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Ultrasonic-Flow-Converter

Data Sheet

GP30-DEV-KIT

Development System for TDC-GP30
Ultrasonic Flow Converter

March 18, 2015
Document-No: DB_GP30-DEV_en
Version 0.1

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Content

1 Introduction 2
1.1 General 2
1.2 System Components 2
2 Hardware Description 3
2.1 Introduction 3
2.2 Communication Interface 3
3 Software Installation 4
4 Software Tabs in Main Window 5
4.1 Measurement 5
4.2 Ultrasonic Measurement Control 8
4.3 Temperature Measurement Control 9
4.4 General Control 10
4.5 Interfaces 11
4.6 Interrupt & Error Handling 12
5 Software Menu 13
5.1 File 13
5.2 Tools 13
5.3 Firmware 16
5.4 Calibration 19
5.5 Help 19
6 Development Board Hardware Details 21
6.1 Schematics / Layout 21
6.2 Bill of Materials 23
7 Miscellaneous 24
7.1 Literature Guide 24
7.2 Last Changes 24

1 Introduction

1.1 General

The GP30-DEV-KIT is designed as a platform for a quick and easy start-up and evaluation of the TDC-GP30 Ultrasonic Flow Converter. The development kit offers user-friendly configuration and extensive testing of the TDC-GP30, but also the complete assembler environment for programming the device. For a proper use of the evaluation system, we strongly recommend to refer to the latest TDC-GP30 datasheets. Please request them from acam.

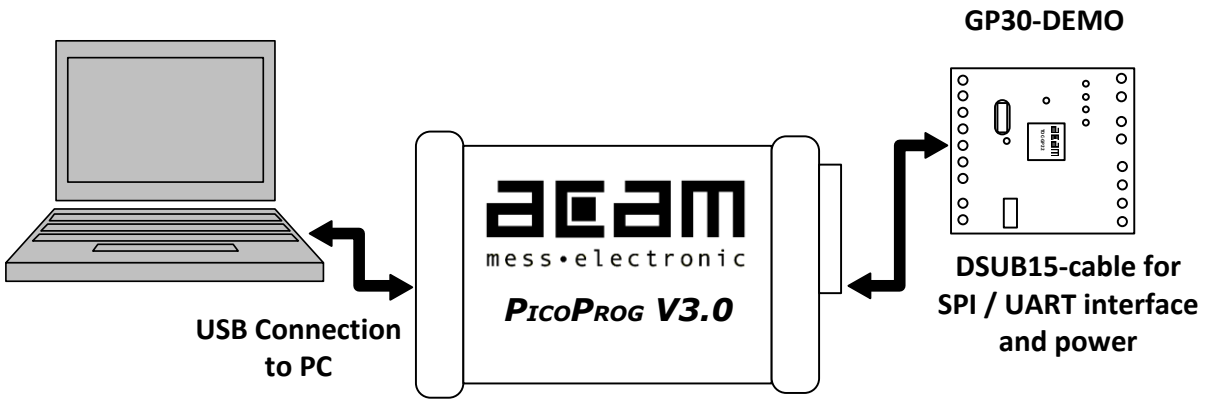
1.2 System Components

The GP30-DEV-KIT includes the following components:

- GP30-DEMO--PCB: Small demo board with TDC-GP30, assembled with DSUB15 cable
- PICOPROG V3.0: USB-to-SPI/UART communication interface
- USB cable: For connecting the PICOPROG communication Interface to the local PC
- CD-ROM: Contains software, drivers, examples and technical documentation

The GP30-DEMO-PCB is connected to the PC via the PICOPROG SPI-to-USB converter.

Figure 1

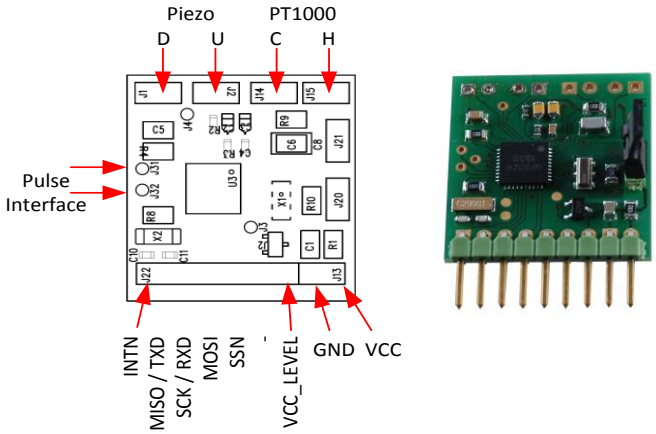


2 Hardware Description

2.1 Introduction

The GP30-DEMO-PCB, shown in figure 2.1, represents the complete front-end for a water or heat meter. The transducers and temperature sensors can be connected directly to this board. It comes with a 32,768 kHz quartz (X2) and a 4 MHz ceramic oscillator (X1).

Figure 2

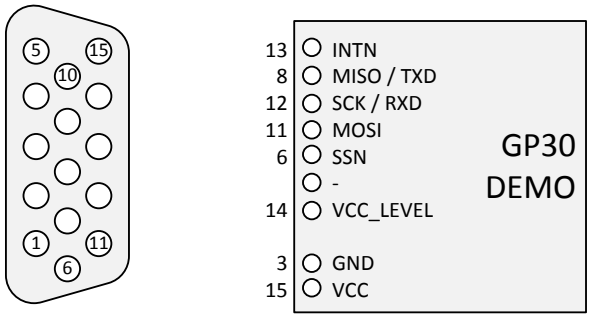


2.2 Communication Interface

The PICOPROG device is acam's standard USB-to-SPI converter box that interfaces all acam evaluation systems. With version 3.0, the PICOPROG also supports the USB-to-UART conversion of GP30. The PICOPROG is registered by operating system initially as "picoprog v3.0 unprogrammed". As soon as the GP30 evaluation software is started, a special firmware is written into the PICOPROG to make the SPI or UART communication with the GP30. For SPI communication only, PICOPROG version 2.0 is sufficient.

Figure 2.2 shows the connection between the PICOPROG and the GP30 board. The flat connector includes the power lines and the SPI or UART communication lines. On demo board the communication interface is initially selected to SPI (by solder bridge LJ2).
VCC_LEVEL is the voltage feedback for the PICOPROG level shifters.

Figure 2.2



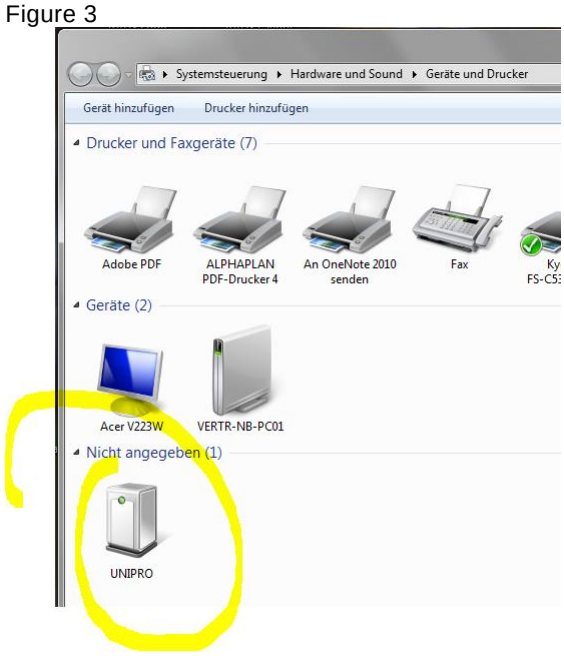
3 Software Installation

The GP30 evaluation software described here is an early version for use with the TDC-GP30. It is continuously under evaluation and subject to on-going improvement. Please hold contact with acam to be informed about latest revisions.

