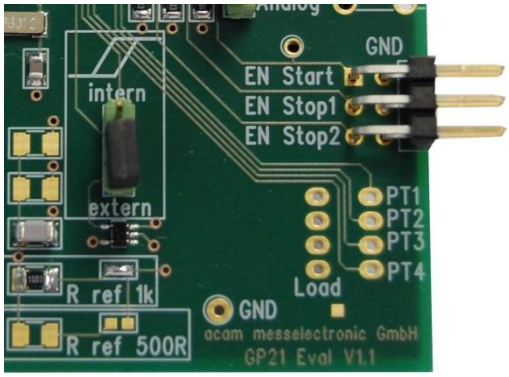


Figure 2.14: Hardware section for temperature measurement

2.6.1 Connecting the temperature sensor

The system offers 4 temperature ports with the possibility of connecting up to 4 temperature sensors. Each of the up to 4 sensors has to be connected between the Load line and the PT1 to PT4 temperature ports. The load pads are wired in parallel.

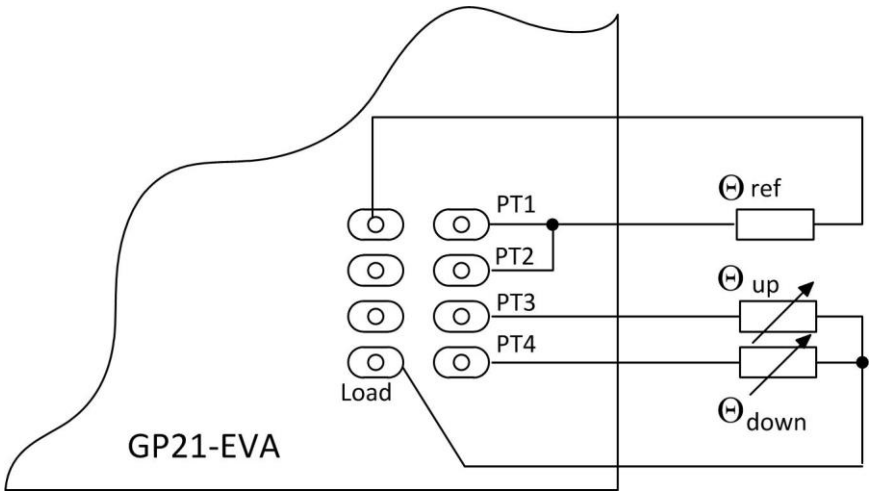


Figure 2.15: Temperature difference measurement with one external reference resistor

PT1+PT2: External reference resistor

PT3: Temperature sensor for higher temperature (hot)

PT4: Temperature sensor for lower temperature (cold)

As a further option, the system allows temperature difference measurement against an on-board metal film resistor as a reference. By default, a temperature stable 1k metal film resistor (R29, 50 ppm) is assembled and solder connector LJ5 is closed. This prepares the system for Pt1000 sensors. Optionally, a 500 Ohm resistor can be soldered on the board, as Pt500 reference. The selection of the correct reference is simply done by closing the corresponding solder connector. The following picture shows the details.

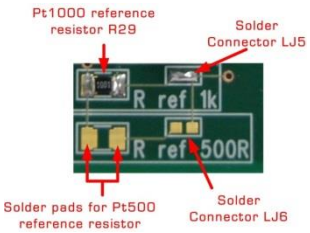


Figure 2.16: On-board reference resistor

If the On-board reference is used, the temperature sensors have to be connected in the following manner:

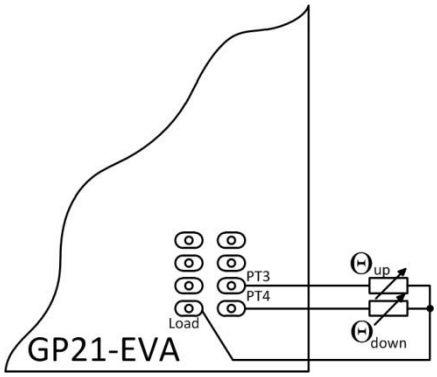


Figure 2.17 Connecting the temperature sensors using the on board reference resistor

