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## **GP30**

### **Standard Board**

**GP30-EVA-KIT** 

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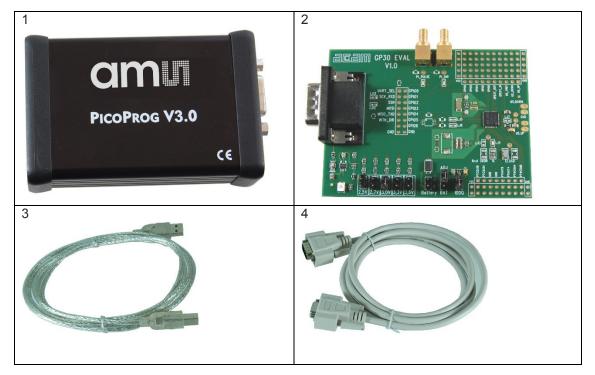
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#### 1 Introduction

The GP30-EVA-KIT is a platform for a quick and easy start-up and evaluation of the TDC-GP30 ultrasonic flow converter (UFC). It supports the QFN40 package, which makes available the full functionality of TDC-GP30. 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.





| Pos. | Item                      | Comment                                   |
|------|---------------------------|-------------------------------------------|
| 1    | PICOPROG V3.0             | Programmer and interface                  |
| 2    | GP30-EVA-BOARD            | Based on TDC-GP30 in QFN40 package        |
| 3    | High density DSUB15 cable | Connecting Evaluation board to programmer |
| 4    | USB cable                 | Connects PicoProg V3.0 to PC              |

The board shows a patch field close to the GPIO pins where an external amplifier as well as analog switches for gas meter operation can be connected.

Please download the latest software for the kit from

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

#### 2 Quick Start Guide

This section describes how to quickly set up the GP30-EVA-KIT, establish basic operation and make measurements.

#### 2.1 Install the Software

It is crucial to install the software before connecting the evaluation kit to your computer. A default driver loading of your OS may interfere with correct installation.

- Download the latest zipped software installation package to the desired directory.
- Unzip the package to the desired directory.
- Open "setup.exe" from the unzipped directory.
- Follow the instructions on the screen.

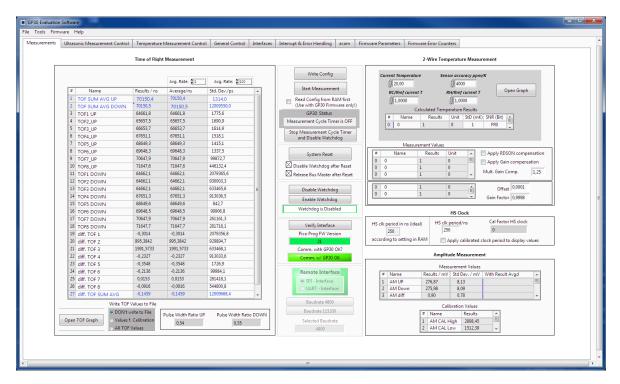
#### 2.2 Install the Hardware:

- Make sure software is installed correctly before proceeding with this step!
- Connect your computer with the PicoProg V3.0 using USB cable.
- Connect PicoProg V3.0 and the evaluation kit motherboard using the DB15 interfaces
- The green LED on the evaluation kit should be on.
- Connect your spool piece to US\_UP and US\_DOWN

#### 2.3 Quick Start for Initial Measurements

From the "Start" menu, go to "All Programs" and then to the "acam" directory. Double click the "GP30\_v1\_5\_3" icon (or newer versions, if available) to begin execution of the evaluation software. The following screen should appear:

#### Figure 2: Measurement Page





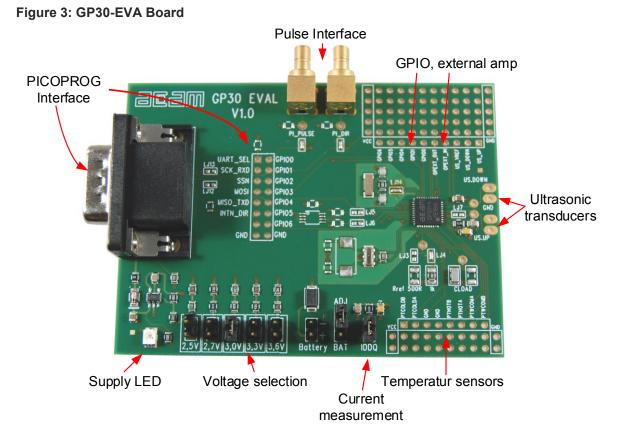
- 1. Click the "Verify Interface" button to confirm communication between PicoProg V3.0 and TDC-GP30 is working. Both fields, "Pico Prog FW version " and "Comm. With GP30 OK?" should become green.
- 2. Next, open our configuration GP30Y\_config\_default\_A1.A2.11.03 and download it into the chip, pressing "Write Config".
- 3. Connect your spool piece to pins US\_UP and US\_DOWN.
- 4. Press "Start Measurement" to begin measuring.

At this point, after successful completion of the above steps, a basic operation of the EVA kit should be possible. The following sections provide a detailed description of the hardware and software for advanced operation.

#### 3 Hardware Description

#### 3.1 Introduction

The GP30-EVA-BOARD, shown in figure 3, s the 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). All ports of TDC-GP30 are available. Additional patch fields allow an easy extension with additional circuits. Those can be amplifiers or analog switches for operation in gas meter mode.



#### 3.2 Communication Interface

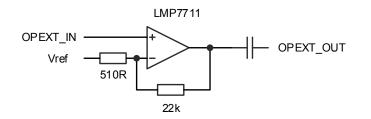
The PICOPROG device is a USB-to-SPI converter box that interfaces all UFC evaluation systems. With version 3.0, the PICOPROG also supports the USB-to-UART conversion of TDC-GP30. The PICOPROG is registered by the operating system initially as "picoprog v3.0 unprogrammed". As soon as the GP30 evaluation software starts, a special firmware is written into the PICOPROG to handle the SPI or UART communication with the TDC-GP30. The PICOPROG is now listed as "UNIPRO" in the device manager. For SPI communication only, PICOPROG version 2.0 is sufficient.



#### 3.3 External amplifier

A typical circuit for an external amplifier at high frequencies (1 to 4 MHz) could be this one:

Figure 4: External amplifier example



#### 4 Software Description

#### 4.1 Measurement

When started, the software comes up with the main window, showing the "Measurements" tab.