The description herein is based on software version 1.2.7

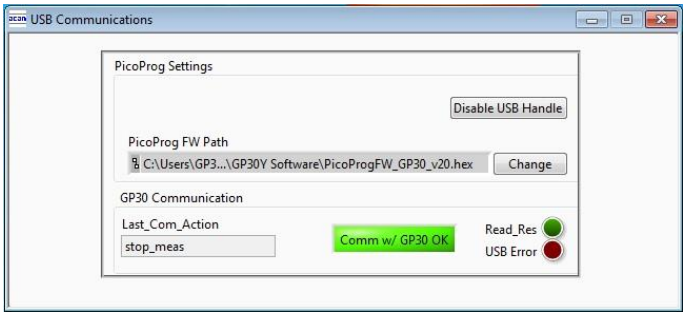
To install the software, go to folder GP30y_Software\acam GP30 Installer v1_2_7\ Volume and run setup.exe. Follow the instructions. After starting the software the PICOPROG is listed under devices and printers as “UNIPROG”.
If not, go to the drivers folder , e.g. GP30_Confidential\drivers\Win7_8 and install the driver for your operating system manually.
In case of an upgrade of the software to a newer version please make sure that the software uses the latest driver. The driver is located in C:\Program Files (x86)\acam-messelectronic\GP30\data.

Figure 3



Therefore open the USB communications window and check the firmware version of the PICOPROG. It should be version PicoProg_GP30_v21.hex or higher:

Figure 4

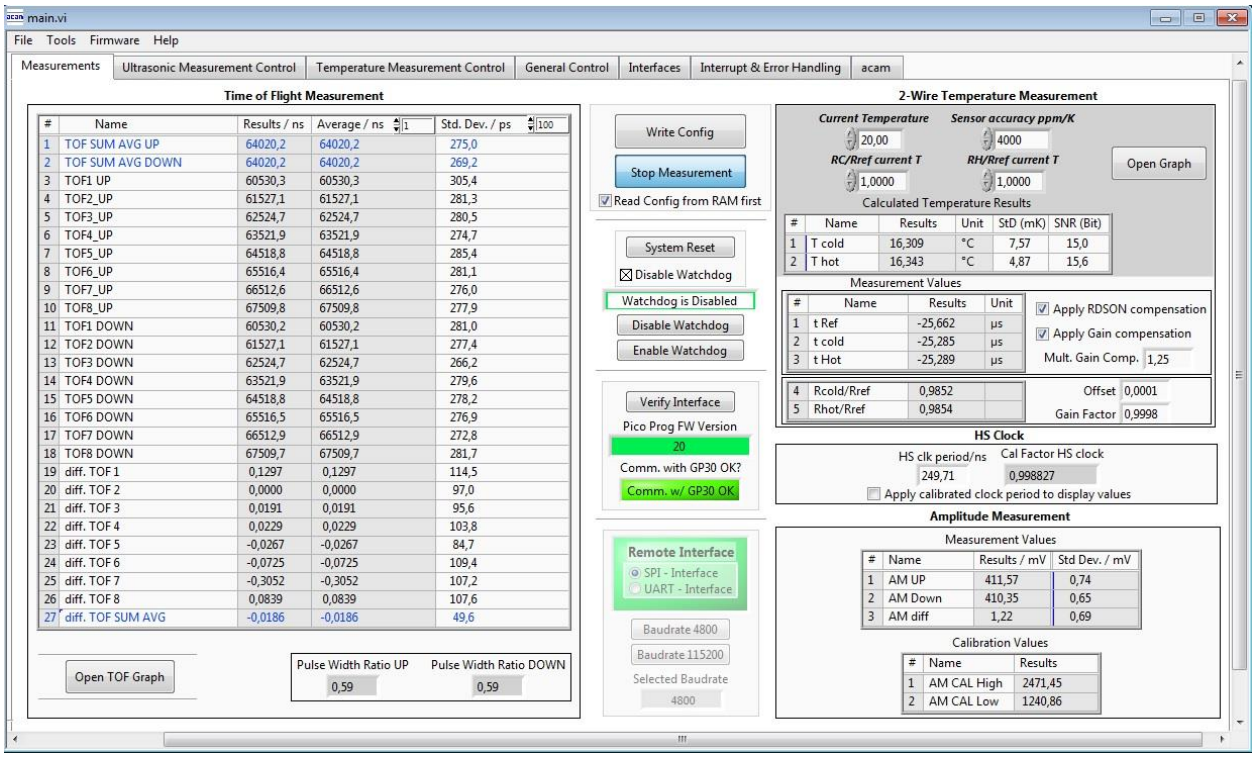


4 Software Tabs in Main Window

4.1 Measurement

When started, the software comes up with the main window, showing the “Measurement” tab.

Figure 5 Main window



4.1.1 First step with measurement control elements

A good first step is to load a working configuration and make measurements in frontend mode (without using the internal 32-Bit µP). acam provides some sample configuration files the software which are working well. Please use those for a first measurement

- **Load configuration file:** File menu → Open Config → choose appropriate config file
- **Next step:** Press “System Reset” button. Now the PicoProg FW version field should get green and the appropriate version should be displayed (20 or higher). Also “Comm GP30 OK?” should get green to show that communication with GP30 works.
- **Next step:** If watchdog is not disabled by “System Reset” button → press “Disable Watchdog” button.
- **Next step:** Press “Write Config” button. Now the configuration settings are downloaded to GP30 and written to register area of GP30.
- **Next step:** Press “Start measurement” button. Now the chip starts to measure and the results are displayed in the tables of different measurements.

Now, this configuration can be modified to fit the user's needs. In the end the user can store his own configuration files.

4.1.2 Time of Flight Measurement Results

GP30 stores the first 8 hits of every TOF direction separately and also the sum of all measured hits. For both directions these 9 results are displayed. The evaluation software additionally calculates the difference between up and downstream, DIFF-TOF. In total, all 27 results are displayed in the "Results" column.

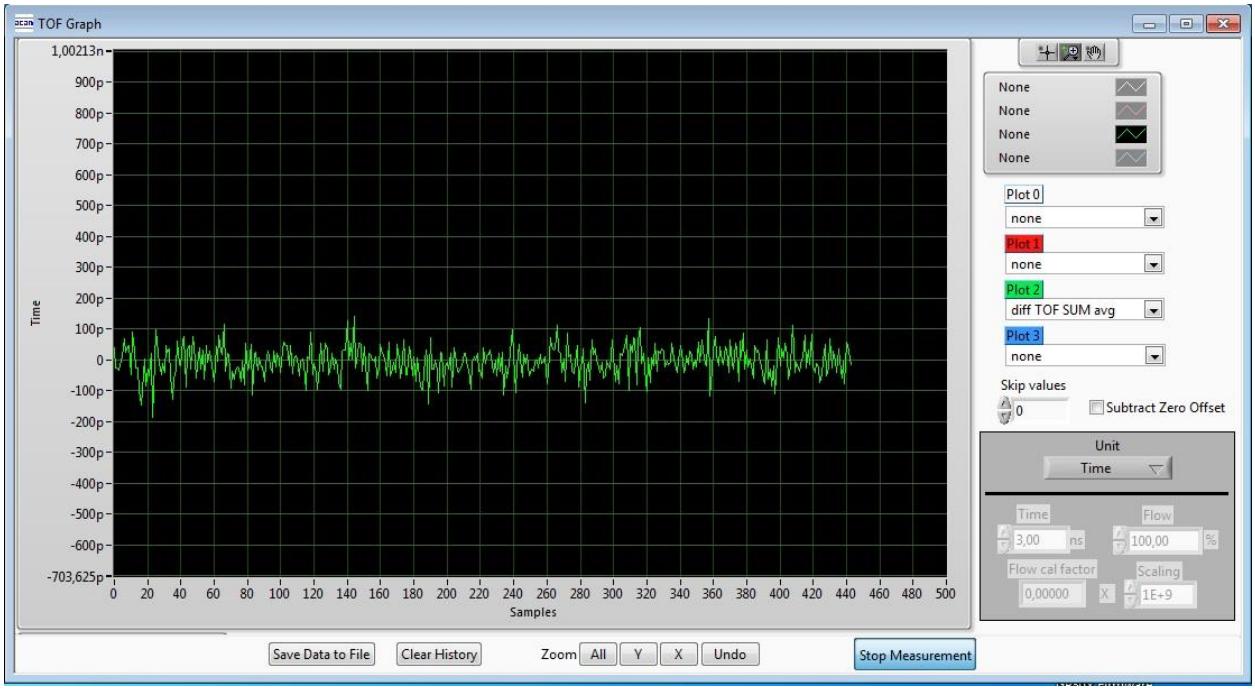
In the "Average" column the user can set the sample size for the averaging (<1000) and the software calculates the rolling average of the results accordingly. In "Std. Dev." column the standard deviation, calculated over a variable sample size, is displayed. The number of samples can be chosen (e.g. 100).