PT1+PT2: On board Reference resistor, connected by closing the corresponding soldering connector LJ6, LJ7 (see figure 2.14)

PT3: Temperature sensor for higher temperature (hot)

PT4: Temperature sensor for lower temperature (cold)

2.6.2 Load Capacitor Selection and Assembly

Depending on your temperature sensor's base resistance a load capacitor has to be selected and assembled on the system. As the discharge time should be in the range of 150 µs the following capacitor values are recommended:

Pt500: 220 nF

Pt1000: 100 nF (Default)

To get best results, we recommend COG type or CFCap series from Tayo Yuden. Up to three capacitors can be soldered in parallel. By default the system comes with a 100 nF COG type, suited for Pt1000 measurements

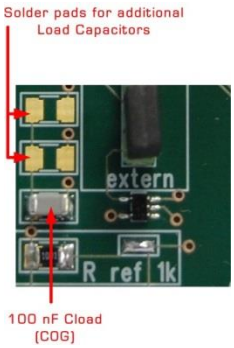


Figure 2.18: Load capacitor C17 and additional solder pads

2.6.3 Selecting the Comparator

For temperature measurement the external 74AHC14 Schmitt Trigger or the GP22 internal low noise comparator can be used. The selection is done by setting jumper, as shown in the picture below. Here the external Schmitt Trigger is selected:

Figure 2.19: Jumper to select between internal comparator or external Schmitt Trigger

intern: Selects the GP22 internal comparator

extern: Uses external 74AQHC14 Schmitt Trigger (Default)

Note: For a proper, work the correct setting of „NEG_STOP_TEMP“ parameter in the “Temperature Measurement” sheet of the software is mandatory. For details, please refer to table 3.24 in chapter 3.2.6.3 „Temperature port settings“

3 Software Description

The GP22-EVA-KIT evaluation system comes with a comfortable Windows based configuration and measurement software. This chapter describes the installation and explains how to access all the functionality of the GP22-EVA-KIT. The following steps are required:

1. Install the PicoProg 2.0 driver
2. Install the GP22-EVA-KIT software
3. Restart the PC
4. Connect evaluation system to the PC und run the GP22-EVA-KIT software

Important Note:

Install the PicoProg 2.0 driver and the GP22-EVA-KIT software before connecting the system to the USB port of the PC. This ensures that the system is correctly recognized when it is connected to the PC. The PicoProg 2.0 driver and the GP22-EVA-KIT software is compatible to Windows XP (SP3) and Windows 7 (32 and 64-Bit version)

3.1 Installation

3.1.1 PicoProg 2.0 Driver Installation

Insert the GP22-EVA-KIT CD, select the folder Driver\PicoProg v2 Driver Installer Stand-Alone and run the installer by double clicking setup.exe.

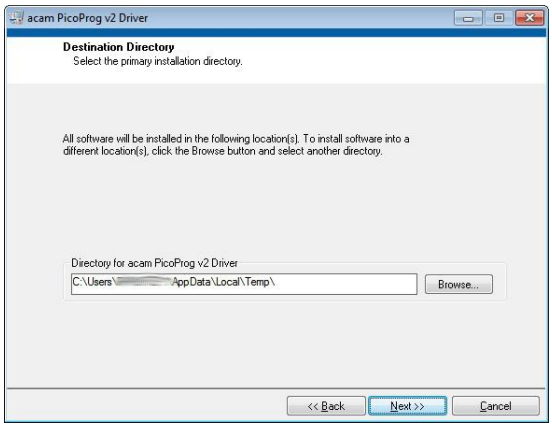


Figure 3.1: Run the Driver Installer

Accept the proposed path by clicking on “Next” button and confirm the license agreement. The following Screen appears:

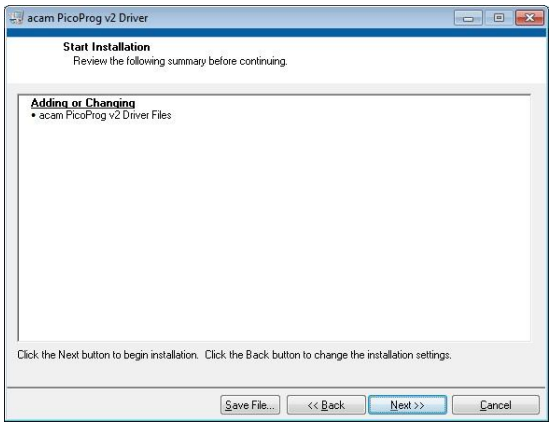


Figure 3.2 Run the PicoProg 2.0 installer

Now run the installer by again clicking on “Next”.

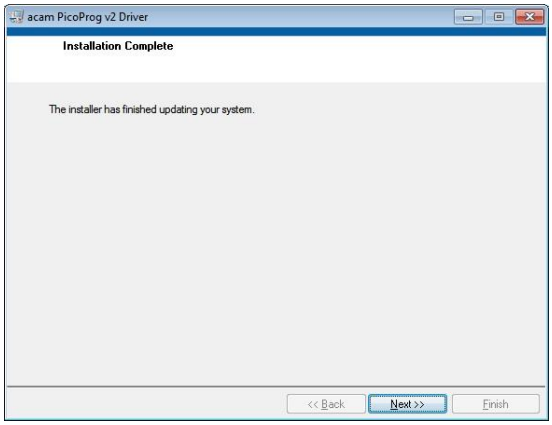


Figure 3.3: Installation complete

Confirm with “Next”. Then a command shell window comes up and asks you to unplug the PicoProg.

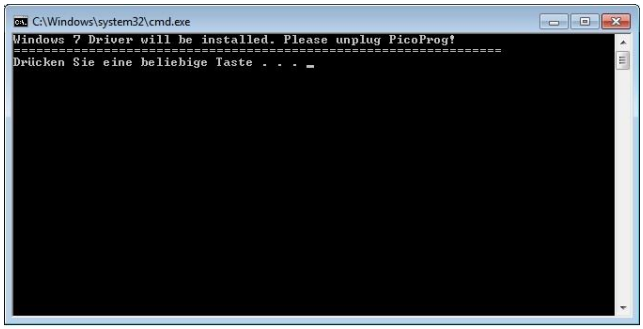


Figure 3.4: Command shell comes up

Check that there is no PicoProg device connected to the PC. Then press a key to proceed. Override the “unsigned driver“ warning.

Figure 3.5 Confirmation before driver installation

Please install the driver anyway. Then the command shell asks you to plug in the PicoProg V2.0

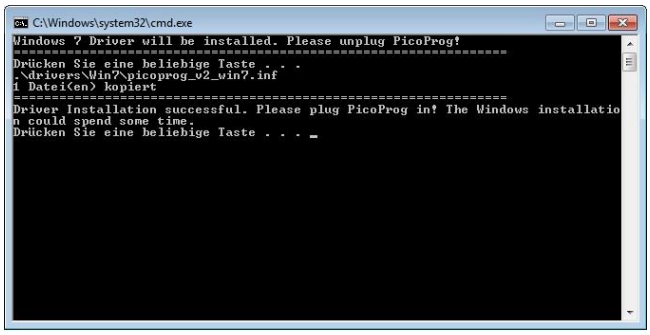


Figure 3.6 Plug in PicoProg V2.0

Plug in the PicoProg device and press a key.