#### Figure 5 Main window

| Itrasonic Measurement Control    |                        | Measurement Contro   | ol General Control   |      | Interrupt & Error Handling acam Fi | imware Parameters Firmware Error Counters                                   |
|----------------------------------|------------------------|----------------------|----------------------|------|------------------------------------|-----------------------------------------------------------------------------|
|                                  | Time of Flight         | t Measurement        |                      |      |                                    | 2-Wire Temperature Measurement                                              |
|                                  |                        |                      |                      |      | Write Config                       | Current Temperature Sensor accuracy ppm/K                                   |
|                                  |                        | Avg. Rate: 📲         | Avg. Rate: \$100     |      | Start Measurement                  | () 20,00 () 4000                                                            |
| # Name                           | Results / ns           | Average/ns           | Std. Dev./ps         |      |                                    | RC/Rref current T RH/Rref current T Open Graph                              |
| 1 TOF SUM AVG UP                 | 70150,4                | 70150,4              | 1314,0               |      | Read Config from RAM first         | 1,0000                                                                      |
| 2 TOF SUM AVG DOWN               | 70150,5                | 70150,5              | 12009550,0           |      | (Use with GP30 Firmware only!)     | Calculated Temperature Results                                              |
| 3 TOF1 UP                        | 64661,8                | 64661,8              | 1775,6               |      | GP30 Status                        | # Name Results Unit StD (mK) SNR (Bit)                                      |
| 4 TOF2_UP                        | 65657,5                | 65657,5              | 1690,9               |      | Measurement Cycle Timer is OFF     | 0 0 1 0 1 FR0                                                               |
| 5 TOF3_UP                        | 66653,7                | 66653,7              | 1614,9               |      | Stop Measurement Cycle Timer       | · · · · · · · · · · · · · · · · · · ·                                       |
| 6 TOF4_UP                        | 67651,1                | 67651,1              | 1518,1               |      | and Disable Watchdog               |                                                                             |
| 7 TOF5_UP                        | 68649,3                | 68649,3              | 1415,1               |      |                                    | Measurement Values                                                          |
| 8 TOF6_UP                        | 69648,3                | 69648,3              | 1337,5               |      | System Reset                       | # Name Results Unit Apply RDSON compensation                                |
| 9 TOF7_UP                        | 70647,9                | 70647,9              | 99872,7              | -    | Maria                              | 0 0 1 0 E Apply Gain compensation                                           |
| 10 TOF8_UP                       | 71647,6                | 71647,6              | 446132,4             | -    | Disable Watchdog after Reset       | 0 0 1 0 Mult. Gain Comp. 1,25                                               |
| 11 TOF1 DOWN                     | 64662,1                | 64662,1              | 2079365,6            | -    | Release Bus Master after Reset     | 0 0 1 0 + Mult. Gain Comp. 1,25                                             |
| 12 TOF2 DOWN                     | 64662,1                | 64662,1              | 930003,3             | - 1  |                                    | 0 0 1 0 Offset 0,0001                                                       |
| 13 TOF3 DOWN                     | 64662,1                | 64662,1              | 633465,6             | =    | Disable Watchdog                   |                                                                             |
| 14 TOF4 DOWN                     | 67651,3                | 67651,3              | 913036,5             | - 11 | Enable Watchdog                    | Gain Factor 0,9998                                                          |
| 15 TOF5 DOWN                     | 68649,6                | 68649,6              | 842,7                | - 11 | Watchdog is Disabled               | <u>u</u>                                                                    |
| 16 TOF6 DOWN                     | 69648,5                | 69648,5              | 99906,8              |      | Trateina og is ofsatorea           | HS Clock                                                                    |
| 17 TOF7 DOWN                     | 70647,9                | 70647,9              | 261161,3<br>281718 1 |      | Verify Interface                   | HS clk period in ns (ideal) HS clk period/ns Cal Factor HS clock            |
| 18 TOFS DOWN                     | 71647,7                | 71647,7              | 2079356.8            |      |                                    | 250 250 0                                                                   |
| 19 diff. TOF 1                   | 995,3842               | 995.3842             | 929894,7             | - 11 | Pico Prog FW Version               | according to setting in RAM Apply calibrated clock period to display values |
| 20 diff. TOF 2<br>21 diff. TOF 3 | 1995,5842<br>1991,5733 | 1991,5733            | 633468.1             |      | 21                                 | Apply calibrated clock period to display values                             |
|                                  | -0.2327                | -0.2327              | 913033.6             |      | Comm. with GP30 OK?                | Amplitude Measurement                                                       |
| 22 diff. TOF 4<br>23 diff. TOF 5 | -0,2327                | -0,2327              | 913033,6             |      | Comm. w/ GP30 OK                   |                                                                             |
| 24 diff. TOF 5                   | -0,3548                | -0,3548              | 99984.1              | - 11 |                                    | Measurement Values                                                          |
| 24 diff. TOF 6<br>25 diff. TOF 7 | -0,2136                | -0,2136              | 281418.1             | -    | Remote Interface                   | # Name Results / mV Std Dev. / mV With Result Avgd                          |
| 25 diff. TOF 8                   | -0.0916                | -0.0916              | 544800.8             | _    | SPI - Interface                    | 1 AM UP 276,87 8,13                                                         |
| 27 diff. TOF SUM AVG             | -0.1459                | -0.1459              | 12009668.4           | -    | O UART - Interface                 | 2 AM Down 275,98 8,09                                                       |
|                                  | 1.1                    | 0,1109               | 200000,4             |      | Baudrate 4800                      | 3 AM diff 0,90 0,78 +                                                       |
|                                  | Values to File         |                      |                      |      |                                    | Calibration Values                                                          |
|                                  |                        | Pulse Width Ratio UP | Pulse Width Ratio    | DOWN | Baudrate 115200                    | # Name Results                                                              |
|                                  | f. Calibration         | 0,54                 | 0,55                 |      | Selected Baudrate                  | 1 AM CAL High 2898,45                                                       |
| C All TOP                        | Values                 |                      |                      |      | 4800                               | 2 AM CAL Low 1512,39 +                                                      |
|                                  |                        |                      |                      |      |                                    |                                                                             |

#### 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  $\mu$ P). ams provides a sample configuration file named GP30Y\_config\_default\_A1.A2.11.03 which typically works well with DN20 spool pieces.

**Load configuration file:** File menu  $\rightarrow$  Open Config  $\rightarrow$  choose appropriate configuration 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). Further, "Comm GP30 OK?" should get green to show that communication with TDC-GP30 works.
- Next step: If watchdog is not disabled by "System Reset" button → press "Disable Watchdog" button.
- Next step: Press "Write Config" button to download the configuration settings into TDCX-GP30.
- **Next step:** Press "Start measurement" button. Now the chip starts to measure and the software displays the results in the table "Time of Flight Measurements".

The user can now modify the configuration to fit it to his needs. Having done this, the user can store his own configuration files.

#### 4.1.2 Time of Flight Measurement Results

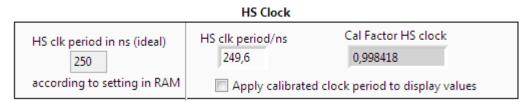
GP30 stores the first 8 hits of every TOF direction separately and also the sum of all measured hits. These 9 results are displayed for both directions, as we call them up and down. The evaluation software additionally calculates the difference between up and down stream, DIFF-TOF. In total, all 27 results are displayed in the "Results" column.

In the "Average" column the user can set the sample size for the averaging (<1000). 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.

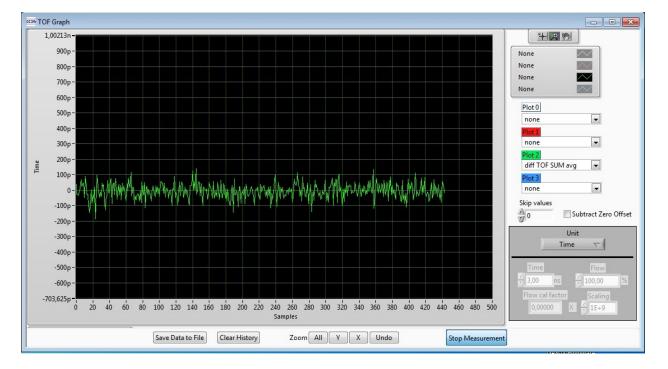
**Note**: The high speed calibration is by default off. This is more convenient when comparing measurement data. But when collecting data for calibration it is strongly recommended to have this active.

#### Figure 6 HS Clock calibration



A graph to display TOF measurement results opens in a separate window by pressing "TOF Graph" button

It is possible to activate up to four plots. Each plot has various selections, e.g. TOF1UP, TOF2UP etc.. Always averaged values are displayed.



#### Figure 7 TOF Graph

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The measurement data can be exported into text files, either the main values for calibration only, or the full data.

#### Figure 8 Data export for calibration

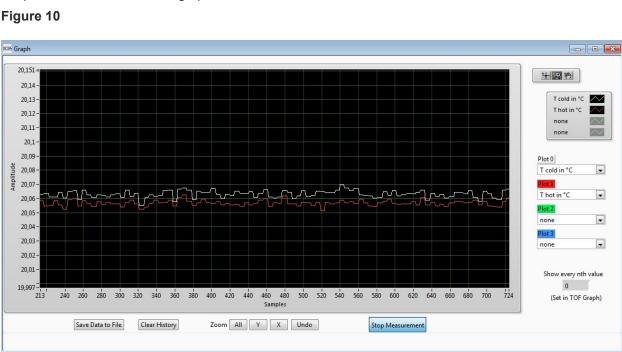
|   | А                | В         | С         | D        | E        | F        | G         | Н         | Ι         | J         | К         | L       |
|---|------------------|-----------|-----------|----------|----------|----------|-----------|-----------|-----------|-----------|-----------|---------|
| 1 | 08.08.2016 16:18 | s Elapsed | diffTOFSu | sumTOFS  | diffTOF1 | sumTOF1  | PW UP     | PW DOW    | AM UP     | AM DOW    | Status Re | gister  |
| 2 | 16:18:50         | 0         | 0,000000  | 0,000000 | 0,000000 | 0,000000 | 1,992,187 | 1,992,187 | 7,168,211 | 6,991,830 |           | FFFFFFF |
| З | 16:19:03         | 13,69     | 0,000000  | 0,000000 | 0,000000 | 0,000000 | 1,992,187 | 1,992,187 | 7,152,268 | 7,215,327 |           | FFFFFFF |
| 4 | 16:19:04         | 14,03     | 0,000000  | 0,000000 | 0,000000 | 0,000000 | 1,992,187 | 1,992,187 | 7,152,268 | 7,215,327 |           | FFFFFFF |
| 5 | 16:19:04         | 14,49     | 0,000000  | 0,000000 | 0,000000 | 0,000000 | 1,992,187 | 1,992,187 | 8,988,957 | 9,103,998 |           | FFFFFFF |
| 6 | 16:19:05         | 15,02     | 0,000000  | 0,000000 | 0,000000 | 0,000000 | 1,992,187 | 1,992,187 | 9,177,363 | 9,125,247 |           | FFFFFFF |