The same is done with the amplitude values of the receiving signals and the pulse width ratio between first hit and start hit. The values for both directions are displayed.

A graph to display TOF measurement results can be opened in a separate window by "TOF Graph" button

Up to 4 plots can be activated. Every plot have various possible values which can be shown (e.g. TOF1UP, TOF2UP …). The averaged values are displayed.

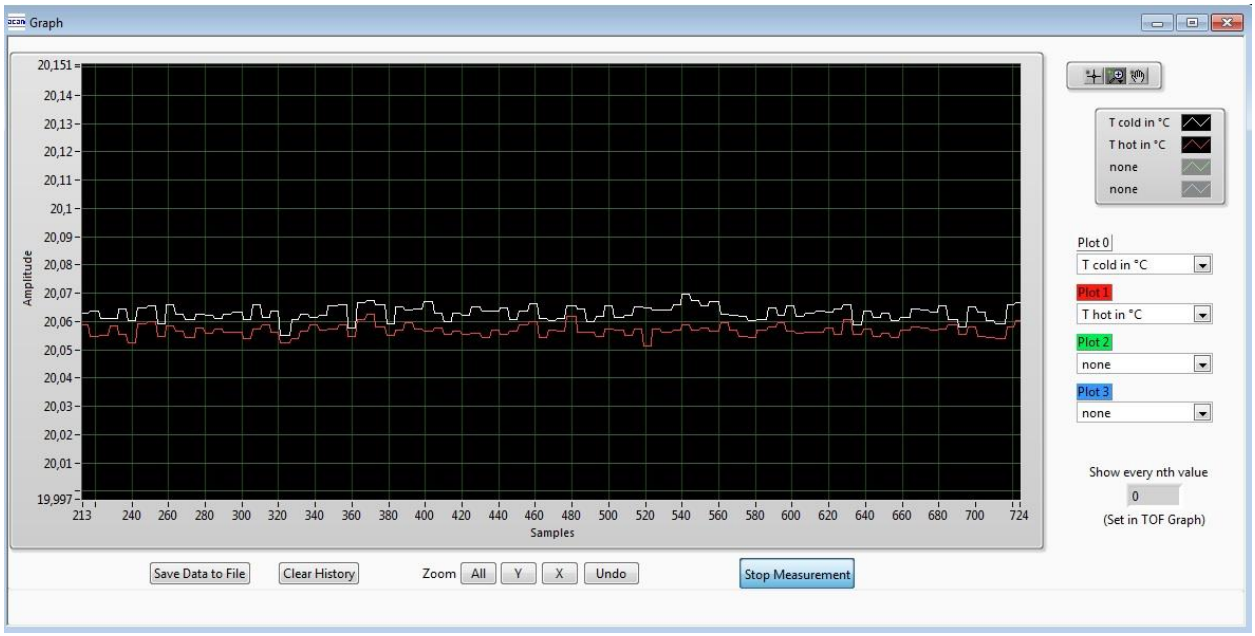
Figure 6 TOF Graph



4.1.3 **2-Wire Temperature Measurement Results**

A graph to display temperature measurement results can be opened in a separate window by “Temperature Graph” button, similar to TOF graph.

Figure 7

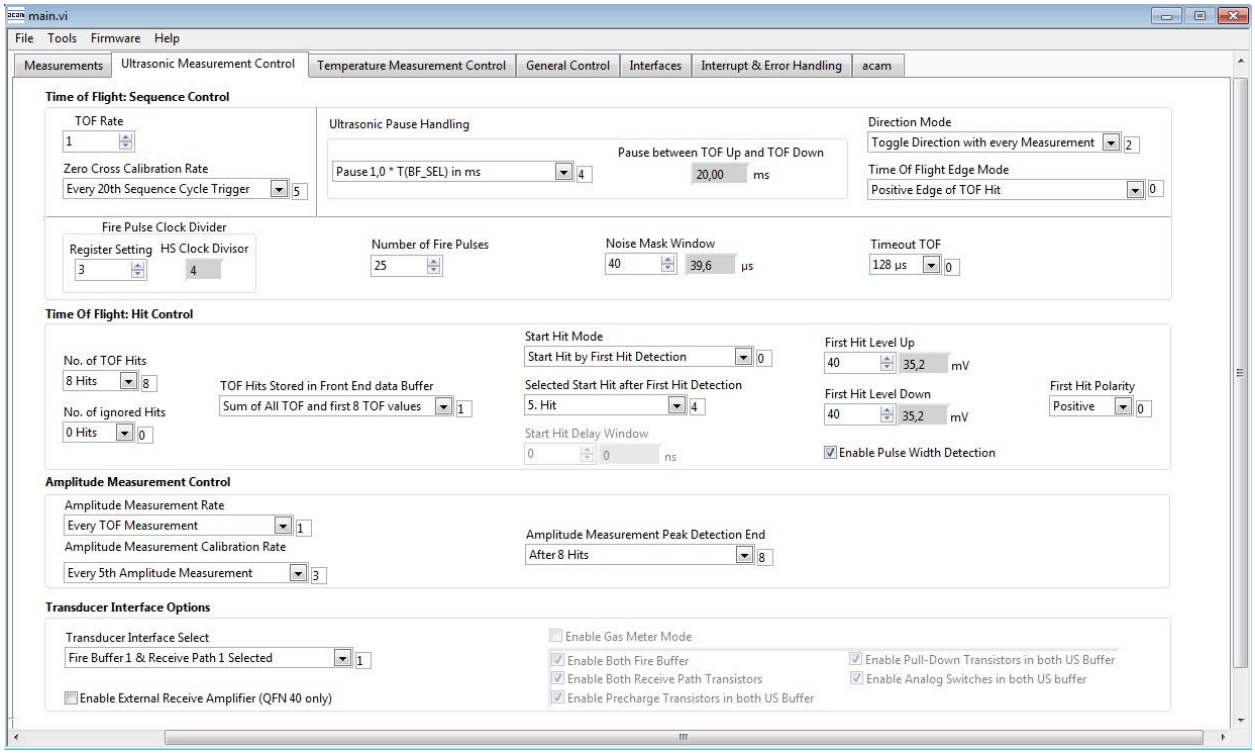


4.2 Ultrasonic Measurement Control

All settings for an appropriate ultrasonic measurement are done in this tab, which are grouped as follwos:

- Time of Flight Sequence Control
- Time of Flight Hit Control
- Amplitude Measurement Control
- Transducer Interface Options