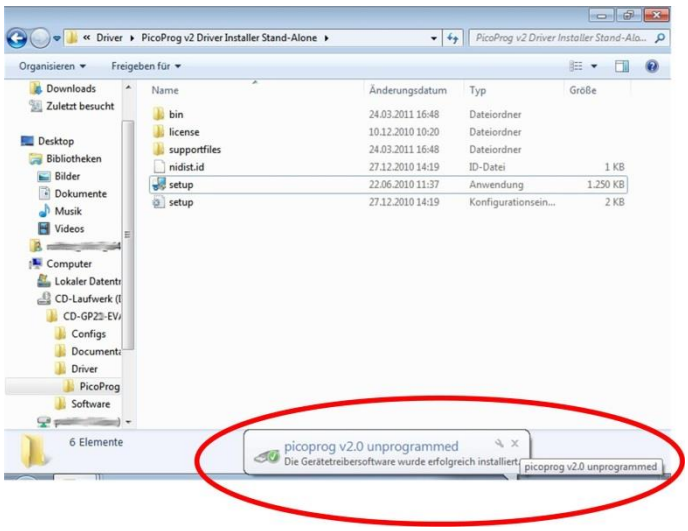


Figure 3.7 Driver installed

Now the PicoProg v2.0 driver has successfully been installed. To verify the installation you can open the device manager and locate the driver as shown in figure 3.8.

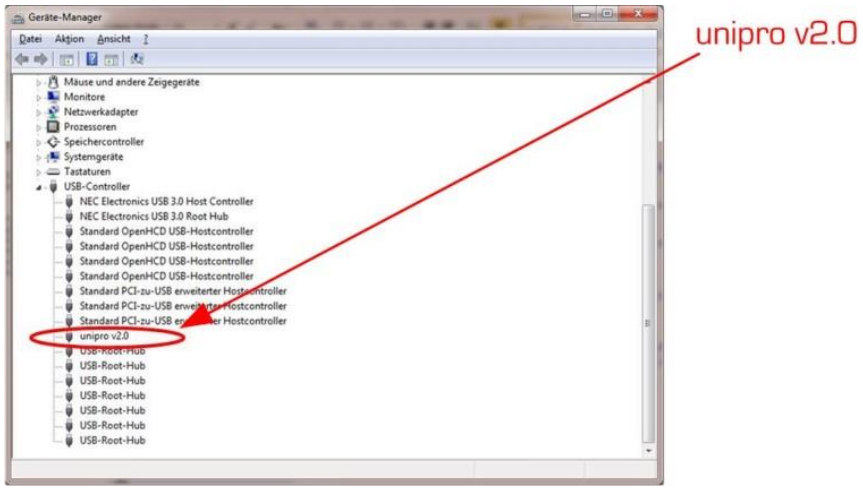


Figure 3.8 PicoProg 2.0 driver verification

3.1.2 Software Installation

The GP22-EVA-Kit comes with a self-installing measurement and configuration software. It is provided on the CD and can be installed after the PicoProg installation has been finished successfully. The following screenshots explain the software installation procedure.

Insert the CD, go to folder Software\GP22_v19 (version 1.9 or newer) Installer and run the installer by clicking “setup.exe”

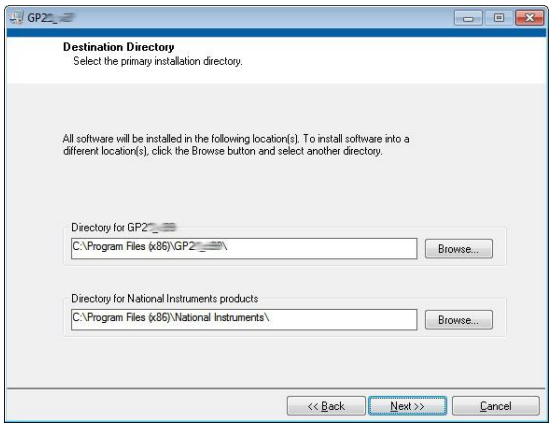


Figure 3.9 Run the installer

Now select the installation path. Recommended is the default setting. Then click to “Next” and confirm the license agreement. After that, a window appears that shows a summary of the software to be installed.