#### Figure 9 Dat export complete

|   | A        | в        | C      | D      | E      | F       | G       | н       | 1       | J       | K       | L       | M       | N       | 0       | P       | Q       | B       | S       | т       | U         | V         | V         | ×          | Y         | Z         | AA        | AB        | AC        | AD    | AE     | AF   | AG    | AH       | AL       |
|---|----------|----------|--------|--------|--------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|-----------|-----------|-----------|------------|-----------|-----------|-----------|-----------|-----------|-------|--------|------|-------|----------|----------|
| 1 | ******   | s Elapse | TOFSun | TOFSur | TOF1up | TOF2 up | TOF3 up | TOF4 up | TOF5 up | TOF6 up | TOF7 up | TOF8 up | TOF1dov | TOF2 do | TOF3 do | TOF4 do | TOF5 do | TOF6 do | TOF7 do | TOF8 do | diff. TOF | diff. TOF | diff. TOF | diff. TOF4 | diff. TOF | PW UP | PW DOW | AMUP | AMDOW | Status P | legister |
| 2 | 16:19:10 | 0        | 0,00   | 0,00   | 0,00   | 0.00    | 0,00    | 0,00    | 0,00    | 0,00    | 0,00    | 0,00    | 0,00    | 0,00    | 0,00000 | 0,00000 | 0,00000 | 0,00000 | 0,00000 | 0,00000 | 0,00000   | 0,00000   | 0,00000   | 0,00000    | 0,00000   | 0,00000   | 0,00000   | 0,00000   | 0,00000   | 1,99  | 1,99   | 8,89 | 9,10  |          | FFFFFFFF |
| 3 | 16:19:22 | 12,05    | 0,00   | 0,00   | 0,00   | 0,00    | 0,00    | 0,00    | 0,00    | 0,00    | 0,00    | 0,00    | 0,00    | 0,00    |         |         |         |         |         |         |           |           |           |            |           | 0,000000  |           |           |           |       | 1,99   | 9,26 | 8,81  |          | FFFFFFFF |
| 4 | 16:19:22 | 12,30    | 0,00   | 0,00   | 0,00   | 0,00    | 0,00    | 0,00    | 0,00    | 0,00    | 0,00    | 0,00    | 0,00    | 0,00    | 0,00000 | 0,00000 | 0,00000 | 0,00000 | 0,00000 | 0,00000 | 0,00000   | 0,00000   | 0,00000   | 0,00000    | 0,00000   | 0,00000   | 0,00000   | 0,00000   | 0,00000   | 1,99  | 1,99   | 9,26 | 8,81  |          | FFFFFFFF |
| 5 | 16:19:23 | 12,75    | 0,00   | 0,00   | 0,00   | 0.00    | 0,00    | 0,00    | 0,00    | 0,00    | 0,00    | 0,00    | 0,00    | 0,00    | 0,00000 | 0,00000 | 0,00000 | 0,00000 | 0,00000 | 0,00000 | 0,00000   | 0,00000   | 0,00000   | 0,00000    | 0,00000   | 0,00000   | 0,00000   | 0,00000   | 0,00000   | 1,99  | 1,99   | 8,81 | 8,46  |          | FFFFFFFF |
| 6 | 16:19:23 | 13,30    | 0,00   | 0,00   | 0,00   | 0,00    | 0,00    | 0,00    | 0,00    | 0,00    | 0,00    | 0,00    | 0,00    | 0,00    | 0,00000 | 0,00000 | 0,00000 | 0,00000 | 0,00000 | 0,00000 | 0,00000   | 0,00000   | 0,00000   | 0,00000    | 0,00000   | 0,00000   | 0,00000   | 0,00000   | 0,00000   | 1,99  | 1,99   | 8,18 | 8,41  |          | FFFFFFFF |
| 7 | 16:19:24 | 13,79    | 0,00   | 0,00   | 0,00   | 0,00    | 0,00    | 0,00    | 0,00    | 0,00    | 0,00    | 0,00    | 0,00    | 0,00    | 0,00000 | 0,00000 | 0,00000 | 0,00000 | 0,00000 | 0,00000 | 0,00000   | 0,00000   | 0,00000   | 0,00000    | 0,00000   | 0,00000   | 0,00000   | 0,00000   | 0,00000   | 1,99  | 1,99   | 6,81 | 6,91  |          | FFFFFFFF |
|   |          |          |        |        |        |         |         |         |         |         |         |         |         |         |         |         |         |         |         |         |           |           |           |            |           |           |           |           |           |       |        |      |       |          |          |

#### 4.1.3 2-Wire Temperature Measurement Results

A graph to display temperature measurement results opens in a separate window by "Temperature Graph" button, similar to TOF graph.



#### Figure 10

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Amplit

#### 4.2 Ultrasonic Measurement Control

In this tab the user makes all settings for an appropriate ultrasonic measurement. They group as follows:

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

#### Figure 11

| GP30 Evaluation Software                                    |                                   |                             |                                                                                                                     |                                                                             |                        |                   |                                      | _ <b>-</b> × |
|-------------------------------------------------------------|-----------------------------------|-----------------------------|---------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|------------------------|-------------------|--------------------------------------|--------------|
| File Tools Firmware Help                                    |                                   |                             |                                                                                                                     |                                                                             |                        |                   |                                      |              |
| Measurements Ultrasonic Measurement Control Temperature Mea | asurement Control General Control | Interfaces Interrupt & E    | rror Handling acam Fin                                                                                              | rmware Parameters F                                                         | Firmware Error Cou     | unters            |                                      | ^            |
|                                                             |                                   | т                           | ime of Flight: Sequence Con                                                                                         | trol                                                                        |                        |                   |                                      |              |
|                                                             |                                   |                             | Ultrasonic Pause                                                                                                    | -                                                                           |                        |                   | Direction Mode                       |              |
|                                                             | 25                                | Pause 1,0 * T(BF_SEL) in m  |                                                                                                                     | ause between TOF Up a<br>20,00 m                                            |                        | Toggle Directio   | n with every Measurement             | 2            |
| Fire Pulse Clock Divider Ze                                 | ero Cross Calibration Rate        |                             |                                                                                                                     |                                                                             |                        |                   | Time Of Flight Edge Mode             |              |
| Register Setting HS Clock Divisor<br>3 1 4                  | equence Cycle Trigger 🗾 👩         | Noise Mas                   |                                                                                                                     | Timeout TOF<br>128 µs                                                       | • 0                    | Positive Edge of  | of TOF Hit                           | • 0          |
|                                                             |                                   | Time Of Flig                | ht: Hit Control                                                                                                     |                                                                             |                        |                   |                                      |              |
| TOF Hits                                                    | Stored in Front End data Buffer   | Start H                     | it Mode                                                                                                             |                                                                             |                        |                   |                                      |              |
| No. of TOF Hits           12 Hits         12                | DF and first 8 TOF values         | Start Hit by First Hit Dete | ction 🔹 0                                                                                                           | Firs<br>85                                                                  | t Hit Level Up<br>74,8 | mV                | First Hit Polarity Positive 0        |              |
|                                                             |                                   | Selected Start Hit aft      | er First Hit Detection                                                                                              |                                                                             |                        |                   |                                      |              |
| No. of ignored Hits Si<br>0 Hits 0                          | itart Hit Delay Window            | 9. Hit                      | 8                                                                                                                   | First<br>85                                                                 | Hit Level Down         | mV                | Enable Pulse Width Detection         | 1            |
|                                                             |                                   | A                           | mplitude Measurement Con                                                                                            | trol                                                                        |                        |                   |                                      |              |
|                                                             | Amplitude Measurement Ra          | te Amp                      | litude Measurement Calibrati                                                                                        | on Rate A                                                                   | Amplitude Measur       | ement Peak Detect | ion End                              |              |
|                                                             | Every TOF Measurement             | Every 20t                   | h Amplitude Measurement                                                                                             | • 5                                                                         | After 8 Hits           |                   | 8                                    |              |
|                                                             |                                   |                             | Transducer Interface Option                                                                                         | ns                                                                          |                        |                   |                                      |              |
| Transducer Interface 5                                      |                                   | Enable Gas Meter Mode       | Enable Analog Switt     Enable Precharge Tr     Enable Pull-Down T     Enable Both Receive     Enable Both Fire But | ransistors in both US But<br>ransistors in both US Bu<br>t Path Transistors |                        | 🛄 Enable E        | ixternal Receive Amplifier (QFN 40 c | unly)        |
| <[                                                          |                                   |                             | III                                                                                                                 |                                                                             |                        |                   |                                      |              |

