

GP30

Standard Board

GP30-EVA-KIT

ams Eval Kit Manual [v1-02] 2017-Oct-25 Page 1 Document Feedback

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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

	Time of Fligh	t Measurement				2-Wire Temperature Measurement
					Write Config	Current Temperature Sensor accuracy ppm/K
		Avg. Rate: 🗐 1	Avg. Rate: \$100			20,00
# Name	Results / ns	Average/ns	Std. Dev./ps	*	Start Measurement	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 DOW	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) a
4 TOF2_UP	65657,5	65657,5	1690,9		Measurement Cycle Timer is OFF	
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		System Neset	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 Apply dail compensation
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			
13 TOF3 DOWN	64662,1	64662,1	633465,6	=	Disable Watchdog	0 0 1 0 Offset 0,0001
14 TOF4 DOWN	67651,3	67651,3	913036,5		Enable Watchdon	0 0 1 0 T Gain Factor 0.9998
15 TOF5 DOWN	68649,6	68649,6	842,7		chable Watchdog	
16 TOF6 DOWN	69648,5	69648,5	99906,8		Watchdog is Disabled	HS Clock
17 TOF7 DOWN	70647,9	70647,9	261161,3			Cal Easter HS clock
18 TOF8 DOWN	71647,7	71647,7	281718,1		Verify Interface	HS clk period in ns (ideal) HS clk period/ns Corr actor HS clock
19 diff. TOF 1	-0,3014	-0,3014	2079356,8		Pico Prog FW Version	250 230 0
20 diff. TOF 2	995,3842	995,3842	929894,7		21	according to setting in RAM Apply calibrated clock period to display values
21 diff. TOF 3	1991,5733	1991,5733	633468,1		Comm. with GP30 OK?	
22 diff. TOF 4	-0,2327	-0,2327	913033,6		Comm. w/ GP30 OK	Amplitude Measurement
23 diff. TOF 5	-0,3548	-0,3548	1726,9			Measurement Values
24 diff. TOF 6	-0,2136	-0,2136	99984,1		Remote Interface	# Name Results / mV Std Dev / mV With Result Avaid
25 diff. TOF 7	0,0153	0,0153	281418,1		SPI - Interface	1 AM IIP 276.87 813
26 diff. TOF 8	-0,0916	-0,0916	544800,8		O UART - Interface	2 AM Down 275.98 8.09
27 diff. TOF SUM AVG	-0,1459	-0,1459	12009668,4	-		3 AM diff 0,90 0,78
	OF Values to File			_	Baudrate 4800	
0.001	I't write to File				Baudrate 115200	Calibration Values
Dnen TOF Granh	es f. Calibration	Pulse Width Ratio U	P Pulse Width Ratio D	OWN	Selected Paudrate	INAME RESULTS
	OF Valuer	0,54	0,55		Selected Baudrate	2 AM CAL High 2898,45
() All I	OF Values				4800	2 AW CALLOW 1312,59 +