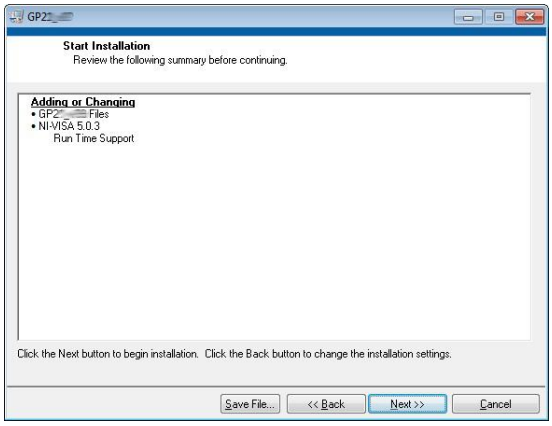


Figure 3.10: Summary of installation

Go on with “Next”. Then the software installation will be completed.

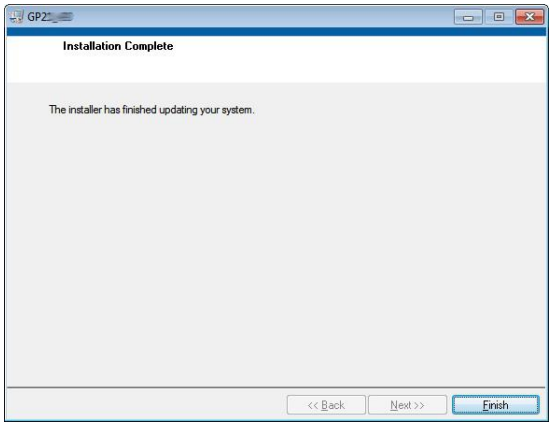


Figure 3.11: Installation complete

Finally, confirm with “Finish”. Now the system asks for a restart of the PC.

Figure 3.12: Restart your System

Click to “Restart”.

3.2 Setup & General Settings Tab

After starting the software by selecting GP22_v19 (version 1.9 or newer) from the Windows start menu the following screen appears.