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 12

| GP30 Evaluation Software                                |                                                           |                                                 |                                                                  | - • × |
|---------------------------------------------------------|-----------------------------------------------------------|-------------------------------------------------|------------------------------------------------------------------|-------|
| File Tools Firmware Help                                |                                                           |                                                 |                                                                  |       |
| Measurements Ultrasonic Measurement Control Temperature | e Measurement Control General Control Interfaces Interrup | ot & Error Handling acam Firmware Parameters    | Firmware Error Counters                                          |       |
|                                                         |                                                           | Sequence Control                                |                                                                  |       |
|                                                         | Measurement Repetition Ra                                 | te                                              |                                                                  |       |
|                                                         | Temperature Measurement every: 0                          | Sequence Cycle Triggers                         | Measurement Subtask Handling (Pause Time)<br>5 * T(BF_SEL) in ms |       |
|                                                         | Port Measurement Order<br>1. Default Order -> 2. Reversed | Pause I                                         | between Temperature Measurements<br>30,00 ms                     |       |
|                                                         |                                                           |                                                 |                                                                  |       |
|                                                         |                                                           | Measurement Control                             |                                                                  |       |
|                                                         | Wire Mode *                                               |                                                 |                                                                  |       |
|                                                         |                                                           | Port Control                                    |                                                                  |       |
|                                                         |                                                           | Number of Ports 3 Ports 1                       | Number of Fake Measurements                                      | =     |
|                                                         | Measurement Mode                                          | s Ports                                         | 2 Fake Measurements                                              |       |
|                                                         | Internal Resistor                                         | Inactive Ports during Measurement Pulled to GND |                                                                  |       |
| * Curren                                                | nt Software Release supports only 2-wire Temperature Mode |                                                 |                                                                  |       |
|                                                         |                                                           |                                                 |                                                                  |       |
|                                                         |                                                           | Temperature Measurement Cycle Time              |                                                                  |       |
|                                                         | Į                                                         | Discharge Select                                |                                                                  |       |
|                                                         |                                                           |                                                 |                                                                  |       |
|                                                         |                                                           |                                                 |                                                                  |       |
|                                                         |                                                           |                                                 |                                                                  |       |
|                                                         |                                                           |                                                 |                                                                  | -     |
| •                                                       |                                                           | m                                               |                                                                  | ► a   |

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 sequencing
- High speed clock control
- Voltage measurement
- CPU handling
- Timer Settings

#### Figure 13

| GP30 Evaluation Software                                                                               |                                                                   |                                     |
|--------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------|-------------------------------------|
| File Tools Firmware Help                                                                               |                                                                   |                                     |
| Measurements Ultrasonic Measurement Control Temperature Measurement Control General Control Interfaces | Interrupt & Error Handling acam Firmware Parameters Firmware E    | rror Counters                       |
|                                                                                                        |                                                                   |                                     |
|                                                                                                        | Task Sequencing                                                   |                                     |
| Set Cycle Time of Task Sequencer Select Base Frequency for Pause Times                                 | V Enable Task Sequencer Restart                                   | Bandgap Pulse Mode                  |
| Cycle Time Task Sequencer Base Frequency Select                                                        | Task Sequencer Start Mode                                         | Synchronized with task sequencer    |
| 128 m 125 ms BF_SEL = 50 Hz 💌 0 T                                                                      | Task Sequencing Starts: Independent of Remote Interface State 💌 1 |                                     |
|                                                                                                        |                                                                   |                                     |
|                                                                                                        | High Speed Clock Control                                          |                                     |
| Settling Time                                                                                          | High Speed Clock Select                                           | HS_CLK Calibration Rate             |
| 135 µs 💌 2                                                                                             | 4MHz 💌 0                                                          | Every 20th Sequence Cycle 💌 5       |
|                                                                                                        |                                                                   |                                     |
|                                                                                                        | Voltage Measurement                                               |                                     |
| Vcc Measurement Rate                                                                                   | Low Battery Detection Threshold                                   | Vcc Measured                        |
| Every 50th Sequence Cycle 🔹 6                                                                          | 14 🚖 2,48 Volt                                                    | 0,00 Read Measured Vcc              |
|                                                                                                        |                                                                   |                                     |
|                                                                                                        | CPU Handling                                                      |                                     |
| VEnable Post Processing VCPU Request Enable V Post Processing Enable                                   |                                                                   |                                     |
| Post Processing Mode                                                                                   | Enable General Purpose Timer Request                              | Checksum Execution after Bootloader |
| Post Precessing only after TOF, AM, AMC, TM or HCC Measurement                                         |                                                                   |                                     |
|                                                                                                        |                                                                   |                                     |
|                                                                                                        | Timer                                                             |                                     |
| Update Mode for Time Stamp Value                                                                       | General Purpose Timer                                             | Checksum Timer                      |
| Updated Automatically every second                                                                     | 1 hour 💌 D                                                        | Checksum Every hour                 |
|                                                                                                        | General Purpose Handling with HS Clock                            |                                     |
|                                                                                                        |                                                                   |                                     |
| 4                                                                                                      | 111                                                               | •                                   |
| ٠                                                                                                      |                                                                   | • at                                |

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

#### Firmware

In case the TDC-GP30 has firmware, setting flag "Enable post processing" turns on the CPU (flow meter mode). Having this not set, the GP30 runs as front-end in time conversion mode.

#### 4.5 Interfaces

The "Interfaces" tab covers configuration settings for

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

#### Figure 14

| ents Ultrasonic Measurement Control Temperature Measureme | ent Control General Control           | Interfaces   | Interrupt & Error Handling ad  | am Firmware Parameters | Firmware Error Counters                                          |
|-----------------------------------------------------------|---------------------------------------|--------------|--------------------------------|------------------------|------------------------------------------------------------------|
| Pulse Interface                                           |                                       |              | GPIOs                          |                        | UART Interface Control *                                         |
| Pulse Interface Control                                   |                                       |              |                                |                        | CRC Control                                                      |
| Finable Pulse Interface                                   |                                       | Configuratio | n SCK (SPI) or RxD (UART) Port |                        | UART CRC Polynomial                                              |
| General Update Mode                                       |                                       |              |                                | J                      | 1021                                                             |
| Update by PI_UPD only                                     | GPIO                                  | )            | GF                             | 10 1                   | UART CRC Reversed Order                                          |
| Output Mode                                               | Configuration GPIO 0                  |              | Configuration GPIO 1           |                        | UART CRC in Unreversed Order                                     |
| Forward and Backward Pulses on 1 Line                     | Output                                |              | 0 Output                       | • 0                    | UART Initial CRC Value                                           |
| Pulse Width                                               | Select GPIO 0                         |              | Select GPIO 1                  |                        | Initial CRC Value 0x1111                                         |
| 32 🚖 31,25 ms                                             | Pulse Interface->Pulse                |              | 1 Pulse Interface->Direct      | ion 🔹 1                | UART CRC Mode                                                    |
| Pulse Interface Test                                      |                                       |              |                                |                        | Default Settings                                                 |
| ruse interrace l'est                                      | GPIO 2                                | 2            | GF                             | 10 3                   |                                                                  |
| Update Pulse Interface                                    | Configuration GPIO 2                  |              | Configuration GPIO 3           |                        | UART Wake Up Command Enable                                      |
| No. of Pulses                                             | Input Pull Up                         |              | 1 Input Pull Up                | • 1                    | Wake Up Command Enabled                                          |
| 0,00000                                                   | Select GPIO 2                         |              | Select GPIO 3                  |                        | Baud rate                                                        |
|                                                           | General Purpose Out [2]               |              | 0 General Purpose Out [3       | ] 🔹 0                  | UART High Baud Rate                                              |
| Minimum Distance 2 Pulses                                 |                                       |              |                                |                        | 19200 Baud 💌 0                                                   |
| 32,227 ms                                                 | GPIO 4 (QFN                           | 40 only)     |                                | FN 40 only)            | High Baud Rate Timeout                                           |
| Time Between Internal Updates                             | Configuration GPIO 4                  | -            | Configuration GPIO 5           | _                      | 120 ms 💌 7                                                       |
| 3 🔅 2,93 ms                                               | Input Pull Up                         |              | 1 Input Pull Up                | • 1                    | UART High Baud Mode                                              |
| No. of Internal Upd. between General Upd.                 | Select GPIO 4                         |              | Select GPIO 5                  |                        | High Baud rate controlled by remote controller 💌 👔               |
|                                                           | General Purpose Out [4]               |              | 0 General Purpose Out [        | ] • 0                  |                                                                  |
|                                                           | GPIO 6 (QFN                           | 40 only)     |                                |                        | Clear Mode for UART IRQ<br>UART INT cleared by remote controller |
| External EEPROM Interface                                 | ·                                     |              |                                |                        | OAKTINT cleared by remote controller                             |
|                                                           | Configuration GPIO 6<br>Input Pull Up | -            | -                              |                        | UART Data Message                                                |
| ROM Interface Mode                                        |                                       |              | 1                              |                        | Address Length                                                   |
| ROM Disabled 💽 0                                          | Select GPIO 6                         |              | 1                              |                        | 0 0                                                              |
| ROM Pull Up Enable                                        | General Purpose Out [6]               |              | 0                              |                        | * Current Software Release supports only SPI Interface           |
| erface Pull Ups Disabled 🔹 💿                              |                                       |              |                                |                        |                                                                  |
|                                                           |                                       |              |                                |                        |                                                                  |
| ROM Slave Address                                         |                                       |              |                                |                        |                                                                  |
| •                                                         |                                       |              |                                |                        |                                                                  |