Figure 8



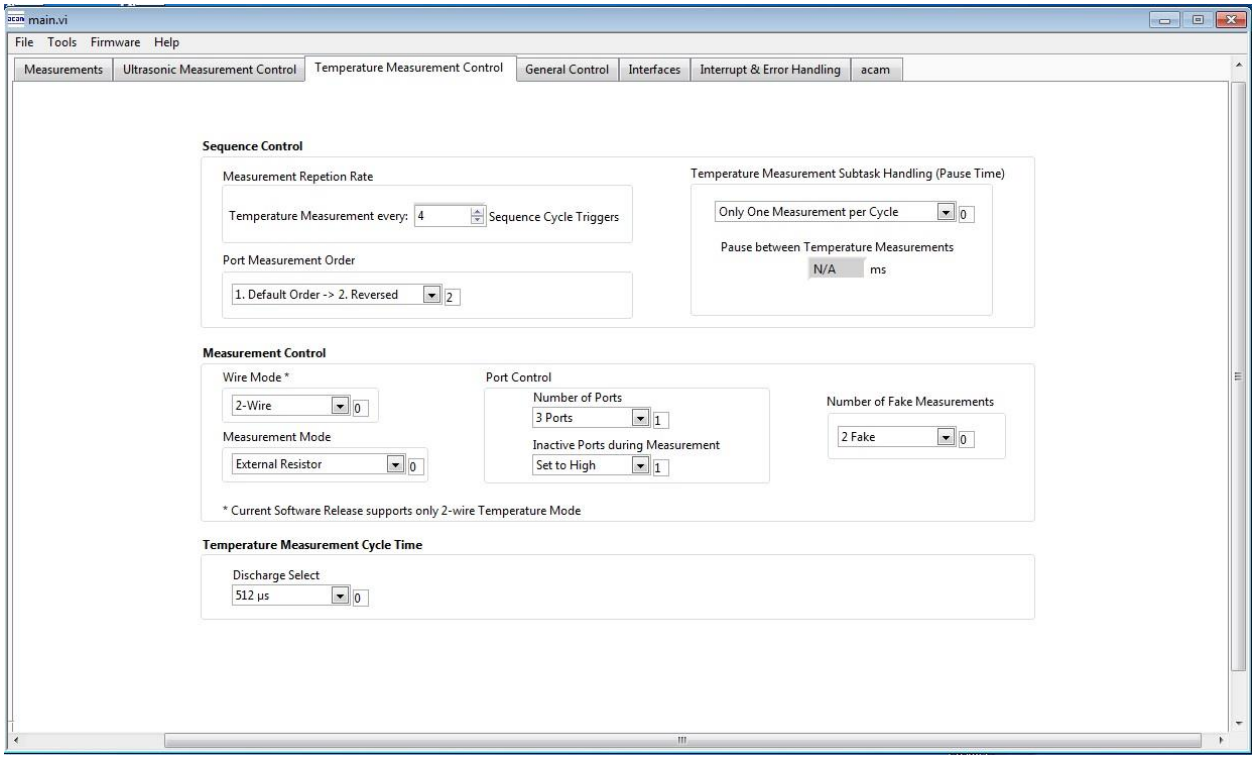
The meanings of the various settings are displayed in clear text. For more details about the register settings please refer to the GP30 manual.

4.3 Temperature Measurement Control

All settings for an appropriate temperature measurement are done in this tab, which are grouped as follows:

- Sequence Control
- Measurement Control
- Temperature Measurement Cycle Time

Figure 9



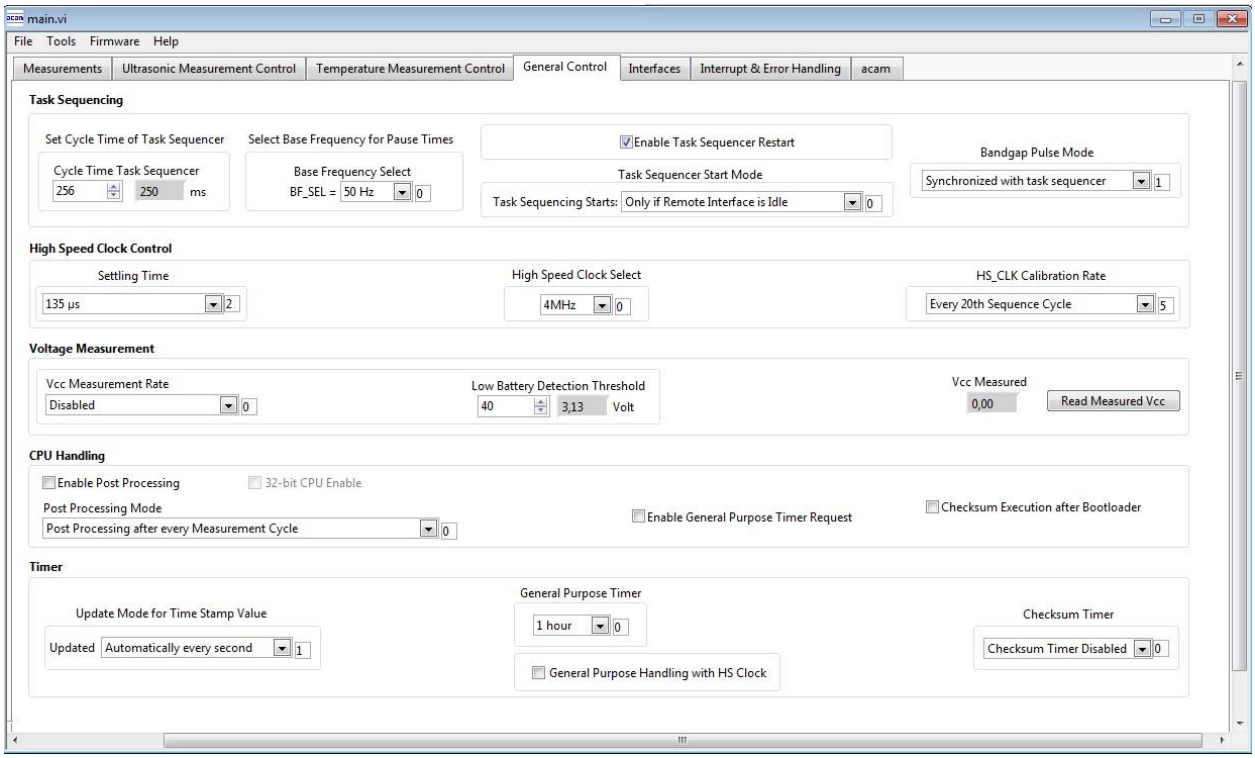
The meanings of the various settings are displayed in clear text. For more details about the register settings please refer to the GP30 manual.

4.4 General Control

The “General Control” tab covers configuration settings for

- Task sequencer
- High speed clock control
- Voltage measurement
- CPU handling
- Timer Settings

Figure 10



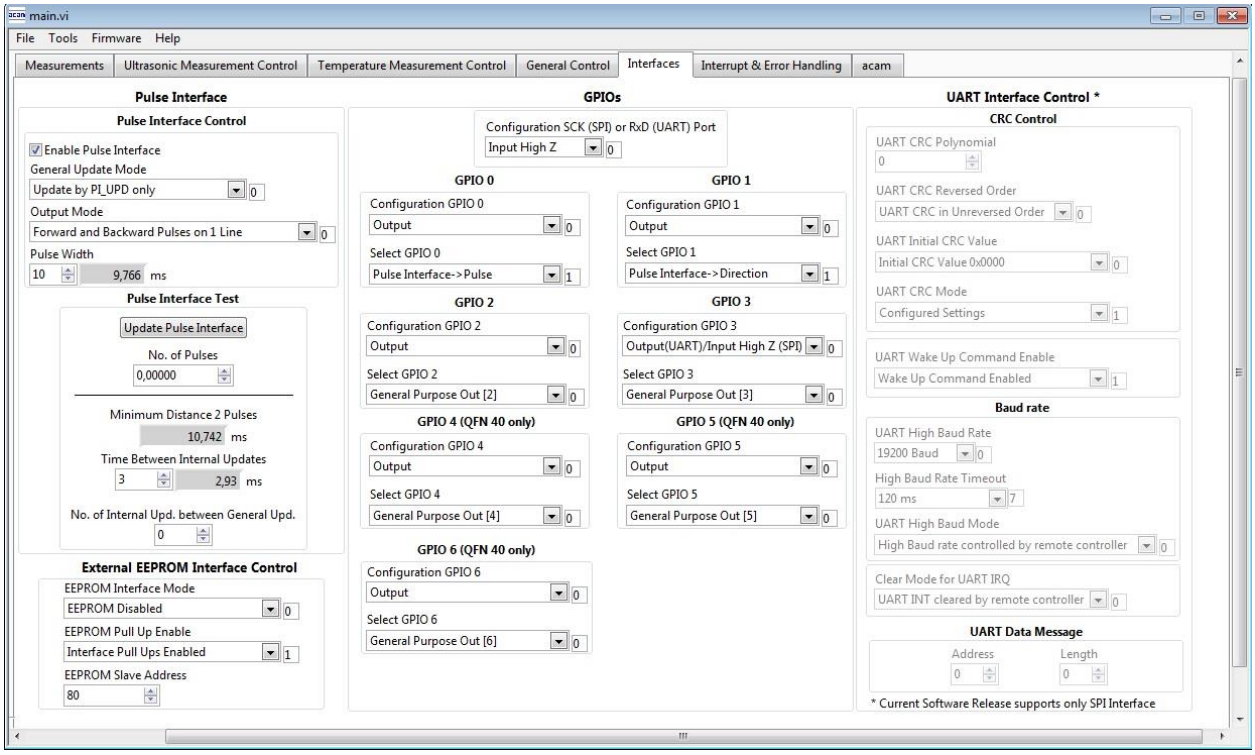
The meanings of the various settings are displayed in clear text. For more details about the register settings please refer to the GP30 manual.