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 μ 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	K	L
1	08.08.2016 16:18	s Elapsed	diffTOFSu	sumTOFSu	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
3	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	H	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	+ TOFSum	TOFSun	n TOF1up	TOF2 up	TOF3 up	TOF4 up	TOF5 up	TOF6 up	TOF7 up	o TOF8 up	TOF1do	TOF2 do	TOF3 do	TOF4 do	TOF5 do	TOF6 do	TOF7 do	TOF8 do	diff. TOF	diff. TOF	diff. TOF	diff. TOF4	diff. TOF	PWUP	PWDO	AMUP	AMDOW	Status R	egister				
2	16:19:10	(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	0,00000	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
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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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								×
File Tools Firmware Help								
Measurements Ultrasonic Measurement Control Temperature Meas	surement Control General Control	Interfaces Interrupt & Error	Handling acam Fir	rmware Parameters F	Firmware Error Cor	unters		^
		Time	of Flight: Sequence Con	trol				
			Ultrasonic Paus	e Handling			Direction Mode	
10F Rate Ni 4 m	umber of Fire Pulses	Pause 1,0 * T(BF_SEL) in ms	P	ause between TOF Up a 20,00 m	and TOF Down	Toggle Direction	n with every Measurement	2
Fire Pulse Clock Divider Zero	o Cross Calibration Rate						Time Of Flight Edge Mode	
Register Setting HS Clock Divisor 3 4 Every 50th Seq	uence Cycle Trigger 🔹 👩	Noise Mask V 40	findow 9,6 µs	Timeout TOF 128 µs	• 0	Positive Edge of	f TOF Hit	
		Time Of Flight:	Hit Control					
TOF Hits St	tored in Front End data Buffer	Start Hit N	ode					
No. of TOF Hits 12 Hits 12	and first 8 TOF values 🔹 1	Start Hit by First Hit Detection	in 💌 0	Firs 85	t Hit Level Up	mV	First Hit Polarity Positive 0	
		Selected Start Hit after F	irst Hit Detection					
No. of ignored Hits Sta 0 Hits 0	nt Hit Delay Window	9. Hit	• 8	First 85	Hit Level Down	mV	Enable Pulse Width Detectio	n
		Amp	itude Measurement Con	trol				
	Amplitude Measurement Rat	te Amplitu	de Measurement Calibrati	on Rate A	Amplitude Measur	ement Peak Detection	ion End	
E	very TOF Measurement	Every 20th A	mplitude Measurement	• 5	After 8 Hits		8	
		Tra	nsducer Interface Option	ns				
Transducer Interface Se Fire Buffer 1 & Receive Path 1 Selected	lect	Enable Gas Meter Mode	Enable Analog Swite Enable Precharge Tr Enable Pull-Down T Enable Both Receive Enable Both Fire But	ches in both US buffer ransistors in both US Buf ransistors in both US Bu r Path Transistors ffer	iffer uffer	Enable Ex	xternal Receive Amplifier (QFN 40 -	only)
		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 Inter	rupt & Error Handling acam Firmware Parameter	rs Firmware Error Counters	
		Sequence Control		
	Measurement Repetition	Rate		
	Temperature Measurement every: 0	Sequence Cycle Triggers	ture Measurement Subtask Handling (Pause Time) se 1,5 * T(BF_SEL) in ms	
	Port Measurement Ord	der P.	ause between Temperature Measurements 30,00 ms	
		Massurament Control		
	Wire Mode*	measurement Control		
	2 Mire Mansurement	Port Control		
	2-Wire Measurement	Number of Ports	Number of Fake Measurements	=
	Measurement Mode	s Ports	2 Fake Measurements	
	Internal Resistor	Inactive Ports during Measurement Pulled to GND		
* Currer	nt Software Release supports only 2-wire Temperature Mode			
		Temperature Measurement Cycle Time		
		Discharge Select		
•		m		E 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.

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	🕑 Enable Task Sequencer Restart	Bandgap Pulse Mode
Cycle Time Task Sequencer Base Frequency Select	Task Sequencer Start Mode	Synchronized with task sequencer
128 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
Undeted Automatically every second	1 hour 💌 D	Charlerum Soans hour
	General Purpose Handling with HS Clock	
	11	•
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
					Default Settings
ruse interrace l'est	GPIO :	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)	GPIO 5 (Q	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 Lind. Anticent General Lind	Select GPIO 4		Select GPIO 5		High Baud rate controlled by remote controller 💌 👔
0	General Purpose Out [4]		0 General Purpose Out [
	GPIO 6 (OFN	40 only)			Clear Mode for UART IRQ
External EEDROM Interface					OAKTINT Cleared by femote controller
Exernal EPriori anellate	Configuration GPIO 6	-	-		UART Data Message
ROM Interface Mode	input Pull Up		11		Address Length
KUM Disabled	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			
	Read & Write Val	ues in RAM Memory	
	Â	ddress EC	
	Write Value	Read Data	
	Write RAM	00 00 09 40	

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

ters						
gister	Settings	User Interface		Register	Settings	GP30 RAM
1	Configuratio	n Register UI		Config	uration Regi	ster GP30
0xC0	× 00230808	CR_WD_DIS		0xC0	× 00000000	CR WD DIS
0xC1	× 00230808	CR_PI_E2P		0xC1	× 0034010A	CR PI E2P
0xC2	× 00230808	CR_GP_CTRL		0xC2	× 00000044	CR_GP_CTRL
0xC3	× 00230808	CR_UART	Read Settings from GP30	0xC3	× 00003000	CR_UART
0xC4	× 00230808	CR_IEH	RAM and Transfer to GUI	0xC4	× 001F03FF	CR_IEH
0xC5	× 00230808	CR_CPM	Read and Transfer	0xC5	× 00680AE8	CR_CPM
0xC6	× 00230808	CR_MRG_TS	Reau anu Transfer	0xC6	× 00012100	CR_MRG_TS
0xC7	× 00230808	CR_TM	<	0xC7	× 003B0004	CR_TM
0xC8	x 00230808	CR_USM_PRC		0xC8	× 00002824	CR_USM_PRC
0xC9	× 00230808	CR_USM_FRC		0xC9	× 03E68C83	CR_USM_FRC
0xCA	× 00230808	CR_USM_TOF		0xCA	× 00002808	CR_USM_TOF
0xCB	× 00230808	CR_USM_AM		0xCB	× 0000B481	CR_USM_AM
0xCC	× 00230808	CR_TRIM1		0xCC	× 04A0C07C	CR_TRIM1
0xCD	× 00230808	CR_TRIM2		0xCD	× C03765CF	CR_TRIM2
0xCE	× 00230808	CR_TRIM3		0xCE	× 00230808	CR_TRIM3
	SHR Regis	ter UI		S	HR Register	GP30
	TOF Rate			1	TOF Rate	
	1				1	
	Start Hit Dela	v Window			Start Hit Delay	Nindow
	0	School Hilling		1	0	
	First Wave Lo	vellin				111-
	A0	ter op			40	i up
	40				40	
	First Wave Le	vel Down		F	First Wave Leve	Down
	40				40	
				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 Recall FW Code System Init CPU Init SV Init FEP Init	
Request Bus Master Release Bus Master	
Measure Cycle Timer Off Measure Cycle Timer On	
Clear Interrupt Flags	
Communication Request 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