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

#### **Pulse Interface**

The pulse interface needs an appropriate firmware in the chip. The settings in the evaluation software only generate an artificial pulse to test the general functionality. The output is not related to any measurement.

#### UART

The UART is not supported in this software version.

#### 4.6 Interrupt & Error Handling

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

#### Figure 15

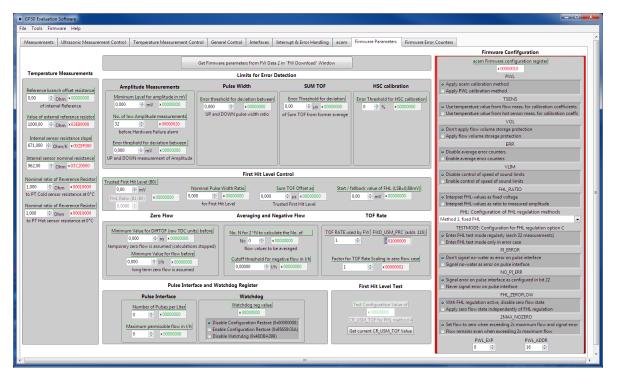
The meanings of the various settings are displayed in clear text. For more details about the register settings please refer to the GP30 manual.

#### 4.7 acam

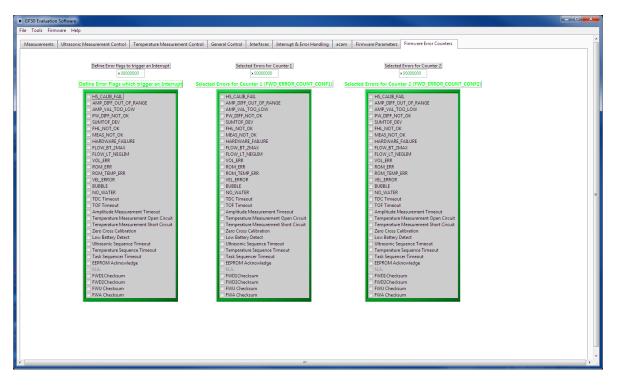
On this tab specific parameters are displayed, but for ams internal use and analysis only.

#### 4.8 Firmware Parameters and Firmware Error Counters

Those two tabs display and allow editing of parameters related to the ams flow firmware. They are of use only for TDC-GP30-F01. For details please refer to the datasheet TDC-GP30 Vol.4 Firmware Overview.



#### Figure 16



#### 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

• 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.

• Save Config

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

Close

Close all open windows of the GP30 Evaluation software.

#### 5.2 Tools

Run Measurement

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

• TOF Graph

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

• Temperature Graph

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

RAM Memory

Figure 17

| RAM Memory |             |                    |  |
|------------|-------------|--------------------|--|
|            |             |                    |  |
|            |             |                    |  |
|            |             | lues in RAM Memory |  |
|            | A<br>M<br>V | ddress<br>EC       |  |
|            | Write Value | Read Data          |  |
|            | 1556        | 00 00 09 40        |  |
|            | Write RAM   | Read RAM           |  |
|            |             |                    |  |
|            |             |                    |  |
|            |             |                    |  |
|            |             |                    |  |

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.

• Registers

| ers  |                                                                                                                                                                                                                |                                                                                                                                     |                                                                              |                      |                                                                                                                           |                                                                                                                                                             |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------|----------------------|---------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | -                                                                                                                                                                                                              | User Interfac                                                                                                                       | e                                                                            | -                    |                                                                                                                           | GP30 RAM                                                                                                                                                    |
|      | Configuratio                                                                                                                                                                                                   | n Register UI                                                                                                                       |                                                                              | Config               | uration Regi                                                                                                              | ster GP30                                                                                                                                                   |
| 0xCB | x 00230806<br>x 00230806<br>x 00230808<br>x 00230808 | CR_PI_E2P<br>CR_GP_CTRL<br>CR_UART<br>CR_JEH<br>CR_CPM<br>CR_MRG_TS<br>CR_TM<br>CR_USM_PRC<br>CR_USM_PRC<br>CR_USM_TOF<br>CR_USM_AM | Read Settings from GP30<br>RAM and Transfer to GUI<br>Read and Transfer<br>< | 0xC9<br>0xCA<br>0xCB | x 0034010A<br>x 00000044<br>x 00003000<br>x 001F03FF<br>x 00680AE8<br>x 00012100<br>x 00380004<br>x 0002824<br>x 03E68C83 | CR_WD_DIS<br>CR_PIE2P<br>CR_GP_CTRL<br>CR_UART<br>CR_JEH<br>CR_CPM<br>CR_MRG_TS<br>CR_TM<br>CR_USM_PRC<br>CR_USM_FRC<br>CR_USM_TOF<br>CR_USM_AM<br>CR_TRIMI |
| 0xCD | × 00230808<br>× 00230808<br>SHR Regis                                                                                                                                                                          | CR_TRIM2<br>CR_TRIM3                                                                                                                |                                                                              | 0xCD<br>0xCE         | × C03765CF<br>× 00230808                                                                                                  | CR_TRIM2<br>CR_TRIM3                                                                                                                                        |
|      | TOF Rate<br>1<br>Start Hit Dela<br>0<br>First Wave Le<br>40<br>First Wave Le<br>40                                                                                                                             | y Window<br>vel Up                                                                                                                  |                                                                              |                      | TOF Rate<br>1<br>Start Hit Delay 1<br>0<br>First Wave Leve<br>40<br>First Wave Leve<br>40                                 | Nindow<br>I Up                                                                                                                                              |
|      |                                                                                                                                                                                                                |                                                                                                                                     |                                                                              | Read                 | I GP30 Register                                                                                                           | Settings                                                                                                                                                    |

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.

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.

