

User Guide

SC-000865-UG

AS6040-DK V1.0

Development Kit for Ultrasonic Gas Meter Frontend

Preliminary Version for B-Samples

v2-00 • 2020-Jun-26



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1 Introduction

The AS6040-DK V1.0 is a platform for a quick and easy start-up and evaluation of the AS6040 ultrasonic flow converter (UFC). It supports the functionality needed for standard water and heat meters. The development kit offers user-friendly configuration and extensive testing of the AS6040, 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 AS6040 datasheets.

1.1 Kit Content & Ordering Information

Figure 1: Kit Content

AS6040-DK (Based on AS6040 in QFN48 package)

PICOPROG V3.0 (Programmer and interface)





Cable connecting board and PICOPROG

USB cable (Connects PICOPROG V3.0 to PC)



Please download the latest software for the kit from https://downloads.sciosense.com/as6040

Ordering Code	Part Number	Description
AS6040-DK V1.0	221010003	AS6040 Demo Kit including PICOPROG and cables
AS6040-DK	221010002	AS6040 Reference board



2 Quick Start Guide

This section describes how to quickly set up the AS6040-DK V1.0, establish basic operation and make measurements.

- It is crucial to install the software before connecting the evaluation kit to your computer: https://downloads.sciosense.com/as6040/
- Unzip the package to the desired directory, open "setup.exe" and follow the instructions on the screen
- Connect the PICOPROG V3.0 to the computer using the USB cable. And connect the board to the PICOPROG using the DB15 connector cable.
- Connect your spool piece to US_UP and US_DOWN. US_UP fires upstream, means versus flow. US_DOWN fires downstream, with the flow.
- Quick Start for Initial Measurements

From the "Start" menu, go to "All Programs" and then to the "ScioSense" directory. Double click the "AS6031_AS6040_Frontpanel" icon (or newer versions, if available) to begin execution of the evaluation software. The following screen should appear:

Figure 2 : Opening Page

III AS6031/AS6040 Evaluation Software	- 🗆 X
File Tools Firmware Help	
Open Config Ctri+0 3 week Manuarenet Central Tananantius Timing Constal Interfaces Interviet / Error Handling	
Save Config Ctrl+S	- am
Close Ctrl+W	
	4
1 Chip Type AS6040 Read Chip Type	write config
	Start Measurement
Configurations and the use with Evolution Contary	5
Configurations ready to use with Evaluation System	Disphie Watchdog
First kit laual Confin 2	Disable Watchoog
	Enable Watchdog
	Watchdog is Enabled
	Chin Status
	Chip Status
	Not responding
	TOF SUM AVG UP
	0
	TOF SUM AVG DOWN
	Diff TOF SUM AVG
	0
	Amplitude Measurement
	0 0
	UP DOWN
	Pulse With Ratio
	0,00 0,00
2 Verify Interface System Reset	System Status Flags
Pico Prog FW Version	Bus Occupied
⊠Release Bus Master after Reset	TS Busy in 10ms
Comm. with GP40 OK?	MCT count Low
No comm. w/ GP31/GP40	MCT count High
	MCT is Running
	Communication Failed
	Reset Flag
	Error Flag
	Clear Flags:
l	Reset Error



- Check for the right device, AS6031 or AS6040. Click the "Verify Interface" button to confirm communication between PICOPROG V3.0 and AS6040 is working. Both fields, "Pico Prog FW version" and "Comm. W. GP31/GP40 OK", should become green.
- Next, open our configuration AS6031_water_meter_Demo_FHL.cfg and download it into the chip, pressing "Write Config".
- 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.

Figure 3: Setup Window

AS60	31/AS6040 Evaluation Se	oftware							- 🗆 X
File Too	ols Firmware Help								
Setup	TOF Measurements	Ultrasonic Measurement Control	Temperature	Timing	General Control	Interfaces	Interrupt / Error Handling		amu
			Chip Type	AS6040	Read Chip T	ype			Write Config
		Configuration	ns ready to	o use w	ith Evaluatio	n System			Start Measurement
		First Hit Level					Config 2		Disable Watchdog Enable Watchdog
									Watchdog is Disabled
									MCT is ON
									TOF SUM AVG UP 227600 77
								TOF & DIFTOF	TOF SUM AVG DOWN
								in [ns]	227607,46 Diff_TOE SUM AVG
									-6,6878001
								Amplitude	Amplitude Measurement
								in [mV]	UP DOWN Pulse With Ratio
									1,01 1,00 UP DOWN
			Pico	erify Interfa Prog FW Ve	ersion		System Reset		System Status Flags
		Should be		2			able Watchdog after Reset		Bus Occupied TS Busy in 10ms
		Should be	Comn	n. with GP4	0 OK?	Enter	tuse bus muster unter neset		MCT count Low
		green	Comm	. w/ GP31/C	SP40 OK				MCT count High
									Communication Failed
									Reset Flag
								Press to clear	Clear Flags:
								reset flag	Reset Error

Clear the reset and error flags by pressing the buttons at the lower right. MCT Count Low and High should blink while the measurement is running.

2.1 Manual driver Installation

If PICOPROG is not displayed correctly then go to the drivers folder , e.g. C:\Program Files\ScioSense\AS6031_AS6040\drivers and install the driver for your operating system manually.



Figure 4: Device Manager

🕫 Devices and P	rinters				-	- 🗆	×
$\leftarrow \rightarrow \neg \uparrow$	💼 « All Co	> Devices an	d Printers	~ Ū	Search Devices an	nd Printers	Q
Add a device	Add a printer					•••	?
✓ Printers (6)							^
	Ś				۲		
Adobe PDF	Fax	Microsoft Print to PDF	Microsoft XPS Document Writer	PSB01 o SSB2103.0 ice.amsia com	n Send To off OneNote ig. 16		4
✓ Unspecified	(4)						
Apple iPhone	Digilent USB Device	UNIPRO	USB Root Hub (USB 3.0)				~
	9 items						

In case of an upgrade of the software to a newer version please make sure that the software uses the latest driver. For manual installation open the USB communications window and check the firmware version of the PICOPROG. It should be version PicoProgFW_GP40_v02.hex or higher:

Figure 5: PICOPROG Manual Installation

	III USB Communications - 🗆 🗙
	PicoProg Settings
	Disable USB Handle
	PicoProg FW Path B C:\Program Files\am\data\PicoProgFW_GP40_v02.hex Change
	GP40 Communication
AS6031/AS6040 Evaluation Software	wr RAM No comm w/ GP40 Read_Res
File Tools Firmware Help	USB Error
Setup TOF Measure About F12	



3 Hardware Description

3.1 Introduction

The AS6040-DK board, shown in Figure 6, is a front-end for a water or heat meters. The transducers and temperature sensors are directly connected to this board. It comes with a 32.768 kHz quartz (X2) and a 4 MHz ceramic oscillator (X1).