4.5 Interfaces

The “Interfaces” tab covers configuration settings for

- Pulse interface including test option
- EEPROM interface
- GPIO Control
- UART remote interface.

Figure 11

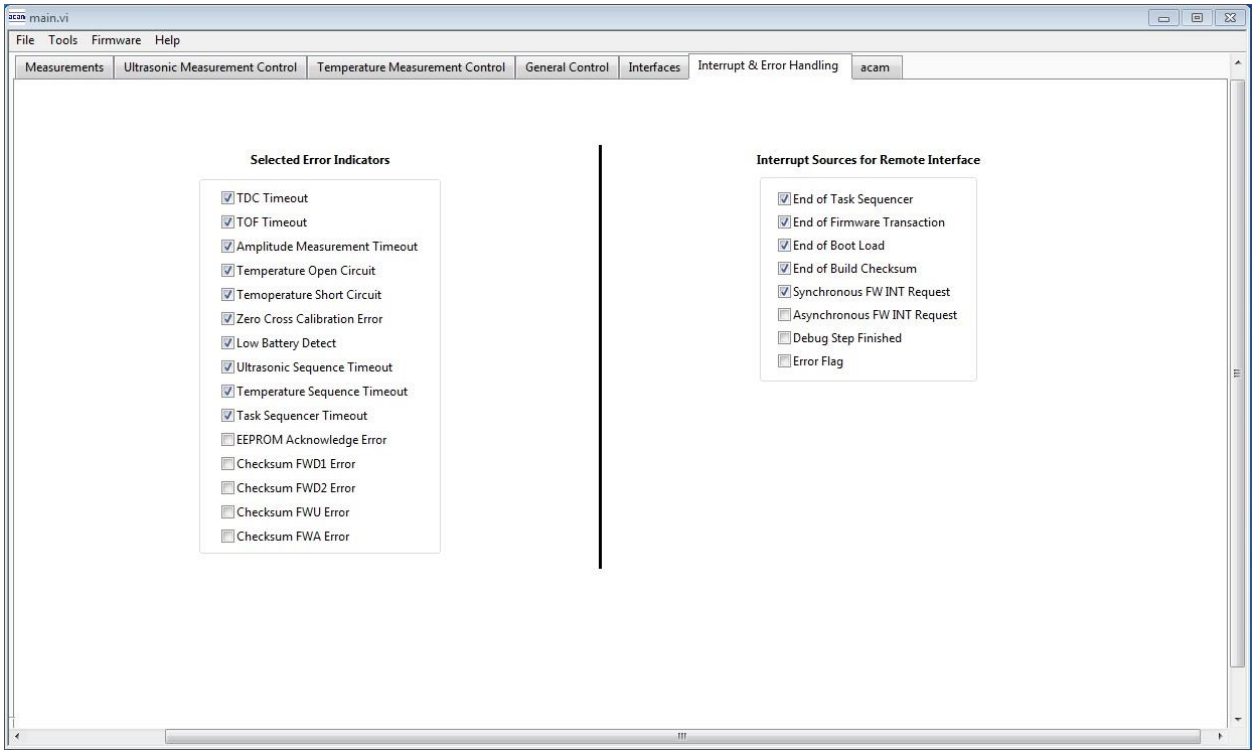


The meanings of the various settings are displayed in clear text. For more details about the register settings please refer to the GP30 manual.

4.6 Interrupt & Error Handling

On this tab error indicators and interrupt sources for remote interface can be selected.

Figure 12



The meanings of the various settings are displayed in clear text. For more details about the register settings please refer to the GP30 manual.

5 Software Menu

Beside main window, the software menu allows the opening of other windows. There are some menu items which are redundant to available buttons of main window.

5.1 File

5.1.1 Open Config

This dialog box allows the path selection of a configuration file, covering the register settings, necessary for a proper configuration of the GP30. After opening this file, the control settings are updated in the GUI.

5.1.2 Save Config

This menu item allows the saving of the current GUI control settings into a configuration file

5.1.3 Close

Close all open windows of the GP30 Evaluation software.

5.2 Tools

5.2.1 Run Measurement

Same function as “Start/Stop Measurement” button in “Measurement” tab of main window.

5.2.2 TOF Graph

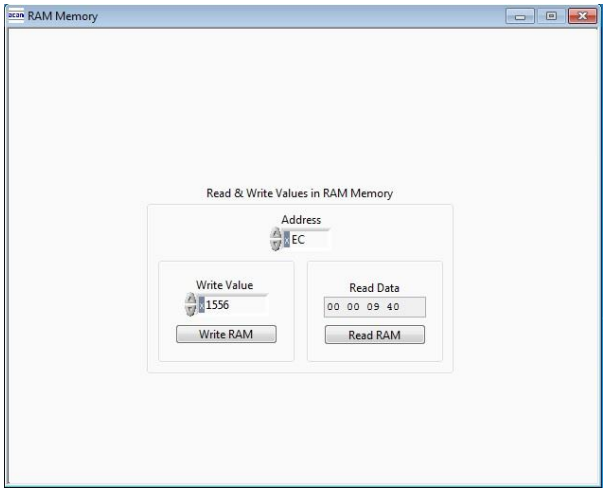
Same function as “Open TOF Graph” button in “Measurement” tab of main window.

5.2.3 Temperature Graph

Same function as “Open Graph” button for temperature measurement in “Measurement” tab of main window.

5.2.4 **RAM Memory**

Figure 13

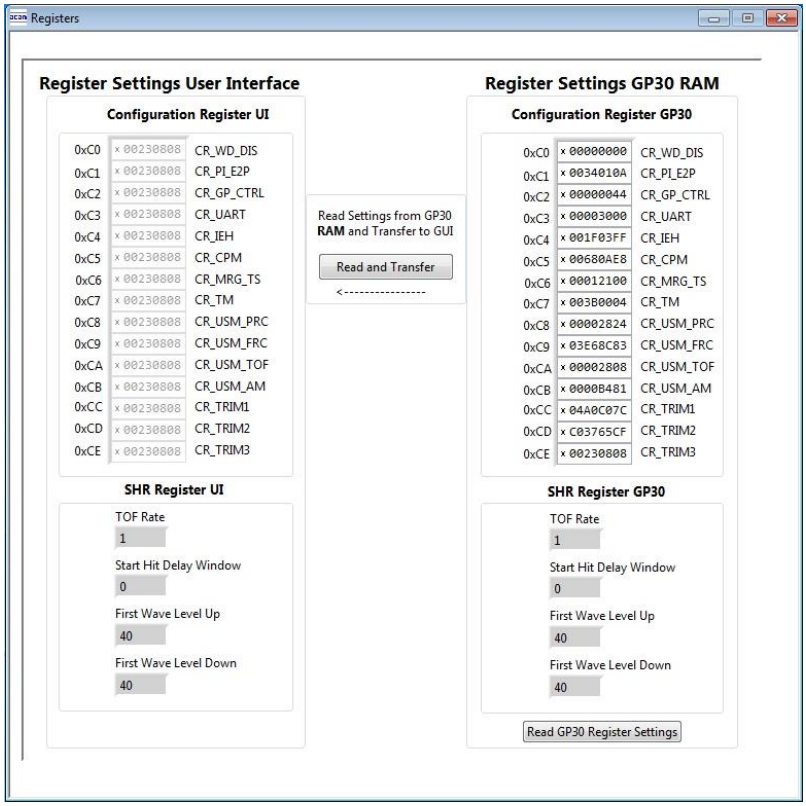


Opens a window which allows single write and read accesses to random access area for addresses 0x000 – 0x0FF.