acan	ma	in.	vi						
Fil	e	То	ols	Firmware	Calibration	He	lp		
N	leas	sun	eme	Assemb	ler	Ctrl	۰A	trol	Temp
				Debugging		Ctrl-	Ctrl+D		remp
			_	Firmwar	re Download			ic Mea	Table
	#			CPU Val	ues	Ctrl-	۰V		
				INdiffie			result	s / ns	Avera
	1	L	TOF	SUM AVG L	JP		64558	,4	64558
	2	2	TOF	SUM AVG E	NWOO		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 11CC	PASS 25 PASS 26	00001B53 00002C4A	5	7 00357176 8 0097C276	89 90	00000004 00000010	121 401725CF 122 00270808
Checksums	Checksums FWD 2	27	000040AD 000054A4	6	9 0000724A 0 00000F5C	91 92	0000000A 00000BB8	123 ABCD7654 124 000011CC
Calculated by GP30 06A3BA	Calculated by Software	29	00012170	6	1 000004BD 2 FFFA3B9B	93 94	FFFA0000 0000000B	125 00005B28 126 00001B1D
0 Checksum FWA manual entry A1A21103 acam FW Revision	Calculated by GP30 5828	PASS 31	1B193E25	6	3 FFFA3B9B	95	00008000	127 00000000

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

		Stop N	leasurement	:5		Open CPL	l Graph			
	_	CPU Temperature Results f	rom Flow	1			CPU Results		1	
	#	Name	Results	Unit	#	Name	Results	Ur	nit	
	1 Temperature		30,28	°C	1	Flow	0,000	Lit	er / Hour	
	2 Sound Velocity		1510,36	μs	2	Flow averaged	-0,062 Liter / Hour		er / Hour	
	CPU Results with ext. Ten			ors	3	Volume Flow	0,000000	m	^3	
	# Name		Results	Unit	4	Volume Flow	0,000 Liter		er	
	1	Temperature Cold	0.00	°C	5	Flow Speed	-0,00 m/s		/5	
	2 Temperature Hot 0.00		°C	CPU TOF Values						
	3 Resistance Cold Sensor 4 Resistance Hot Sensor	3	0,00	Ohm	#	Name		Results	Unit	
		Resistance Hot Sensor	0,00	Ohm	1	TOF sum	1	41777,25	ns	
	5	Temperature Internal	0,00	°C	2	TOF diff		-0,0648	ns	
		Address 1	CPU Results a	at self-defi Mult. Facto	ned R	AM Adresses Calculated	Result 1			
	Address 2 M			0 Mult. Facto	r 2	= 0 Calculated	Result 2			
		Address 3	* 🐨	0 Mult. Facto	r 3	= 0 Calculated	Result 3			
			• A	0		- 50				

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	lp

• Help Contents

Not supported in this software revision

USB Communication

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PicoProg Settings
Disable USB Handle
PicoProg FW Path
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

ltem	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	1	U5	GP30Y/QFN40	TDC GP30Y	
8	1	D3	LED/HSMX- PLCC2,Grün	SURFACE MOUNT LED	
9	1	D2	LL4148	DIODE	
10	1	U1	LT1761	LOW NOISE LDO	LT1761ES5-BYP
11	4	LJ1 LJ2 LJ4 LJ14	L_JUMPER	SOLDER BRIDGE	
12	1	D1	MRA4007T3	DIODE	
13	1	X2	Q/CSTCR_G,4MHz	CERAMIC RESONATOR	CSTCR4M00G53-R0
14	1	X3	Q/KX- 327XS,32,768kHz	CRYSTAL 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 J6 7 J9	ST/254_2	STIFTLEISTE 2POL.	

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

7 Ordering & Contact Information

Ordering Code	Part Number	Description
GP30-EVA-KIT	220260004	GP30 Eval Kit for QFN40 version including 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.