Figure 6: AS6040-DK



3.2 Communication Interface

The PICOPROG device is a USB-to-SPI converter box that interfaces all UFC evaluation systems. The PICOPROG is registered by the operating system initially as "PICOPROG v2.0 unprogrammed". As soon as the AS6040-DK evaluation software starts, a special firmware is written into the PICOPROG to handle the SPI communication with the AS6040-DK V1.0. The PICOPROG is now listed as "UNIPRO" in the device manager. For SPI communication only, PICOPROG version 2.0 is sufficient.

The flat connector connecting the PICOPROG and the AS6040-DK. includes the power lines and the SPI communication lines. VCC_LEVEL is the voltage feedback for the PICOPROG level shifters.



4 Software Description

4.1 A First Measurement

When started, the software comes up with the main window, showing the "Setup" tab. See Figure 3: Setup Window.

A good first step is to load a working configuration and make measurements in frontend mode (without using the internal 32-Bit μ P). **ScioSense** provides a sample configuration files, which you can select from the setup tab. You find them also in the data folder. They typically work well with DN20 spool pieces.

Load Configuration File: File menu \rightarrow Open Config \rightarrow choose appropriate configuration file

- 1. 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 GP40 OK?" should get green to show that communication with AS6040-DK V1.0 works.
- 2. If watchdog is not disabled by "System Reset". Button \rightarrow press "Disable Watchdog" button.
- 3. Press "Write Config" button to download the configuration settings into AS6040.
- 4. Press "Start measurement" button. Now the chip starts to measure and the software displays the major results on the right side.

You can now modify the configuration to fit it to his needs. Having done this, you can store your own configuration files.

4.1.1 Time of Flight Measurement Results

The TOF Measurements page gives a complete overview of the individual TOF measurement results. AS6040 stores the first 8 hits of every TOF direction separately and also the average 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 sample size for the averaging is 100 by default. The same number of samples is used for the standard deviation.

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.



Figure 7: TOF Measurements

AS6031/AS6040 Evaluation Softw	vare					×
etup TOF Measurements U	Itrasonic Measurement	t Control	Temperature	Timin	General Control Interfaces Interrupt / Error Handling	
	TOT Describe Table					
# Nama	TOF Results Table		an Stat Day (m		Amplitude Measurement	
# Name	Results / H	TOTTO A	ns std. Dev./ps		Measurement Values Calibration Values	Maine Confin
1 TOF SUM AVG UP	79579,4	/95/9,4	1312,9	- 11	# Name Results / mV Std Dev. / mV With Result Avg A # Name Results A	Write Config
2 TOF SUM AVG DOWN	/95/9,4	/95/9,4	1313,8		1 AM UP 241,28 0,69 1 AM CAL High 5417,81	-
3 TOF UP Value 0	75075,1	75075,1	1330,5		2 AM Down 241,69 0,62 2 AM CAL Low 3643,91 V	Start Measurement
4 TOF UP Value 1	76080,2	76080,2	1321,4		3 AM diff -0,41 0,90 V	
5 TOF UP Value 2	77083,8	77083,8	1292,6			Disable Watchdog
6 TOF UP Value 3	78084,7	78084,7	1309,3	-	HS Clock	Epoble Watchdog
7 TOF UP Value 4	79083,2	79083,2	1319,3	T		Linable watchoog
8 TOF UP Value 5	80079,6	80079,6	1311,2	T	Pond US CLK Divider	Watchdog is Disable
9 TOF UP Value 6	81076.7	81076.7	1338,4	+	HS clk period in ns (ideal) HS clk period/ns Cal Factor HS clock	r
10 TOF UP Value 7	82075.8	82075,8	1314.5	- 1	HS Clock Divider 249.79 250	Chip Status
11 TOF UP Value 8	83076,9	83076,9	1316,6	- 1	250 NOT Set	MCT is ON
12 TOF UP Value 9	84078,4	84078,4	1321,7		Apply calibrated clock period to display values	TOF SUM AVG UP
13 TOF DOWN Value 0	75075,1	75075,1	1341,1			70570 449
14 TOF DOWN Value 1	76080,2	76080,2	1326,7	-		TOE SUM AVC DOWN
15 TOF DOWN Value 2	77084,1	77084,1	1334,7	-	Write IOF Values to File Don't write to File	TOP SOM AVG DOWN
	70004.0	70004.0	1005.0	-		/95/9,419
18 TOF DOWN Value 3	78084,8	78084,8	1325,2	4		Diff. TOF SUM AVG
18 TOF DOWN Value 5	80079.6	80070 6	1305,0	+		0,029754639
10 TOT DOWN VUICE 5	00075,0	00075,0	1303,7	4		Amplitude Measureme
19 TOF DOWN Value 6	81076,5	81076,5	1318,5	-		240,907 241,574
20 TOF DOWN Value 7	82075,7	82075,7	1307,8	-		UP DOWN
21 TOF DOWN Value 8	83076,8	83076,8	1300,3	+		Pulse With Ratio
22 TOP DOWN Value 9	84078,3	84078,3	1512,8	-		0,62 0,62
23 diff. TOF 0	-0,0153	-0,0153	185,7	4		UP DOWN
24 diff. TOF 1	0,0267	0,0267	178,0	4		System Status Flags
25 diff. TOF 2	-0,2747	-0,2747	180,7			Bus Occupied
26 diff. TOF 3	-0,1221	-0,1221	167,1	1		TS Busy in 10ms
27 diff. TOF 4	0,0610	0,0610	180,5	T		MCT count Low
28 diff. TOF 5	0,0496	0,0496	160,9			MCT count High
29 diff. TOF 6	0,1945	0,1945	169,4	+		MCT is Running
30 diff. TOF 7	0,1373	0,1373	166,2			Communication Fa
31 diff. TOF 8	0,1259	0,1259	164,1			Reset Flag
32 diff. TOF 9	0,1144	0,1144	170,8			Error Flag
33 diff. TOF SUM AVG	0,0298	0,0298	79,2			Clear Flags:
				i		Reset Error



Information

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

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	I	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: Data Export Complete



It is possible to display the results graphically, too. Open menu item "Tools/TOF Graph" to open this separate window.

Figure 10: Opening a TOF Graph

ហ /	AS6031/AS6040	Eval	uatio	n Softwa	re				
File	Tools Firmv	vare	Hel	р					
Set	Run Measu	ireme	ent	Ctrl+R	on				
	TOF Graph			Ctrl+T					
#	Temperatu	re Gr	aph	Ctrl+G	- H				
1	RAM Mem	ory		Ctrl+M	Ŀ				
2	Registers	Registers							
3	Remote Co	mma	ands		-				
	TOP UP VALUE	. 4	-	_	_				

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



Figure 11 : TOF Graph



4.2 Ultrasonic Measurement Control

On this page 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 12 :

Ultrasonic Measurement Control Tab



The meanings of the various settings are displayed in clear text. For more details about the register settings please refer to the AS6040 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

On the right side, the individual measurements of the temperature measurement task are displayed numerically.