The random access area from 0x100 – 0x17F, containing the firmware data, can be accessed separately by “Firmware Download” window.

5.2.5 **Registers**

Figure 14



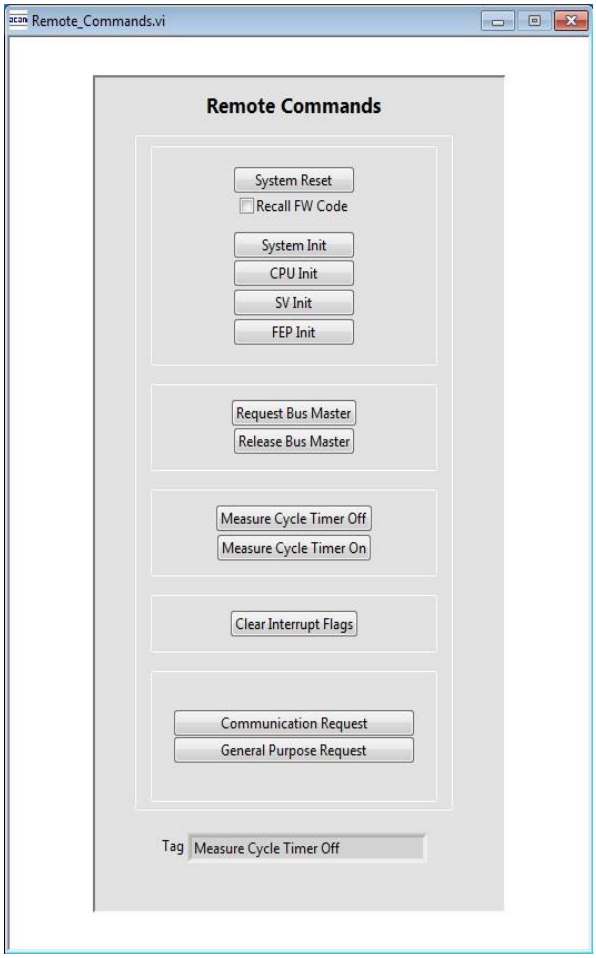
Opens a window which shows the registers important for a proper configuration setting of the GP30. In the left column, the register contents correspond to the settings done in tabs of GUI main window. If the button “Read GP30 Register Settings” is pressed, the configuration settings located in GP30 registers are displayed in the right column,. By pressing “Read and Transfer” button, the register settings in the tabs of main window and in the left column of this window are updated with the register settings from right column.

5.2.6 **Remote Commands**

This window summarizes some additional commands which can be executed via remote interface.

- System Reset: Executes a complete system reset of GP30. Same function as “System Reset” button in “Measurement” tab of main window.
- System Init: Same function as “System Reset” without clearing the configuration (CR_...) and the system handling (SHR_...) register.

Figure 15



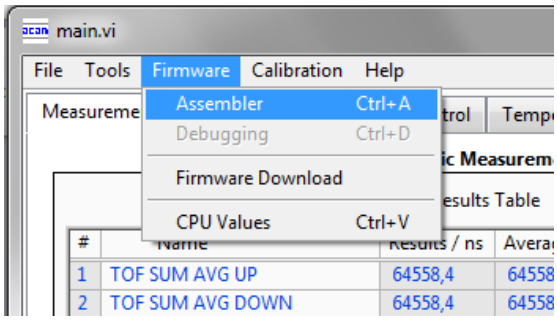
- CPU Init: Clears the CPU block in GP30
- SV Init: Clears the supervisor block in GP30
- FEP Init: Clears the frontend processing block in GP30
- Request/Release Bus Master: Allows the request of the bus master in GP30, e.g. if the random access bus is blocked by a deadlock, caused by an improper firmware download.
- Measure Cycle Timer Off/On: Stop & start of the measure cycle timer.
- Clear Interrupt Flags: Clears all bits in SRR_IRQ_FLAG register
- Communication Request: Allows an asynchronous demand by remote controller to get an interrupt by GP30, signalizing the time for remote communication
- General Purpose Request: Allows an asynchronous request by remote controller to initiate a general purpose handling in in firmware of integrated GP30 CPU.

5.3 Firmware

5.3.1 Assembler

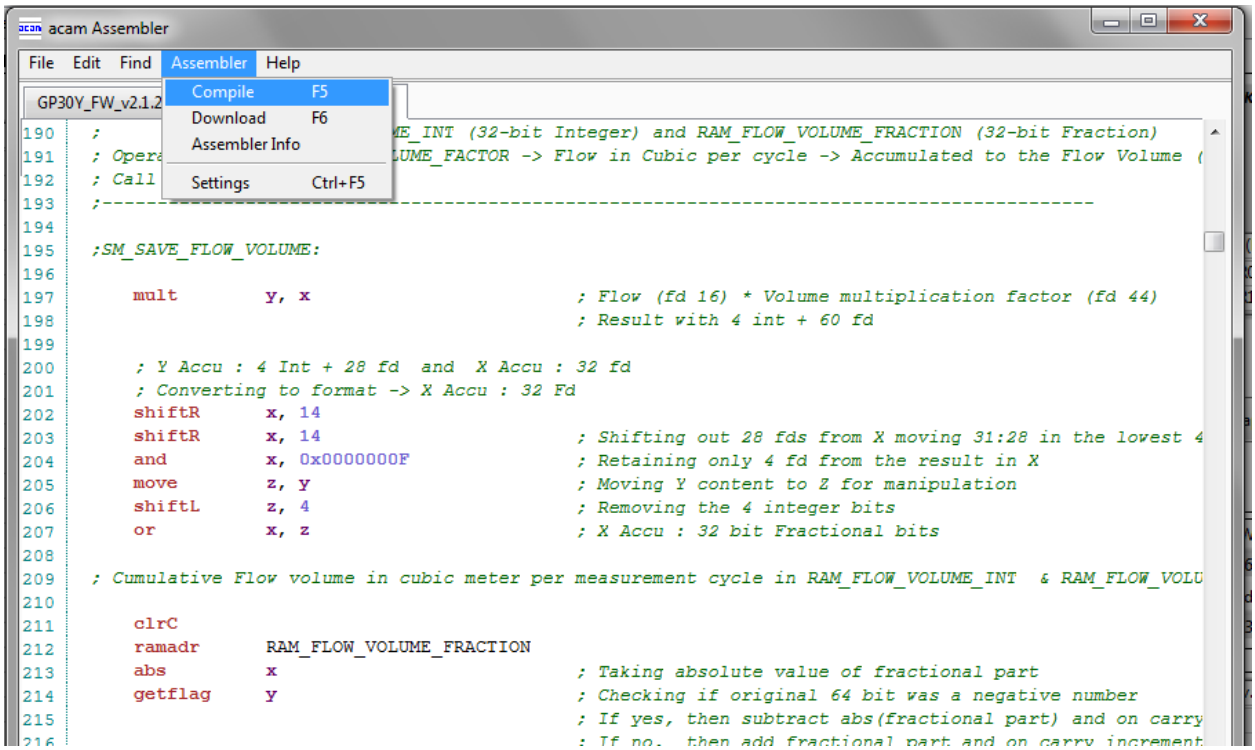
The TDC-GP30 assembler is integrated into the GP30 evaluation software. It is opened in the Firmware menu of the main program:

Figure 16



The following window comes up:

Figure 17



This is a comfortable editor with syntax highlighting, search and replace, copy and paste functions.

Under menu item “Assembler” the user finds the compile and download options. The download option effects, that “Firmware Download” window is opened (see also below).

Whether the call of these functions was successful or not is indicated by the messages at the bottom of the assembler window.