### am

#### Figure 19

| Remote Commands                                                                  |  |
|----------------------------------------------------------------------------------|--|
| System Reset<br>Recall FW Code<br>System Init<br>CPU Init<br>SV Init<br>FEP Init |  |
| Request Bus Master<br>Release Bus Master                                         |  |
| Measure Cycle Timer Off<br>Measure Cycle Timer On                                |  |
| Clear Interrupt Flags                                                            |  |
| Communication Request<br>General Purpose Request                                 |  |
| Tag Measure Cycle Timer Off                                                      |  |

- 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

Assembler

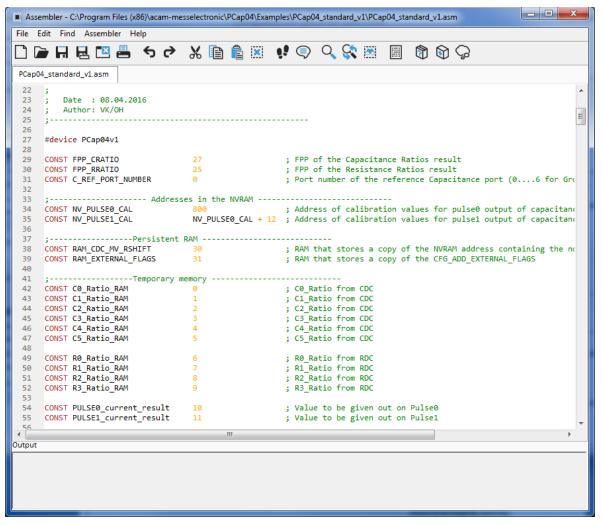
The TDC-GP30 assembler is integrated into the GP30 evaluation software. It is opened in the Firmware menu of the main program:

Figure 20

| a | ican      | mai        | in.      | vi          |             |        |                  |       |    |       |
|---|-----------|------------|----------|-------------|-------------|--------|------------------|-------|----|-------|
| ſ | File      | File Tools |          | Firmware    | Calibration | Н      | elp              | _     |    |       |
|   | Measureme |            | Assem    | oler        | Ct          | rl+A   | trol             | Temp  |    |       |
|   |           |            |          |             | Debugging   |        | Ctr              | rl+D  |    |       |
|   | # 1 TOF   |            | Firmwa   | re Download |             |        | ic Mea<br>esults | Table |    |       |
|   |           |            | CPU Va   | lues        | Ctr         | rl+V   | esuits           |       |    |       |
|   |           |            | INdiffie |             | _           | resuit | s / ns           | Avera |    |       |
|   |           |            | SUM AVG  | UP          |             | 64558  | ,4               | 64558 |    |       |
|   |           | 2          | 2        | TOF         | SUM AVG     | DOWN   |                  | 64558 | ,4 | 64558 |

The following window comes up:

#### Figure 21



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

Figure 22



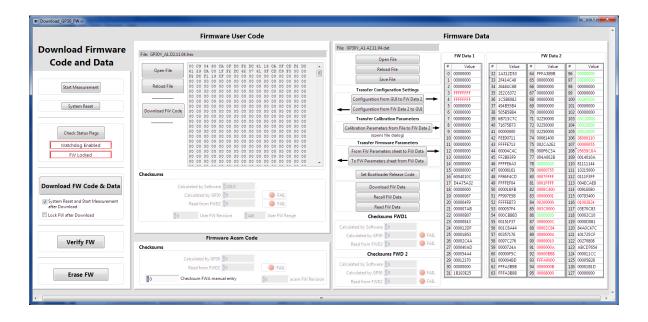
Under menu item "Assembler" the user finds the compile and download options. The download option effects, that "Firmware Download" window is opened (see also below).

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

• Firmware Download

This window allows the download of the user code and firmware data, including the configuration, to the non-volatile memory. In case the bootlaoder release code is set, the configuration from the FW Data 2 section is copied into the configuration registers.

"Firmware User Code" is either one of ams firmware examples, either the customers code or in case of chips with ams firmware (TDC-GP30-F01) the open source part. The FW Data 1 and 2 include firmware relevant coefficients and the configuration. The figure below shows an example for anTDC-GP30-F01 application. As free part of the user code firmware GP30Y\_A1.D2.11.04.hex is loaded. For the configuration and flow calculation data file GP30Y\_A1.A2.11.04.dat is loaded.

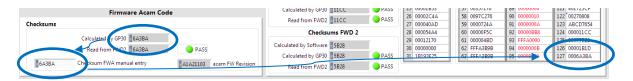


- With "Check Status Flag", the watchdog and the lock state of the GP30 can be checked.
   Please make sure that the watchdog is disabled before starting a download or other transactions in this window.
- In the "Firmware User Code" section, a firmware user code file (\*.hex), which is typically generated 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. The configuration can exchanged between the GUI of the evaluation file and the data file. Calibration can also be exchanged between GUI and data file.

- 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" any 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. A select box allows to reset and restart measurement automatically after download.
- The last four addresses of the FW Data 2 section contain the checksums which are stored to GP30 when downloading firmware to GP30. These fields are directly updated, when firmware files are loaded or content of firmware data fields are changed.
- Pressing the "Verify FW" button after downloading compares the content of the NVRAMs 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. Note: The firmware data file word 127 is by default empty, not knowing the checksum of the on-chip ams firmware.

| Firmware Acam Code          | ,                         | Calculated by GP30          | PASS | 25 00001B53<br>26 00002C4A | 57 00357176<br>58 0097C276           | 89 00000004<br>90 00000010 | 121 401725CF<br>122 00270808 |
|-----------------------------|---------------------------|-----------------------------|------|----------------------------|--------------------------------------|----------------------------|------------------------------|
| Checksums                   |                           | Read from FWD2 11CC         | PASS | 27 000040AD                | 59 0000724A                          | 91 0000000A                | 123 ABCD7654                 |
|                             |                           | Checksums FWD 2             |      | 28 000054A4                | 60 00000F5C                          | 92 00000BB8                | 124 000011CC                 |
| Calculated by GP30          |                           |                             | r.   | 29 00012170                | 61 000004BD 93 FFFA0000 125 00005B28 |                            | 125 00005B28                 |
| Read from FWD2              | G FAIL                    | Calculated by Software 5B28 |      | 30 00000000                | 62 FFFA3B9B                          | 94 000000B                 | 126 00001B1D                 |
|                             |                           | Calculated by GP30 5B28     | PASS | 31 1B193E25                | 63 FFFA3B9B                          | 95 00008000                | 127 00000000                 |
| 0 Checksum FWA manual entry | A1A21103 acam FW Revision | Read from FWD2 5B28         | PASS |                            |                                      |                            |                              |

SO copy manually the calculated checksum for the ams code into the field "Checksum FWY manual entry". Word 127 in the data will be updated and after downloading again the verification will pass for all.



- In the "Firmware Acam Code" section, the checksums for the ams firmware code are also checked and displayed after a "Verify FW". The ams firmware 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.



• CPU Values

This tab is only for customer who uses the ams 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.

The lower sections allows to read from any RAM addresses.