Figure 13 : Temperature Tab

ools Firmware Help				
TOF Measurements Ultrasonic Measurement Control Temperature Timing	General Control Interfaces Interrupt /	Error Handling		
Sequence Control	Temperature Measurement			GIII
	Name	Results / ns	RAM Address 🔺	
Port Measurement Order	Gain Compensation		0x80	write config
Reversed Order	Reference Port REF-AB		0x81	
	Temperature Port M1-A		0x82	Start Measureme
Temperature Measurement Subtask Handling (Pause Time)	Temperature Port M2-A		0x83	
Only One Measurement per Cycle 🗸 🗸 0	RDSON Compensation		0x84	Disable Watchd
	Internal Temperature Reference		0x85	
Pause between Temperature Measurements	Internal Temperature Compensatio	n	0x86	Enable Watchoo
N/A ms	Internal Temperature Measuremen	t	0x87	Watchdog is Disal
	Pressure Port M1-B		0x88	P.
	Pressure Port M1-B		0x89	Chip Status
	Pressure Port M2-B		0x8C	MCT is ON
Measurement Control	Pressure Port M2-B		0x8D	incr is on
	Gain Compensation		0x8E	TOF SUM AVG UP
Measurement Mode *	Reference Port REF-A		0x8F	79579,449
Off v n	Temperature Port M1-A		0x90	TOF SUM AVG DOV
* Current Software Pelease supports only 2-wire Temperature Mode	Temperature Port M2-A		0x91	79579,419
can che obravare nel case supports only 2 whe remperature mode	RUSON compensation		0x92	Diff. TOF SUM AVG
Inactive Ports during Measurement	Internal Temperature Reference	-	0x93	0.029754639
Pulled to GND	Internal Temperature Compensatio	•	0x94	Amplitude Measure
	Pressure Port M1-B		0x95	Amplitude Measure
Number of Fake Measurements Discharge Select	Pressure Port M1-B		0x90	240,907 241,57
2 Fake Measurements V 0 512 µs V 0	Pressure Port M2-B		0x94	Dulse With Patie
	Pressure Port M2-B		0x98	
			0.00	0,62 0,62
				OP DOWN
				System Status Hags
				Bus Occupied
				S Busy in 10ms
				MCT count Low
				MCT count High
				MCT is Running
				Communication
				Reset Flag
				Error Flag
				Clear Flags:
				2

The meanings of the various settings are displayed in clear text. For more details about the register settings please refer to the AS6040 manual.

In addition, a separate window for a graphical display can be opened. In this window also the amplitudes and pulse width ratios can be displayed.



Figure 14: Opening a Temperature Graph



Figure 15: Temperature Graph





4.4 Timing Control

On this page the settings for the major timings of the task sequencer are set.

- Cycle time of the task sequencer
- TOF rate
- Amplitude measurement rate
- Vcc measurement rate
- Temperature measurement rate
- High-speed clock calibration rate
- Zero-cross calibration rate

Figure 16:







4.5 General Control

The "General Control" page covers configuration settings for

- Task sequencing
- High speed clock control
- Charge pump control (relevant for AS6040 only)
- Voltage measurement
- CPU handling
- Timer settings
- Bootloader initialization values for FHL and TOF rate

Figure 17 : General Control Tab

AS603	31/AS6040 Evaluation Se	oftware							
100	is rimware neip								
tup	TOF Measurements	Ultrasonic Measurement Control	Temperature	Timing	General Control	Interfaces	Interrupt / Error Handling		am
				1	ask Sequencing				
			Task Sequence	r Checksun	n Handling Mode				
			Performed as s	soon as tin	ner request occurs		 ✓ 		write Config
									Stop Measuremen
				High	Speed Clock Control				
				Com					Disable Watchdog
	ndividual HS CLK divide	er Mode	× 0	137 I	ing lime		HS_CLK Mode CPU		Enable Watchdog
				107		<u> </u>		- 0	Watchdog is Disable
									L
									Chip Status
				Cha	rge Pump Control				MCT is ON
	Charge Pump Mode		Ref. Charge Pu	ump Voltag	e Fire Voltage (es	timated)	Main Charge Pump Trim Bits Char	ge Pump Wait Time	TOF SUM AVG UP
	Charge Pump Disable	ed 🗸 🗸 O	0		5.6		10:8 2	0.52 ms 🗸 0	79543,576
							Charge Pump Enable Mode		TOF SUM AVG DOWN
							C5:31 As given by Frontend Control	~ 0	79543,55
							L		Diff. TOF SUM AVG
				Volt	age Measurement				0,026702881
		Low Battery Dete	ction Threshold				Vcc Measured		Amplitude Measuren
		6 🚖 2,	28 Volt		Read M	easured VCC	2,13 Volt		241,168 241,356
									Pulse With Ratio
					CPU Handling				0,60 0,60
		Post	Processing Mode	2					UP DOWN
		Post	Precessing only	after TOF,	AM, AMC, TM or HCC	Measuremer	t 🗸 1		System Status Flags
									Bus Occupied
					Timer				MCT count Low
	Measure Tas	k Request Prediction Time	CPU Checksu	m Timer Ra	ite		NVRAM Recall Timer Rate		MCT count High
	1 ms	~ 0	Checksum T	imer Disab	led	~ 0	disabled	~ 0	MCT is Running
			-						Communication F
	Einet Hit Level 1-1	TOF Pate Init		E	ootioader Init				Reset Flag
	35								Error Flag
	55	•							Clear Flags:
									Reset Error

The meanings of the various settings are displayed in clear text. For more details about the register settings please refer to the AS6040 manual



4.6 Interfaces

The "Interfaces" tab covers configuration settings for the GPIOs.

Figure 18 : Interfaces Tab

AS6	6031/AS6040 Evaluation Sc	oftware				
File To	ools Firmware Help					
Setup	TOF Measurements	Ultrasonic Measuren	nent Control	Temperature Ti	iming	General Control
		G	PIOs			
		Configuration S Inputs Pull Dov	CK (SPI) Port vn	2		
(Configuration GPIO 0 Output Select GPIO 0 General Purpose Out [0]	v 0 v 0	Configuration Output Select GPIO General Pu	n GPIO 1 1 rpose Out [1]		V 0
(Configuration GPIO 2 Output Select GPIO 2 General Purpose Out [2]	V 0	Configurati Output(UAI Select GPIO General Pu	on GPIO 3 RTJ/Input High Z (SPI 3 Irpose Out [3])	¥ 0
[Configuration GPIO 4 Output Select GPIO 4 General Purpose Out [4]	0	Configuration Output Select GPIO General Pu	on GPIO 5 5 rrpose Out [5]		¥ 0
			Enable	MCT_SYNC via GPI[0	1	



4.7 Interrupt & Error Handling

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

Figure 19 :

Interrupt and Error Handling



The meanings of the various settings are displayed in clear text. For more details about the register settings please refer to the AS6040 manual.