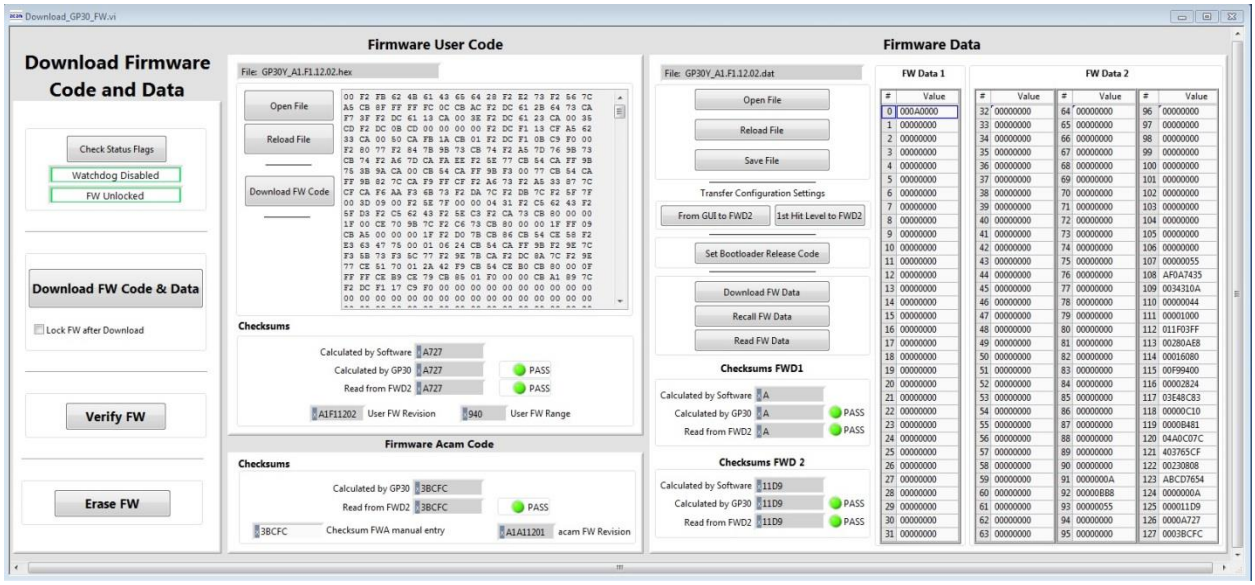
5.3.2 **Debugging**

Not supported in this software revision.

5.3.3 **Firmware Download**

This window allows the download of the firmware which is typically handeld by 2 files, one for the “Firmware User Code” and one for the “Firmware Data”.

Figure 18



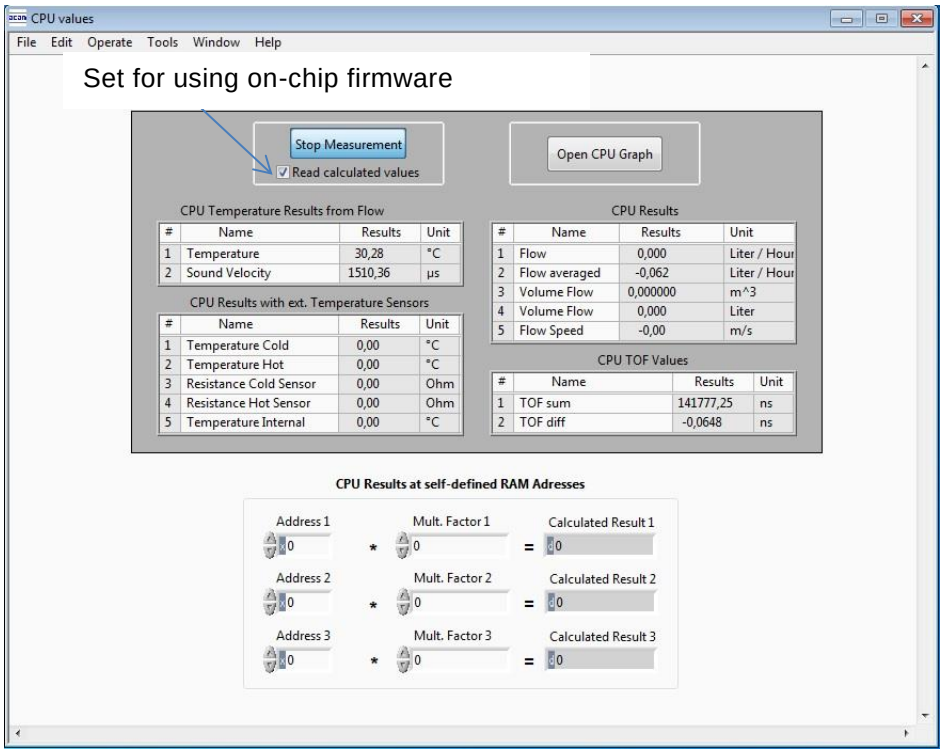
- With “Check Status Flag”, the watchdog and the lock state of the GP30 can be checked. Please make sure that the watchdog is disabled before starting a download or other transactions in this window.
- In the “Firmware User Code” section, a firmware user code file (*.hex), which is typically generated by the assembler tool and intended for the user part of 4kx8 Program NVRAM, can be loaded by pressing “Open File”.
- In the “Firmware Data” section, a firmware data file (*.dat), which is intended for the 128x32 Data NVRAM, can be loaded by pressing “Open File”. This section also contains some additional transfer options from GUI to FW Data 2 fields and from GP30 back to FW Data 2 fields.
- By pressing “Download FW Code & Data” both files are stored in the corresponding NVRAMs. This action takes a few seconds. After the download, both files are located in the volatile as well in the non-volatile part of the appropriate NVRAMs. The download can be combined with a lock option of the firmware.

- When pressing “Download FW Code & Data” a possible auto running firmware program is stopped. If a new proper auto running firmware program is downloaded, this firmware can be started again by performing a system reset.
- The last 4 addresses of FW Data 2 section contains the fields for the checksums which are stored to GP30 when downloading firmware to GP30. These fields are directly updated, when firmware files are loaded or contents of firmware data fields are changed.
- If pressing the “Verify FW” button after downloading, the content of the NVRAMs can be compared with the given files by their checksums. The software calculates the checksum of the given files and reads the calculated checksums of GP30 as well as the stored checksums at the end of FWD2 section. Then the checksums of every section are compared to each other. In case of a successful programming all indicators have to be green.
- In the “Firmware Acam Code” section, the checksums for the firmware acam code are also checked and displayed after a “Verify FW”. The firmware acam code cannot be modified by user. Therefore a checksum calculated by software filed is missing in this section.
- A lock state of GP30 or a hang-up, caused by a faulty firmware user code can be dissolved by pressing “Erase FW” button. After that, a new firmware (user code & data) need to be downloaded again.

5.3.4 **CPU Values**

This tab is only for customer who uses the acam firmware for flow calculation. It reads out some important CPU values like water temperature, flow, velocity, etc. To enable the readout the “Read calculated values” checkbox has to be set.

Figure 19

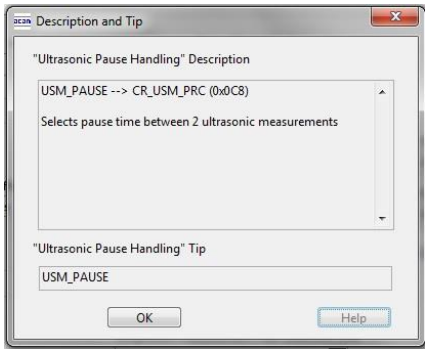


5.4 Calibration

Not supported in this software revision

5.5 Help

When moving the cursor over the values in tabs of main window, the parameter name (used in the GP30 manual) is displayed. By right-click and selection of “Description and Tip”, a window is opened showing additional description of the value.



5.5.1 **Help Contents**

Not supported in this software revision

5.5.2 **USB Communication**

As described in chapter “Software Installation”.

5.5.3 **About**

Displays software version number together with general information about software and acam.