Figure 23

| CPU Temperature Results from Flow       CPU Results         #       Name       Results       Unit         1       Temperature       30,28       °C         2       Sound Velocity       1510,36       us         #       Name       Results       Unit         2       Sound Velocity       1510,36       us         #       Name       Results       Unit         1       Temperature Cold       0,00       °C         2       Temperature Cold       0,00       °C         3       Volume Flow       0,000       m/s         4       Volume Flow       0,000       m/s         5       Temperature Cold Sensor       0,00       Ohm         4       Resistance Cold Sensor       0,00       Ohm         5       Temperature Internal       0,00       °C         #       Name       Results       Unit         1       TOF sum       141777,25       ns         2       TOF diff       -0,0648       ns                                                                                                                      |   |                           | leasurement                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 25             |       | Open CPL    | Graph           | ]        |      |  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|-------|-------------|-----------------|----------|------|--|
| 1       Temperature       30,28       *C         2       Sound Velocity       1510,36       µs         CPU Results with ext. Temperature Sensors         #       Name       Results       Unit         1       Temperature Cold       0,00       *C         3       Resistance Cold Sensor       0,00       O/O         4       Resistance Cold Sensor       0,00       O/O         5       Temperature Internal       0,00       *C         CPU Results at self-defined RAM Adresses <b>CPU Results at self-defined RAM Adresses</b> CPU Results at self-defined RAM Adresses                                                                                                                                                                                                                                                                                                                                                                                                                                                 |   |                           | rom Flow                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                |       |             |                 |          |      |  |
| 2       Sound Velocity       1510,36       µs         CPU Results with ext. Temperature Sensors         #       Name       Results       Unit         1       Temperature Cold       0,00       *C         2       Temperature Cold Sensor       0,00       *C         3       Volume Flow       0,00000       m/3         4       Volume Flow       0,000       Liter         5       Temperature Cold Sensor       0,00       Ohm         5       Temperature Internal       0,00       *C         #       Name       Results       Unit         1       TOF sum       141777,25       ns         2       TOF diff       -0,0648       ns                                                                                                                                                                                                                                                                                                                                                                                    | # |                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                |       |             |                 |          |      |  |
| CPU Results with ext. Temperature Sensors       3       Volume Flow       0,000000       m^33         #       Name       Results       Unit         1       Temperature Cold       0,00       *C         2       Temperature Hot       0,00       *C         3       Resistance Cold Sensor       0,00       m/s         CPU TOF Values       #       Volume Flow       0,000         4       Volume Flow       0,000       m/s         CPU TOF Values       #       Volume Flow       0,000         4       Volume Flow       0,000       m/s         5       Temperature Hot       0,00       *C         #       Name       Results       Unit         1       TOF sum       141777,25       ns         2       TOF diff       -0,0648       ns         CPU Results at self-defined RAM Adresses       Mult. Factor 1       Calculated Result 1         0       *       #       0       =       0         Address 2       Mult. Factor 2       Calculated Result 2       0         0       *       #       0       =       0 |   |                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | °C             |       |             |                 |          |      |  |
| CPU Results with ext. Temperature Sensors         I       Temperature Cold       0,00       *         1       Temperature Cold       0,00       *         2       Temperature Hot       0,00       *         3       Resistance Cold Sensor       0,00       Ohn         4       Resistance Hot Sensor       0,00       Ohn         5       Temperature Internal       0,00       *         7       Top sum       141777,25       ns         2       TOF diff       -0,0648       ns         2       TOF diff       -0,0648       ns                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 2 | Sound Velocity            | 1510,36                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | μs             |       |             |                 |          |      |  |
| #       Name       Results       Unit         1       Temperature Cold       0,00       *C         2       Temperature Hot       0,00       *C         3       Resistance Cold Sensor       0,00       Ohm         4       Volume Flow       0,00       m/s         5       Flow Speed       -0,00       m/s         6       Flow Speed       -0,00       m/s         7       Resistance Cold Sensor       0,00       Ohm         5       Temperature Internal       0,00       *C         7       Temperature Internal       0,00       *C         8       CPU Results at self-defined RAM Adresses         Address 1       Mult. Factor 1       Calculated Result 1         7       0       =       0         Address 2       Mult. Factor 2       Calculated Result 2         10       *       0       =       0                                                                                                                                                                                                            |   | CPU Results with ext. Ten | perature Sens                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | ors            | 1.0   |             |                 | 1.555.67 |      |  |
| 1       Temperature Cold       0,00       *C         2       Temperature Hot       0,00       *C         3       Resistance Cold Sensor       0,00       Ohm         4       Resistance Hot Sensor       0,00       Ohm         5       Temperature Internal       0,00       *C         2       TOF sum       143777,25       ns         2       TOF diff       -0,0648       ns <b>CPU Results at self-defined RAM Adresses</b> Address 1       *       *       0       =       0         Address 2       Mult. Factor 1       Calculated Result 1       Calculated Result 2         0       *       0       =       0                                                                                                                                                                                                                                                                                                                                                                                                       | # |                           | and the second se |                | 10.00 |             | 100 C 100 C 100 |          |      |  |
| 2       Temperature Hot       0.00       *C         3       Resistance Cold Sensor       0.00       Ohm         4       Resistance Hot Sensor       0.00       Ohm         5       Temperature Internal       0.00       *C         CPU Results at self-defined RAM Adresses         CPU Results at self-defined RAM Adresses         Address 1       Mult. Factor 1       Calculated Result 1 $0$ * $0$ = $0$ Address 2       Mult. Factor 2       Calculated Result 2       Calculated Result 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |   |                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                | 5     | Flow Speed  | -0,00 m/s       |          |      |  |
| 3       Resistance Cold Sensor       0,00       Ohm         4       Resistance Hot Sensor       0,00       Ohm         5       Temperature Internal       0,00       °C         CPU Results at self-defined RAM Adresses         CPU Results at self-defined RAM Adresses         Address 1       Mult. Factor 1       Calculated Result 1         Address 2       Mult. Factor 2       Calculated Result 2         0       *       0       =       0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |   |                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | CPU TOF Values |       |             |                 |          |      |  |
| 4       Resistance Hot Sensor       0,00       Ohm       1       TOF sum       141777,25       ns         5       Temperature Internal       0,00       "C       1       TOF sum       141777,25       ns         CPU Results at self-defined RAM Adresses         Address 1       Calculated Result 1         0       *       0       =       0         Address 2       Mult. Factor 1       Calculated Result 2       Calculated Result 2         0       *       0       =       0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |   |                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                | #     | Name        |                 | Results  | Unit |  |
| $CPU \text{ Results at self-defined RAM Addresses}$ $Address 1 \qquad Mult. Factor 1 \qquad Calculated Result 1$ $Address 2 \qquad Mult. Factor 2 \qquad Calculated Result 2$ $Address 4 \qquad 0 \qquad * \qquad 0 \qquad = 0$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |   |                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                | 1     | TOF sum     | 141             | 777,25   | ns   |  |
| Address 1Mult. Factor 1Calculated Result 1 $0$ $*$ $0$ $=$ $0$ Address 2Mult. Factor 2Calculated Result 2 $0$ $*$ $0$ $=$ $0$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 5 | Temperature Internal      | 0,00                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | °C             | 2     | TOF diff    | -0              | 0648     | ns   |  |
| $\begin{array}{c}  \\  \\ \hline \\ \\ \hline \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ $                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |   |                           | CPU Results                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | at self-defir  | ned R | AM Adresses |                 |          |      |  |
| Address 2 Mult. Factor 2 Calculated Result 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |   |                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Mult. Facto    | r 1   | Calculated  | Result 1        |          |      |  |
| $\frac{\lambda}{2} = 0 \qquad \qquad \star  \frac{\lambda}{2} = 0$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |   | 0                         | * 7                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 0              |       | = 0         |                 |          |      |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |   |                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Mult. Facto    | r2    | Calculated  | Result 2        |          |      |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |   |                           | *                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 0              |       | = 0         |                 |          |      |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |   | Address 3                 | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Mult Easte     | . 2   | Caladatad   | D               |          |      |  |
| Address Multi-ractors Calculated Result s                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |   |                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                | 15    |             | Kesult 3        |          |      |  |

#### 5.4 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.

| Pause 1,0 * T(BF_SEL) in ms | ▼ 4 |
|-----------------------------|-----|

| Description and Tip                                  | ×    |
|------------------------------------------------------|------|
| "Ultrasonic Pause Handling" Description              |      |
| USM_PAUSE> CR_USM_PRC (0x0C8)                        | *    |
| Selects pause time between 2 ultrasonic measurements |      |
|                                                      |      |
|                                                      | -    |
| "Ultrasonic Pause Handling" Tip                      |      |
| USM_PAUSE                                            |      |
| ОК                                                   | Help |

Help Contents

Not supported in this software revision

USB Communication

ams Eval Kit Manual [v1-02] 2017-Oct-25

| PicoProg Settings                                                |
|------------------------------------------------------------------|
| Disable USB Handle                                               |
| PicoProg FW Path                                                 |
| R C:\Program Files (x86)\aca\data\PicoProgFW_GP30_v21.hex Change |
| GP30 Communication                                               |
| Last_Com_Action Read_Res                                         |
| stop_meas Comm w/ GP30 OK USB Error                              |

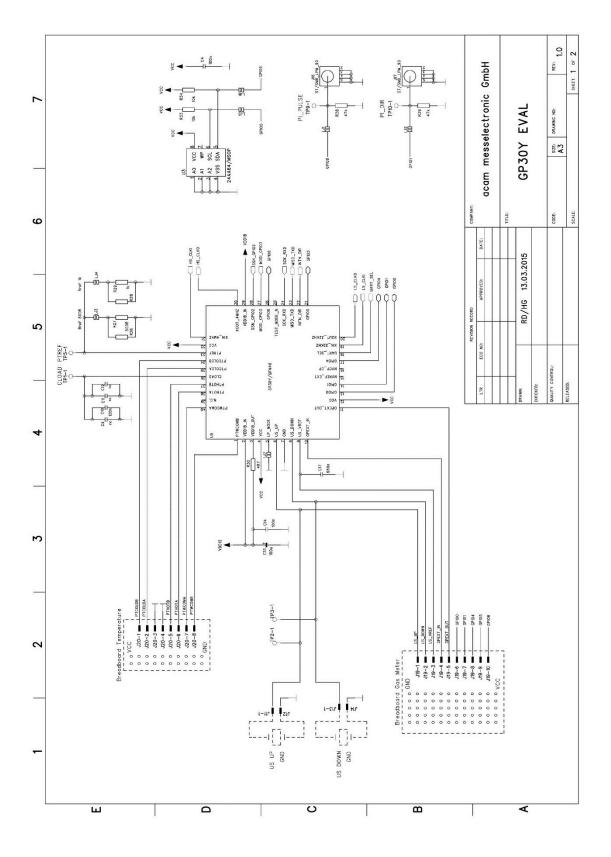
As described in chapter "Software Installation".