5 Software Menu

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

5.1 File

• Open Config

This dialog box allows the path selection of a configuration file, covering the register settings, necessary for a proper configuration of the AS6040. 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 AS6040F1 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 20:

RAM Memory Access

RAM Memory		-		×
Read & Write	Values in	RAM	Memo	ory
Access Memory	Address	= {	0	-
Write Value	<<	Read	d Data	
Write RAM		Read	RAM	
Status	Re	ad RAN	l w Status	;
Access Memory RAM	Address	= 🖁	d 0	~
Write Value	<<	Rea	id Data	
Write RAM		Read	RAM	
Status	Re	ad RAN	I w Status	;
Access Memory	Address		d 0	
Write Value	~	Rea	d Data	
Write RAM		Read	RAM	
Status	Re	ad RAN	1 w Status	\$

- Opens a window which allows single write and read access to random access area or to firmware data.
- Please refer to the AS6040 datasheet for the meaning of the individual addresses.

Registers

Figure 21: Registers

egister S	ettings User Inter	face	Register	Settings	GP40 RAN
Cor	figuration Register UI		Config	uration Regi	ster GP40
Write 0xC0	* 48DBA399 CR_WD_D	IS	0xC0	× 00000000	CR_WD_DIS
Write 0xC1	× 00800401 CR_PI_E2P		OxC1	× 00800401	CR_PI_E2P
Write 0xC2	× 00000000 CR_GP_CT	a	0xC2	× 00000000	CR_GP_CTRL
Write 0xC3	× 20000003 CR_reserv	ed Read Settings from GP40	0xC3	× 00000000	CR_reserved
Write 0xC4	× 000302A7 CR_IEH	RAM and Transfer to GUI	0xC4	× 000302A7	CR_IEH
Write 0xC5	× 2046EE08 CR_CPM	Dand and Transfer	0xC5	× 2046EE08	CR_CPM
Write 0xC6	× 01012080 CR_MRG_1	'S	0xC6	× 01012080	CR_MRG_TS
Write 0xC7	× 00140000 CR_TM		0xC7	× 00140000	CR_TM
Write 0xC8	× 20780A24 CR_USM_P	RC Write Coofig	0xC8	× 20780A24	CR_USM_PRC
Write 0xC9	× 60150204 CR_USM_F	RC Write coning	OxC9	× 60150204	CR_USM_FRC
Write 0xCA	× 00002A0E CR_USM_T	OF	0xCA	× 00002A0E	CR_USM_TOF
Write OxCB	× 23209071 CR_USM_A	M Stop Measurement	0xCB	× 23209071	CR_USM_AM
Write OxCC	× 94A0444C CR_TRIM1		OxCC	× 94A0444C	CR_TRIM1
Write 0xCD	× 401101C2 CR_TRIM2	Disable Watchdog	0xCD	× 401101C2	CR_TRIM2
Write OxCE	× 00270000 CR_TRIM3	Enable Watchdog	OxCE	× 00270000	CR_TRIM3
SH	R Register UI	Disabled	SHR Regist	er GP40	
TOF Rate			TOF Rate		
1			1		
Multihit Rele	ase Delay Window down		Multihit Rel	ease Delay W	indow down
0			0		
Multibit Pele	ase Delay Window up		Multibit Rel	eace Delay W	lindow up
0	,		0		
First wave Le	evel Up First wave Level Do	own	First wave L	evel Up First w	vave Level Dowl

Remote Commands

- Opens a window, which shows the registers important for a proper configuration setting of the AS6040. In the left column, the register contents correspond to the settings done in tabs of GUI main window. If the button "Read AS6040 Register Settings" is pressed, the configuration settings located in AS6040 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. Description of Position 2
- Red field indicate differences between user interface and AS6040 RAM.



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

Figure 22:

Remote Commands

III Remote Commands	-		×
Remote Comma	nds		
System Reset			
System Init			
SV Init			
FEP Init Disable Watchdog after co	mmand		
Request Bus Master Release Bus Master	•]		
Measure Cycle Timer C	Dff		
Measure Cycle Timer C	Dn		
Clear Interrupt Flags	;		
Communication Reque General Purpose Requ	est		
Measu Otop Measurement Task Request Measurement Task Request HS Zer	urement t used f iplitude iplitude mperatur Clk Calib ro Cross (Task(s) Calibration re orationm Calibration	n
Tag			

- System Reset: Executes a complete system reset of AS6040. 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.
- CPU Init: Clears the CPU block in AS6040
- SV Init: Clears the supervisor block in AS6040
- FEP Init: Clears the frontend processing block in AS6040
- Request/Release Bus Master: Allows the request of the bus master in AS6040, 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 AS6040, 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 AS6040CPU.





5.3 Firmware

Assembler

The AS6040-DK V1.0 assembler is integrated into the AS6040-DK evaluation software. It is opened in the Firmware menu of the main program:

Figure 23: Opening the Assembler

M AS603	31//	AS6040 Evaluation Software
File Tools	ls	Firmware Help
Setup	Т	Assembler Ctrl+A
		Firmware Download
s	Se	CPU Values

The following window comes up:

Figure 24 : Assembler Window

File Edit Find Assembler Help	File Edit Find Assembler Help Image: Image	File Edit Find Assembler Help Image: Second Secon	File Edit Find Assembler Help Image: Second Secon	Assembler - C:\Users\nbre\D	ocuments\ams_products\AS6031\Firr	nware\Example 1\AS6031_A	1.F1.11.01.asm		- 0	×
AS6031_ALF1.1101.asm 1 2 ams Assembler File 3 4 5 6 ; Copyright by ams AG 7 ; All rights are reserved. 8 ; 9 ; IMPORTANT - PLEASE READ CAREFULLY BEFORE COPYING, INSTALLING OR USING 10 ; THE SOFTWARE. 11 ; * 12 ; * THIS SOFTWARE IS PROVIDED BY THE COPYRIGHT HOLDERS AND CONTRIBUTORS	ASGOBLALFLILOLASM ASGOBLALFLILOLASM ASGOBLALFLILOLASM	ASSOBLALFILIOLASM ASSOBLALFILIOLASM ASSOBLALFILIOLASM	ASGOSLALFILIDLASM ASGOSLALFILID	File Edit Find Assembler H	lelp					
AS6031_A1.F1.11.01.asm 1 ; ams Assembler File 2 ; ams Assembler File 3 ;	AS6031_ALF11101.asm 1 ; ams Assembler File 3 ;	AS6031_A1F11101asm	AS603LALF11101asm	🗋 🗁 🖬 🛃 💌 🖶	ታ ራ 🕺 🗎 🖡 🗵	📢 💿 🔍 💸	×) 🕅 🖓 (
1 ; ams Assembler File 2 ; ams Assembler File 3 ; ams Assembler File 4 ; 5 ; ams Assembler File 6 ; * Copyright by ams AG 7 ; * All rights are reserved. 8 ; 9 ; * IMPORTANT - PLEASE READ CAREFULLY BEFORE COPYING, INSTALLING OR USING 10 ; * THE SOFTWARE. 11 ; * 12 ; * THIS SOFTWARE IS PROVIDED BY THE COPYRIGHT HOLDERS AND CONTRIBUTORS *	1 ; ams Assembler File 2 ; ams Assembler File 3 ;	<pre>^*** ams Assembler File **********************************</pre>	<pre>^************************************</pre>	AS6031_A1.F1.11.01.asm						
12 * "AC TC" AND ANY EXPRESS OF THEI HARDANTIES INCLUDING BUT NOT *	<pre>13 ; AS IS AND ANT EARNESS ON INFLIED WARANITES OF MERCHANTABILITY AND FITNESS * 14 ; * LIMITED TO, THE IMPLIED WARANITES OF MERCHANTABILITY AND FITNESS * 15 ; * FOR A PARTICULAR PURPOSE ARE DISCLAIMED. IN NO EVENT SHALL THE COPYRIGHT * 16 ; * OWNER OR CONTRIBUTORS BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, * 17 ; * SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT * 18 ; * LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, * 19 ; * DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY * 20 ; * THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT * </pre>	<pre>13 ; AS 3 AND ANT ELEMENTS ON INFILED WARANTES, INCLOUND, BOT 14 ;* LIMITED TO, THE IMPLIED WARANTES OF MERCHANTABILITY AND FITNESS * 15 ;* FOR A PARTICULAR PURPOSE ARE DISCLATHED. IN NO EVENT SHALL THE COPYRIGHT * 16 ;* OWNER OR CONTRIBUTORS BE LIABLE FOR ANY DIRECT, INDIECT, INCIDENTAL, * 17 ;* SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT * 18 ;* LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, * 19 ;* DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY * 20 ;* THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TOR T 11 ;* (INCLUDING NEGLIGENCE OR OTHERMISE) ARISING IN ANY WAY OUT OF THE USE * 22 ;* OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE. * 23 ;************************************</pre>	<pre>13 3 AND ANT EARLESS ON INFILED WARANTIES, INCLOUING, BOTHOT 14 ;* LIMITED TO, THE IMPLIED WARANTIES OF MERCHANTABILITY AND FITNESS 15 ;* FOR A PARTICULAR PURPOSE ARE DISCLAIMED. IN NO EVENT SHALL THE COPYRIGHT 16 ;* OWNER OR CONTRIBUTORS BE LIABLE FOR ANY DIRECT, INDIRECT, INDIDENTAL, * 17 ;* SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT 18 ;* LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, * 19 ;* DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY 20 ;* THEORY OF LLABILITY, WHETHER IN CONTRACT, STRICT LLABILITY, OR TORT 21 ;* (INCLUDING NEGLIGENCE OR OTHERINES) ANISING IN ANY WAY OUT OF THE USE * 2 ;* OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE. 23 ;************************************</pre>	1 ; ams Assembler 2 ; ams Assembler 3 ; 4 ; 5 ; ***********************************	File s AG reserved. ASE READ CAREFULLY BEFORE CO S PROVIDED BY THE COPYRIGHT	PYING, INSTALLING OR	**************************************			
<pre>21 ;* (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE USE * 22 ;* OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE. * 3 ;**********************************</pre>		<pre>31 ; Contents : Simple Firmware for scaled output of DIFTOF over the pulse interface PI 32 ; 33 ; Bugfixes :</pre>	31 ; Contents : Simple Firmware for scaled output of DIFTOF over the pulse interface PI 32 ; 33 ; 34 ; 35 ; 36 : include files 0utput Output	27 ; by : NB 28 ; Company : a 29 ; Projekt : A 30 ;	ms AG S6031					
<pre>21 ;* (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE USE * 22 ;* OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE. * 23 ;************************************</pre>	28 ; Company : ams AG 29 ; Projekt : AS6031 30 ;		34 ; 35 ; 36 : include files •	31 ; Contents : S 32 ; 33 ; Bugfixes :	imple Firmware for scaled ou	tput of DIFTOF over t	he pulse inter	face PI		
<pre>21 ;* (INCLUDING NEGLIGENCE OR OTHERNISE) ARISING IN ANY WAY OUT OF THE USE * 22 ;* OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE. * 23 ;************************************</pre>	28 ; Company : ams AG 29 ; Projekt : AS6031 30 ; 31 ; Contents : Simple Firmware for scaled output of DIFTOF over the pulse interface PI 32 ; 33 ; 34 ; 36 ; Output V									



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

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

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

• 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 **ScioSense** firmware examples, either the customers code or in case of chips with **ScioSense** firmware (AS6040F1) the open source part. The FW Data 1 and 2 include firmware relevant coefficients and the configuration. The figure below shows an example for an AS6040 applicatin. As free part of the user code firmware AS6031_A1.F1.11.01.hex is loaded. For the configuration and other data file AS6031_A1.EMPTY.dat is loaded.

Figure 25 : Firmware Download



- With "Check Status Flag", the watchdog and the lock state of the AS6040 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 AS6040 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 AS6040 when downloading firmware to AS6040. 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 AS6040 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 ScioSense firmware.

Figure 26 :

Firmware ScioSense Code

Firmware ams Code		Calculated by GP31 32C	🔴 FAIL	25 00000000	57 0000000	89 0000000	121 401125C2
Checksums	Calc. Checksum acam Code	FWD ams from FWD 0x17D 32C	FAIL	27 00000000	59 0000000	91 00000000	122 402/0000
	x C19	Checksums FWD user		28 0000000	60 0000000	92 0000000	124 00000000
Calculated by GP31 1031		Calculated by Software		29 0000000	61 0000000	93 00000000	125 00000363
Checksum code ams from FWD 0x17E 1D31	PASS	calculated by software		30 0000000	62 0000000	94 00000000	126 00000000
-	-	Calculated by GP31 × 0	PASS	31 00000000	63 0000000	95 0000000	127 FFFF0000
0 Checksum FWA manual entry	A1E10002 acam FW Revision	FWD user from FWD 0x101	PASS				

So copy manually the calculated checksum for the **ScioSense** 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.