6 Development Board Hardware Details

6.1 Schematics / Layout

Figure 20 Schematics

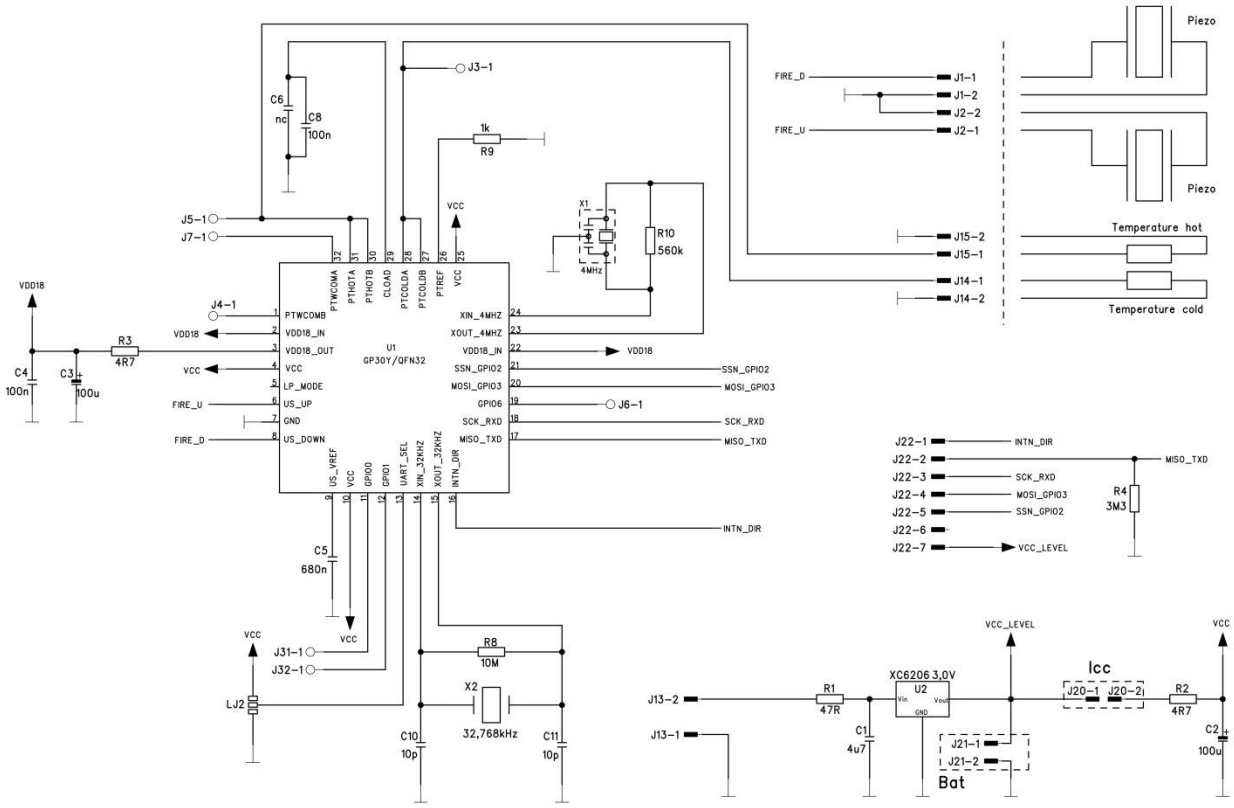


Figure 21 Top layer

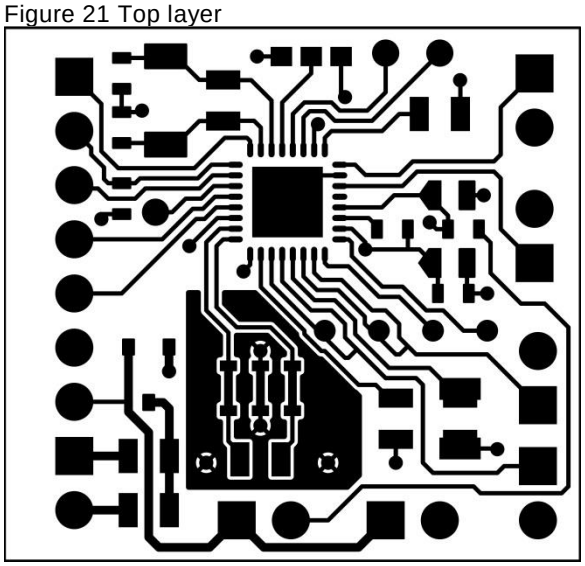


Figure 22 Bottom layer

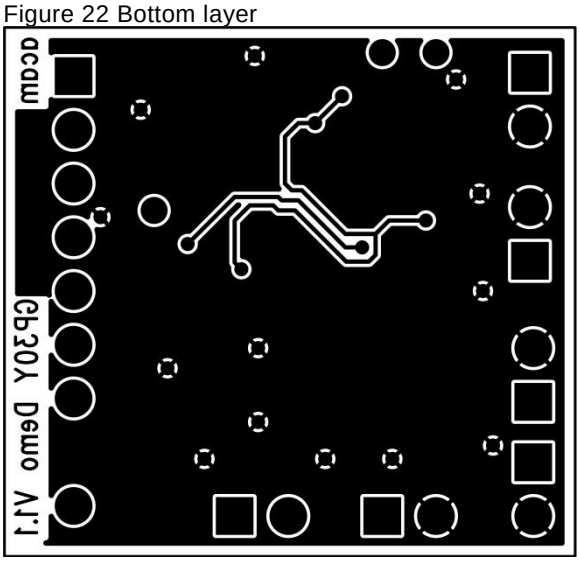
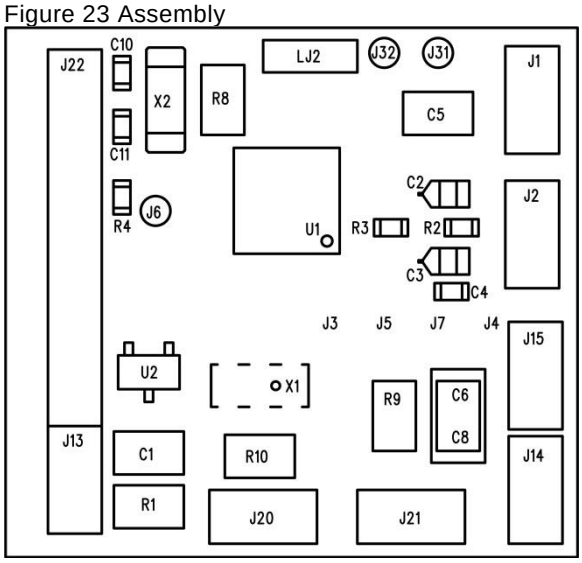


Figure 23 Assembly



6.2 Bill of Materials

Table 6.1 GP30-DEMO-US-PCB BOM

Qty	Reference	Value	Part	Description
1	U1	GP30	QFN32	TDC GP30
	U2	3,0 V	XC6206	Voltage Regulator
1	X1	4 MHz	CSTR_G	Ceramic Resonator
1	X2	32,768 kHz	KX-327XS	Quartz Crystal
1	C1	4u7	C805	Chip Capacitor
2	C2, C3	100u	F95_P	Solid Tantalum
1	C4	100n	CC603	Chip Capacitor
1	C5	680n	C805	Chip Capacitor
1	C6	nc	C805	Chip Capacitor
1	C8	100n	C1206	Chip Capacitor
2	C10, C11	10p	CC603	Chip Capacitor
1	R1	47R	R805	Chip Resistor
2	R2, R3	4R7	R603	Chip Resistor
1	R4	3M3	R603	Chip Resistor
1	R8	10M	R805	Chip Resistor
1	R9	1k	R805	Chip Resistor
1	R10	560k	R805	Chip Resistor
1	J13	2 pol.	ST/254_2	Connector for power supply (combined with J22)
1	J22	7 pol.	ST/254_7_1R	Connector for SPI interface (combined with J13)
1	J20	2 pol.	ST/254_2	Jumper for current measurement of Vcc
1	LJ2	3 pol.		Solder bridge to select between SPI & UART

7 Miscellaneous

7.1 Literature Guide

Datasheets

Title	Document-No.
TDC-GP30 Datasheets	DB_GP30_Vol1.en DB_GP30_Vol2.en
Development kits	DB_GP30-DEV_en

Application Notes

Title	Document-No.

The latest versions of the available documents can be downloaded from the acam website at:

http://www.acam.de/download-center/ultrasonicflowconverter/

7.2 Last Changes

18.03.2015 First release

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