About

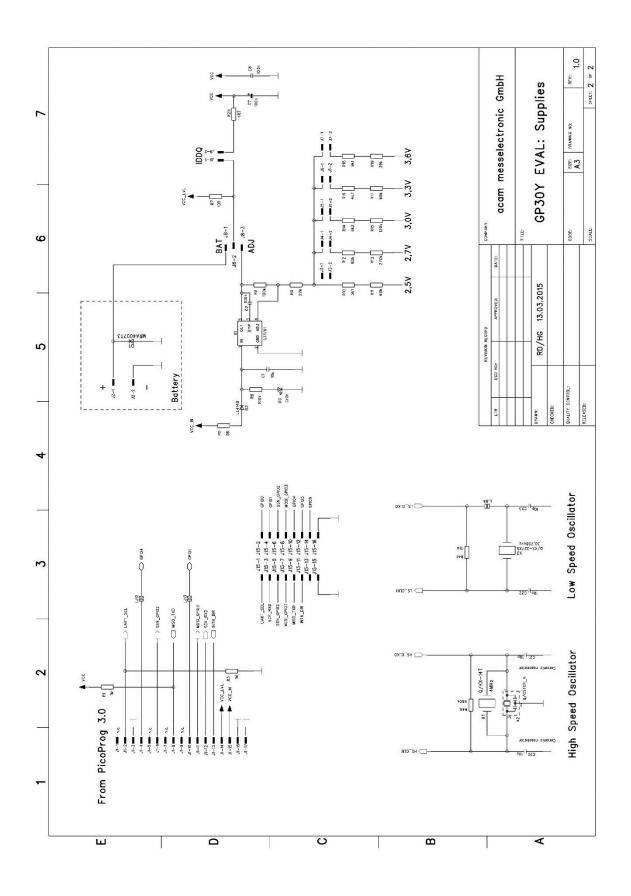
Displays software version number together with general information about software and ams.

#### 6 Schematics, Layers and BOM

#### Figure 24: GP30-EVA-BOARD Schematics

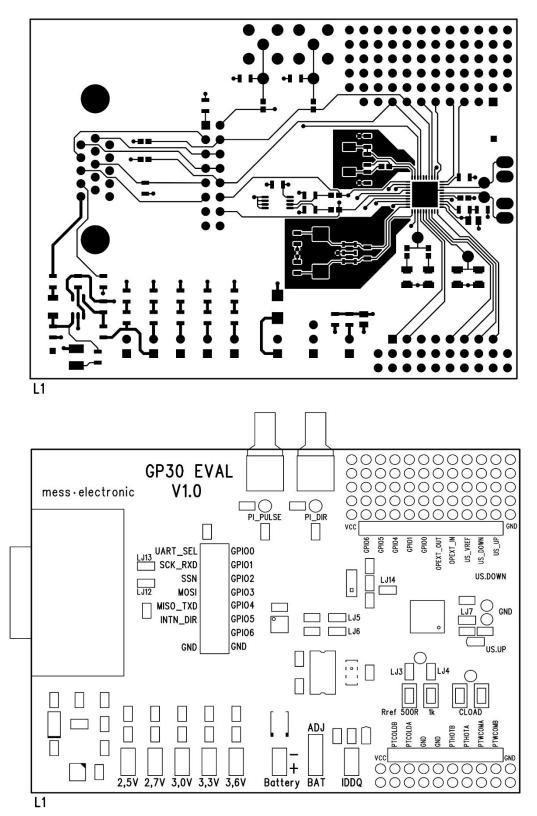


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#### Figure 26: Bill of Materials for GP30-EVA-BOARD

| Item | Qty | Reference              | Part Name                | PART DESC            | ТҮРЕ               |
|------|-----|------------------------|--------------------------|----------------------|--------------------|
| 1    | 3   | C2 C8 C14              | C805,100n                | CHIP-CAPACITOR       |                    |
| 2    | 2   | C22 C23                | C805,10p                 | CHIP-CAPACITOR       |                    |
| 3    | 1   | C1                     | C805,10u                 | CHIP-CAPACITOR       |                    |
| 4    | 1   | C17                    | C805,680n                | CHIP-CAPACITOR       |                    |
| 5    | 1   | C10                    | C1206,100n               | CHIP-CAPACITOR       | GRM31C5C1E104JA01L |
| 6    | 2   | C7 C13                 | F95_P,100u               | TANTAL               | F950J107MPAAQ2     |
| 7    | -   | U5                     | GP30Y/QFN40              | TDC GP30Y            |                    |
| 8    | 1   | D3                     | LED/HSMX-                | SURFACE              |                    |
| U    | ·   | 20                     | PLCC2,Grün               | MOUNT LED            |                    |
| 9    | 1   | D2                     | LL4148                   | DIODE                |                    |
| 10   | 1   | U1                     | LT1761                   | LOW NOISE LDO        | LT1761ES5-BYP      |
| 11   | 4   | LJ1 LJ2<br>LJ4 LJ14    | L_JUMPER                 | SOLDER BRIDGE        |                    |
| 12   | 1   | D1                     | MRA4007T3                | DIODE                |                    |
| 13   | 1   | X2                     | Q/CSTCR_G,4MHz           | CERAMIC<br>RESONATOR | CSTCR4M00G53-R0    |
| 14   | 1   | X3                     | Q/KX-<br>327XS,32,768kHz | CRYSTAL<br>QUARTZ    | KX-327XS           |
| 15   | 1   | R5                     | R805,0R                  | CHIP-RESISTOR        |                    |
| 16   | 2   | R25 R30                | R805,4R7                 | CHIP-RESISTOR        |                    |
| 17   | 1   | R7                     | R805,10R                 | CHIP-RESISTOR        |                    |
| 18   | 1   | R29                    | R805,1k                  | CHIP-RESISTOR        |                    |
| 19   | 1   | R16                    | R805,4k7                 | CHIP-RESISTOR        |                    |
| 20   | 1   | R10                    | R805,5k1                 | CHIP-RESISTOR        |                    |
| 21   | 1   | R14                    | R805,8k2                 | CHIP-RESISTOR        |                    |
| 22   | 1   | R18                    | R805,9k1                 | CHIP-RESISTOR        |                    |
| 23   | 1   | R9                     | R805,22k                 | CHIP-RESISTOR        |                    |
| 24   | 1   | R19                    | R805,39k                 | CHIP-RESISTOR        |                    |
| 25   | 2   | R11 R17                | R805,68k                 | CHIP-RESISTOR        |                    |
| 26   | 1   | R12                    | R805,82k                 | CHIP-RESISTOR        |                    |
| 27   | 2   | R6 R8                  | R805,100k                | CHIP-RESISTOR        |                    |
| 28   | 1   | R15                    | R805,120k                | CHIP-RESISTOR        |                    |
| 29   | 1   | R13                    | R805,270k                | CHIP-RESISTOR        |                    |
| 30   | 1   | R40                    | R805,560k                | CHIP-RESISTOR        |                    |
| 31   | 1   | R41                    | R805,10M                 | CHIP-RESISTOR        |                    |
| 32   | 7   | J2 J3 J4 J5<br>J6 7 J9 | ST/254_2                 | STIFTLEISTE<br>2POL. |                    |
|      |     |                        |                          |                      |                    |

| ltem | Qty | Reference | Part Name       | PART DESC                       | ТҮРЕ         |
|------|-----|-----------|-----------------|---------------------------------|--------------|
| 33   | 1   | J8        | ST/254_3_1R     | STIFTLEISTE<br>3POL.            |              |
| 34   | 1   | J1        | ST/DSUB15HD_ABG | MALE<br>CONNECTOR<br>DSUB15 ABG |              |
| 35   | 2   | J16 J17   | ST/SMB_LPM_90   | SMB<br>CONNECTOR<br>ABG         | R114.665.000 |

#### 7 Ordering & Contact Information

| Ordering Code  | Part Number | Description                                                      |
|----------------|-------------|------------------------------------------------------------------|
| GP30-EVA-KIT   | 220260004   | GP30 Eval Kit for QFN40 version including<br>PICOPROG and cables |
| GP30-EVA-BOARD | 220260008   | GP30 evaluation board for QFN40 version                          |

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#### 9 Revision Information

#### Changes from previous version to current revision 1-02 (2017-Oct-25)

Page

Updated screenshots software

**Note:** Page numbers for the previous version may differ from page numbers in the current revision. Correction of typographical errors is not explicitly mentioned.

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ScioSense:

GP30-EVA-KIT GP30-EVA-KIT-F01 GP30-EVA-BOARD GP30-EVA-F01-BOARD