Figure 27 :

Verification by Calculated Checksum

Checksums Calc. Checksum acam Code FWD ams from FWD 0x170 338 FAIL 27 0000000 91 0000000 123 0000000 92 0000000 92 0000000 92 0000000 92 0000000 92 0000000 92 0000000 92 0000000 92 0000000 92 0000000 92 0000000 92 0000000 92 0000000 92 0000000 92 0000000 92 0000000 92 0000000 92 0000000 92 0000000 93 0000000 93 0000000 93 0000000 93 0000000 93 0000000 93 0000000 93 0000000 93 0000000 93 0000000 93 0000000 93 0000000 126 0000000 126 0000000 126 0000000 126 0000000 126 0000000 127 0000000 126 0000000 126 0000000 126 0000000 126	Firmware	ams Code	Calculated by GP31 338	AIL	25 0000000	57 0000000	90 0000000	121 401125C2 122 40270000
Calculated by GP31 2287 Clip Checksums FWD user 22 0000000 92 0000000 92 0000000 92 0000000 92 0000000 93 <	Checksums	Calc. Checksum acam Code	FWD ams from FWD 0x17D 33B	AIL	27 00000000	59 00000000	91 00000000	123 00000000
Checksum col ms from FWD 0x17 PASS Calculated by Software A2F PASS 61 0000000 93 00000000 93 00000000 93 0	The second s	C19	Checksums FWD user		28 0000000	60 0000000	92 0000000	124 00000000
Calculated by GP31 A2F PASS 31.00000000 85.00000000 95.0000000 927.FFFFeed5 27B7 Checksum FWA manual entry A1E01101 8Cam FW Revision FWD user from FWD 0x101 A2F PASS	Calculated by GP31 027 Checksum cost ms from FWD 0x17E 27	B7 PASS	Calculated by Software		29 0000000 30 0000000	61 00000000 62 00000000	93 0000000 94 000000	125 0000362 126 00002787
2287 Checksum FWA manual entry RAI201101 acam FW Revision FWD 0x101 AAF PASS			Calculated by GP31 A2F	S	31 00000000	63 00000000	95 0000000	127 FFFF0000
	27B7 Checksum FWA manual er	ntry A1E01101 acam FW Revision	FWD user from FWD 0x101 A2F	is i				

• In the "Firmware ams Code" section, the checksums for the **ScioSense** firmware code are also checked and displayed after a "Verify FW". The **ScioSense** firmware code cannot be modified by user. Therefore a checksum calculated by software field is missing in this section.



- A lock state of AS6040 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 ScioSense 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 28 : Flow Calculation Tab

Set with firmware		Start Measurement ✓ Read calculated valu	es	Open	CPU	Graph	Show	/ Error Flags		
		CPU Temperature Results f	rom Flow				CPU Result	5		
	#	Name	Results	Unit	[# Name	Resul	ts Un	it	
						3 Volume Flow	0,000000	m^	3	
						4 Volume Flow	0,000	Lite	er	
		CDU Desuits with out Tee	an arration a Care			5 Flow Speed	0,00	m/	s	
	-	CPU Results with ext. Ten	nperature sen	sors		6				
	#	Name	Results	Unit						
	1	Temperature Cold	0,00	degC		(PLI TOF Value	P.C		
	2	Temperature Hot	235,80	degC	ſ	# Name		Doculto	Unit	
	3	Resistance Cold Sensor	0,00	Onm		# Name		Results	Unit	
	4	Resistance Hot Sensor	0,00	Unm						
	2	remperature internal		uego	ļ					
			CPU Results	s at self-de	efined	RAM Adresses				
		Address 1	Mult. Fac	tor 1		Calculated Result	1 Calculate	ed Result 1		
		A 0 *	A 1	_	=	0.0000	O			
		V=- +	W-		_					
		Address 2	Mult. Fac	tor 2		Calculated Result	2 Calculate	ed Result 2		
		*	1		=	0,0000	×O			
		Address 3	Mult. Fac	tor 3		Calculated Result	3 Calculate	ed Result 3		
		A	A.							



5.4 Help

When moving the cursor over the values in tabs of main window, the parameter name (used in the AS6040 manual) is displayed. By right-click and selection of "Description and Tip", a window is opened showing additional description of the value.

Figure 29: Description and Tip Window

Pause 1,0 * T(BF_SEL) in ms	

"Illtraconic Pause Handling" Description	
on a some radie radie radia and a some radie r	
USM_PAUSE> CR_USM_PRC (0x0C8)	*
Selects pause time between 2 ultrasonic me	asurements
	-
'Ultrasonic Pause Handling'' Tip	-
Ultrasonic Pause Handling" Tip USM_PAUSE	
Ultrasonic Pause Handling" Tip USM_PAUSE	

Help Contents

Not supported in this software revision.

USB Communication

Figure 30:

USB Communication

B Communications
PicoProg Settings
Disable USB Handle
PicoProg FW Path C:\Program Files (x86)\aca\data\PicoProgFW_GP30_v21.hex Change
GP30 Communication
Last_Com_Action Comm w/ GP30 OK Read Res USB Error USB Error

As described in chapter "Software Installation".

About

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



6 Measurements in Practice

This section describes how to set up a gas flow measurement and shows some sample results of a real gas meter spool piece. Configuration example AS6040_gas_200kHz_DLY.cfg is used as basis. The example is built around 200kHz transducers from Jiakang in a distance of about 5 cm.

The example configuration likely needs to be adjusted to the customers setup. The most important parameters are:

- Fire pulse frequency
- Number of fire pulses
- Number of TOF hits
- Method for the start hit definition
- PGA gain of receiving amplitude
- Amplitude measurement
- Charge Pump Voltage
- Measurement Rate

In general, we recommend to have a look at the receive signal by means of an oscilloscope. This clearly helps to find the right settings.

6.1 Measure Receiving Amplitude with Oscilloscope

If the signal is measured after the internal PGA stage there is no influence of the probe capacitance to the measured time values. You can measure the receiving amplitude at test point TP4, which connects to pin pin 17, COMP_IN.. In Figure 31 this points is marked. Another probe should be connected to US_UP for the trigger signal. When looking at minimum noise then this probe of course needs to be removed.

Figure 31: Measure Points





Figure 32:

Typical Send and Receive Signals



The on-board matching resistors R9 and R12 with 330 Ohm are a good fit for the tested transducers. For other transducers it might be necessary to adopt the values.



6.2 Major Parameter Settings

- 1. Fire pulse frequency: The high speed clock divider is set to 20 to match the 200 kHz transducer frequency
- 2. Method for the start hit definition: With gas the amplitude varies likely too much for a reasonable first hit level detection. Therefore we decide to go with the delay window, which directly opens the window for ToF measurements in the center of the receive burst. Ideally, the window opens half a period in advance to the next zero crossing.
- **3.** Number of fire pulses: As we plan to measure 10 stops, starting with the 2nd hit after the window opening, and assuming several waves before the opening, we choose 20 fire pulses. The target is that the fie burst as minimum as long as the receive burst.
- 4. Number of TOF hits: 10
- **5.** PGA gain of receiving amplitude: In our application we set the gain to 132 V/V to get >300mV receive amplitude.
- **6.** Amplitude measurement: We stop the measurement after already 3 hits, because the amplitude should have reached the high level already.