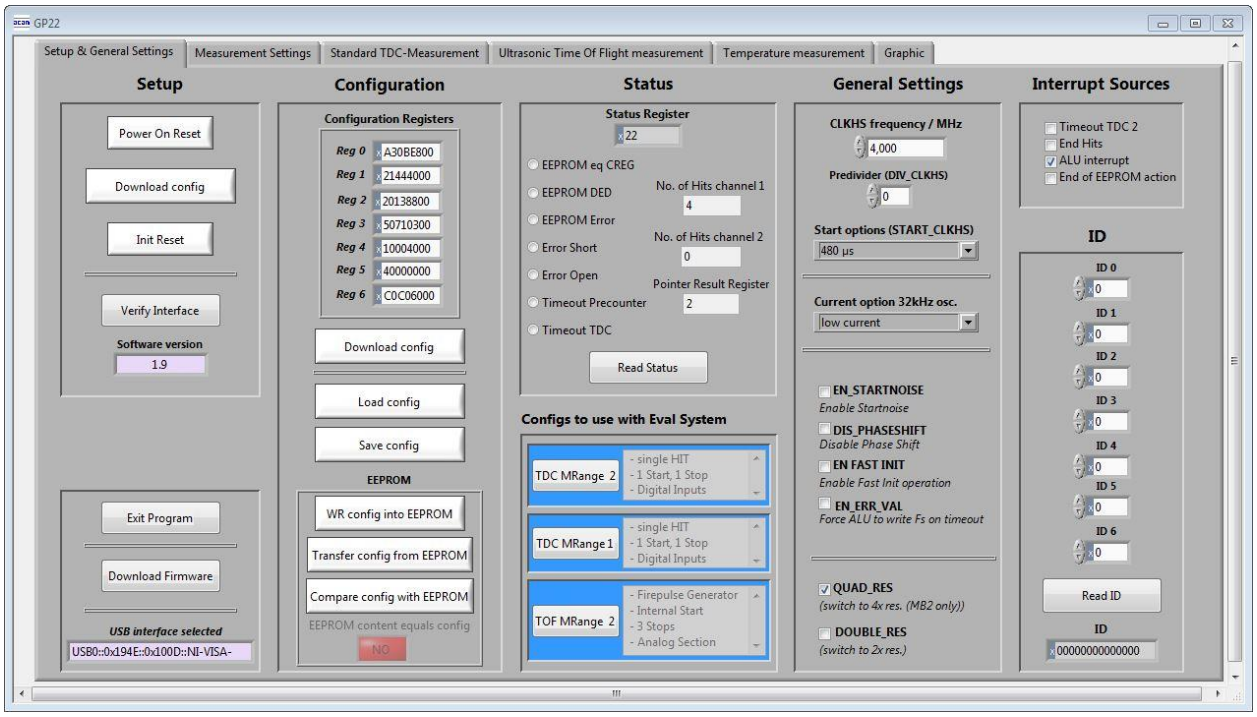


Figure 3.13: Setup & General Settings

The “Setup & General Settings” sheet is divided in different main sections that are explained in the following chapters.

3.2.1 Setup

The setup section provides basic communication functionality between the GP22-EVA-KIT software and the GP22-EVA Hardware. This functionality is mainly used to download the current configuration settings and to prepare the GP22-EVA hardware before starting a measurement.

In general, the following steps have to be executed before a measurement can be started:

Power on Reset → Download Configuration → Init Reset

Then the system is configured and ready to start measuring.

Table 3.1 Software functionality in the Setup section

Terminal	Description
Power On Reset	Executes a Power on Reset of the TDC-GP22 hardware by sending SPI opcode 0x50. This resets the complete hardware including the GP22 configuration registers.
Download config	Transmits the current software configuration to the TDC-GP22 configuration registers
Init Reset	Prepares the TDC-GP22 for a measurement by sending the init instruction (0x70). Compared to the „Power on reset“ command the init instruction does not reset the content of the configuration register.
Verify Interface	Offers the possibility to check the USB to SPI communication between your local PC and the GP22-EVA Kit hardware.
Software Version	Displays the version of the currently installed GP22-EVA software
Exit Program	Exits the GP22-EVA software
Download Firmware	Offers the possibility to manually download the firmware of the PicoProg V2.0 USP to SPI communication interface. Before using this option please contact acam technical support
USB interface selected	Displays the Product ID and Vendor ID of the USB interface that is selected by the NI-VISA driver. Vendor ID: 0x194 GP22-EVA-KIT Product ID: 0x100D

3.2.2 Configuration

This section displays the GP22 register configuration and offers the possibility to

save the configurations settings in a *.cfg-file

load a stored configuration from a *.cfg-file

download the current configuration to the GP22-EVA-KIT.

Additionally, the EEPROM section provides the basic instruction set for GP22 EEPROM access.

Table 3.2 Configuration section

Terminal	Description
Configuration Register	Displays the current configuration setting
Download config	Click on this button transmits the current software configuration into the GP22-EVA-KIT hardware
Load config	Opens a file open dialog to load an existing configuration file (*.cfg) to the software
Save Config	Opens dialog to store the current configuration in a *.cfg file on your PC
WR config into EEPROM	Writes the current configuration settings to GP22 EEPROM
Transfer config from EEPROM	Transfers the configuration from GP22 EEPROM to the GP22 configuration registers
Compare config with EEPROM	Compares the current configuration settings with the register configuration that is stored in the GP22 EEPROM and indicates “YES” or “NO” in case of success or not

3.2.3 Status

Status shows the content of the GP22 status register. To read or update the current GP22 status, just click on the “Read Status” Button.

Table 3.3 Status

Terminal	Description
Status Register	Displays the content of the GP22 status register (by default as hex values)
EEPROM eq. CREG	If this item is activated it indicates that the content of the configuration registers equals to the EEPROM
EEPROM_DED	Indicates a multiple EEPROM error that cannot be corrected
EEPROM_Error	A single error has been detected and corrected
Error Short	Indicates a shorted sensor on GP22 temperature measurement port
Error open	Indicates an open sensor on GP22 temperature measurement port
Timeout Precounter	Indicates an overflow of the 14 bit precounter of the GP22 in Measure Mode 2