Figure 33:

Ultrasonic Measurement Control





7. Charge Pump Voltage: The voltage is set to the low value of 7.4V for power saving reasons.

Figure 34: Charge Pump Setting

Charge Pump Control							
Charge Pump Mode		Ref. Charge Pump Voltage	Fire Voltage (estimated)	Main Charge Pump Trim Bits Ch	arge Pump Wait Time		
Enabled twice at start of US	2	2	7.4	Charge Pump Enable Mode	0.52 ms 🔽 0		
				C5:31 As given by Frontend Control	0		

8. Measurement Rate: This one is defined by the measurement task and the limit in current consumption.

With 125ms cycle time = 8 Hz the current consumption at 200 μ s TOF is about 20 μ A.

6.3 Results

Figure 35: Numerical Results

AS6031/AS6040 Evaluation Softw	are									- 0
lools Firmware Help										
etup TOF Measurements UI	trasonic Measurement	t Control	Temperature	Timir	g General Control	Interfaces	Interrupt	/ Error Handling		
	TOF Results Table						Amplit	tude Measurement		
# Name	Results / n	s Average/	ns Std. Dev./ps			Mea	asurement Va	alues	Calibration Values	
1 TOF SUM AVG UP	205753,0	205753,0	502,3		# Name Re	sults / mV S	td Dev. / mV	With Result Avg	# Name Results ^	Write Config
2 TOF SUM AVG DOWN	205753,3	205753,3	513,9		1 AM UP 3	44,31	1,01		1 AM CAL High 4475,28	
3 TOF UP Value 0	183386.5	183386.5	1666.4	÷ 1	2 AM Down 3	42,91	0,88		2 AM CAL Low 2973,12 🗸	Stop Measuremer
4 TOF UP Value 1	188352,9	188352,9	1569,4	- 1	3 AM diff	1,40	1,22	~		
5 TOF UP Value 2	193319,3	193319,3	1367,3						_	Disable Watchdo
5 TOF UP Value 3	198292.3	198292.3	1189.9	+ 1						Disable Wateriao
7 TOF UP Value 4	203266.3	203266.3	1240.9	+				H5 Clock		Enable Watchdog
3 TOF UP Value 5	208235,9	208235,9	1438,3	+				Inte	rnal HS clock is 4MHz	Watchdog is Disabl
TOF UR Value 6	212200.2	212200.2	1456.2	- 1		Read	HS CLK Divider	HS clk period/ps	Cal Factor HS clock	P
10 TOF UR Value 7	213205,2	213205,2	1430,5	- 1	ns cik period in ris (HS HS	Clock Divider	249.7	250	Chip Status
11 TOF UP Value 8	223155.3	223155.3	1179.9	- 1	250	N	OT Set	1243,7	250	MCT is ON
12 TOF UP Value 9	228129.9	228129.9	1378.9	- 1				Apply calibra	ated clock period to display values	
				- 1						TOF SUM AVG UP
13 TOF DOWN Value 0	183387,0	183387,0	1968,7	- 1						205752,97
14 TOF DOWN Value 1	188349,3	188349,3	1685,3	- 1	Write T	OF Values to	File Don't w	rite to File 🗸 🗸	Show TOF Values in Color	TOF SUM AVG DOW
15 TOF DOWN Value 2	193319,4	193319,4	1389,9							205753,26
16 TOF DOWN Value 3	198293,1	198293,1	1292,5							Diff. TOF SUM AVG
17 TOF DOWN Value 4	203263,8	203263,8	1322,1							-0,28991699
18 TOF DOWN Value 5	208238,7	208238,7	1208,7							Amplitude Measuren
19 TOF DOWN Value 6	213210,5	213210,5	1364,2	T						344 604 343 225
20 TOF DOWN Value 7	218181,8	218181,8	1507,1	-						UP DOWN
21 TOF DOWN Value 8	223157,8	223157,8	1508,1							Pulse With Ratio
22 TOF DOWN Value 9	228131,4	228131,4	1438,5							0.98 0.98
23 diff. TOF 0	-0,4883	-0,4883	2702,6	÷ .						UP DOWN
24 diff. TOF 1	3,6469	3,6469	2394,4							System Status Flags
25 diff. TOF 2	-0,0725	-0,0725	2025,3							Bus Occupied
26 diff. TOF 3	-0.7935	-0.7935	1830.4	+						TS Busy in 10ms
27 diff. TOF 4	2,5558	2,5558	1733.3	+						MCT count Low
28 diff. TOF 5	-2,7924	-2,7924	1642,8	+						MCT count High
diff TOF 6	-1 2308	-1 2308	1921.0	+						MCT is Running
30 diff TOF 7	0 3128	0.3128	1915.3	- 1						Communication 5
31 diff TOF 8	-2 5024	-2 5024	1989 1	+						
32 diff. TOF 9	-1,5259	-1,5259	2100,1	+						Fron Flag
	0.0000	0.0000	700.7	-						Error Flag
55 diff. TOF SUM AVG	-0,2899	-0,2899	/02,/	×						Clear Flags:



7 Schematics, Layers and BOM

Figure 36: Board Schematics





Figure 37: Board Layout



Figure 38: Board components





Figure 39: BOM

1 1 PCB 2 3 C1, C10, C11 10 pF 0603 Chip capacitor 3 1 C18 22 pF 0603 Chip capacitor 4 1 C31 4.7 nF 0603 Chip capacitor 5 C4, C5, C9, C25, C28 100 nF 0603 Chip capacitor 6 1 C6 680 nF 0603 Chip capacitor 7 1 C3 100 nF/25V 0805 Chip capacitor 8 2 C12, C32 100 µF/6V3 0805 Chip capacitor 9 1 C29 100 nF C0G 1206 GRM31C5C1E104JA01L Murata 10 2 C19, C22 22 µF/10V 1206 1206ZD226KAT2A AVX 11 1 C7 22 µF/16V 1210 12107D226KAT2A AVX 12 1 C8 22 mF/25V CKG57 12103D226KAT2A AVX 13 3 R1, R2, R3 4.7 Ω 0603 Chip resistor 14	ltem	QTY	Reference	Value	Part Description	Туре
2 3 C1, C10, C11 10 pF 0603 Chip capacitor 3 1 C18 22 pF 0603 Chip capacitor 4 1 C31 4.7 nF 0603 Chip capacitor 5 C4, C5, C9, C25, C28 100 nF 0603 Chip capacitor 6 1 C6 680 nF 0603 Chip capacitor 7 1 C3 100 nF/25V 0805 Chip capacitor 9 1 C29 100 nF C0G 1206 GRM31C5C1E104JA01L Murata 10 2 C19, C22 22 µF/10V 1206 1206ZD226KAT2A AVX 11 1 C7 22 µF/16V 1210 1210YD226KAT2A AVX 12 1 C8 22 mF/25V CKG57 12103D226KAT2A AVX 13 3 R1, R2, R3 4.7 Ω 0603 Chip resistor 14 1 R20 2.7 kΩ 0603 Chip resistor 15 1 R13 5.6 kΩ 0603	1	1			РСВ	
3 1 C18 22 pF 0603 Chip capacitor 4 1 C31 4.7 nF 0603 Chip capacitor 5 5 C4, C5, C9, C25, C28 100 nF 0603 Chip capacitor 6 1 C6 680 nF 0603 Chip capacitor 7 1 C3 100 nF/25V 0805 Chip capacitor 8 2 C12, C32 100 nF/25V 0805 Chip capacitor 9 1 C29 100 nF C0G 1206 GRN31C5C1E104JA01L Murata 10 2 C19, C22 22 µF/10V 1206 1206ZD226KAT2A AVX 11 1 C7 22 µF/16V 1210 1210YD226KAT2A AVX 12 1 C8 22 mF/25V CKG57 12103D226KAT2A AVX 13 3 R1, R2, R3 4.7 Ω 0603 Chip resistor 14 1 R20 2.7 kΩ 0603 Chip resistor 15 1 R13 5.6 kΩ	2	3	C1, C10, C11	10 pF	0603	Chip capacitor
4 1 C31 4.7 nF 0603 Chip capacitor 5 5 C4, C5, C9, C25, C28 100 nF 0603 Chip capacitor 6 1 C6 680 nF 0603 Chip capacitor 7 1 C3 100 nF/25V 0805 Chip capacitor 8 2 C12, C32 100 µF/6V3 0805 Chip capacitor 9 1 C29 100 nF CoG 1206 GRM31C5C1E104JA01L Murata 10 2 C19, C22 22 µF/10V 1206 1206ZD226KAT2A AVX 11 1 C7 22 µF/16V 1210 1210YD226KAT2A AVX 12 1 C8 22 mF/25V CKG57 12103D226KAT2A AVX 13 3 R1, R2, R3 4.7 Ω 0603 Chip resistor 14 1 R20 2.7 kΩ 0603 Chip resistor 15 1 R13 5.6 kΩ 0603 Chip resistor 16 1 R10 660 kΩ	3	1	C18	22 pF	0603	Chip capacitor
5 5 C4, C5, C9, C25, C28 100 nF 0603 Chip capacitor 6 1 C6 680 nF 0603 Chip capacitor 7 1 C3 100 nF/25V 0805 Chip capacitor 8 2 C12, C32 100 µF/6V3 0805 Chip capacitor 9 1 C29 100 nF COG 1206 GRM31C5C1E104JA01L Murata 10 2 C19, C22 22 µF/10V 1206 1206ZD226KAT2A AVX 11 1 C7 22 µF/16V 1210 1210YD226KAT2A AVX 12 1 C8 22 mF/25V CKG57 12103D226KAT2A AVX 13 3 R1, R2, R3 4.7 Ω 0603 Chip resistor 14 1 R20 2.7 kΩ 0603 Chip resistor 15 1 R13 5.6 kΩ 0603 Chip resistor 16 1 R10 0Ω 0603 Chip resistor 17 1 R8 10 MΩ	4	1	C31	4.7 nF	0603	Chip capacitor
6 1 C6 680 nF 0603 Chip capacitor 7 1 C3 100 nF/25V 0805 Chip capacitor 8 2 C12, C32 100 μF/6V3 0805 Chip capacitor 9 1 C29 100 nF C0G 1206 GRM31C5C1E104JA01L Murata 10 2 C19, C22 22 μF/10V 1206 1206ZD226KAT2A AVX 11 1 C7 22 μF/16V 1210 1210YD226KAT2A AVX 12 1 C8 22 mF/25V CKG57 12103D226KAT2A AVX 13 3 R1, R2, R3 4.7 Ω 0603 Chip resistor 14 1 R20 2.7 kΩ 0603 Chip resistor 15 1 R13 5.6 kΩ 0603 Chip resistor 16 1 R10 560 kΩ 0603 Chip resistor 18 2 R11, R14 0 Ω 0805 Chip resistor 19 2 R9, R12 330 Ω 0	5	5	C4, C5, C9, C25, C28	100 nF	0603	Chip capacitor
7 1 C3 100 nF/25V 0805 Chip capacitor 8 2 C12, C32 100 μF/6V3 0805 Chip capacitor 9 1 C29 100 nF C0G 1206 GRM31C5C1E104JA01L Murata 10 2 C19, C22 22 μF/10V 1206 1206ZD226KAT2A AVX 11 1 C7 22 μF/16V 1210 1210YD226KAT2A AVX 12 1 C8 22 mF/25V CKG57 12103D226KAT2A AVX 13 3 R1, R2, R3 4.7 Ω 0603 Chip resistor 14 1 R20 2.7 kΩ 0603 Chip resistor 15 1 R13 5.6 kΩ 0603 Chip resistor 16 1 R10 560 kΩ 0603 Chip resistor 18 2 R11, R14 0 Ω 0805 Chip resistor 20 1 R16 1 kΩ 0805 Chip resistor 21 1 U1 AS6040 QFN48<	6	1	C6	680 nF	0603	Chip capacitor
8 2 C12, C32 100 μF/6V3 0805 Chip capacitor 9 1 C29 100 nF C0G 1206 GRM31C5C1E104JA01L Murata 10 2 C19, C22 22 μF/10V 1206 1206ZD226KAT2A AVX 11 1 C7 22 μF/16V 1210 1210YD226KAT2A AVX 12 1 C8 22 mF/25V CKG57 12103D226KAT2A AVX 13 3 R1, R2, R3 4.7 Ω 0603 Chip resistor 14 1 R20 2.7 kΩ 0603 Chip resistor 15 1 R13 5.6 kΩ 0603 Chip resistor 16 1 R10 560 kΩ 0603 Chip resistor 17 1 R8 10 MΩ 0603 Chip resistor 18 2 R11, R14 0 Ω 0805 Chip resistor 20 1 R16 1 kΩ 0805 Chip resistor 21 1 U1 A56040 QFN48	7	1	C3	100 nF/25V	0805	Chip capacitor
9 1 C29 100 nF C0G 1206 GRM31C5C1E104JA01L Murata 10 2 C19, C22 22 μF/10V 1206 1206ZD226KAT2A AVX 11 1 C7 22 μF/16V 1210 1210YD226KAT2A AVX 12 1 C8 22 mF/25V CKG57 12103D226KAT2A AVX 13 3 R1, R2, R3 4.7 Ω 0603 Chip resistor 14 1 R20 2.7 kΩ 0603 Chip resistor 15 1 R13 5.6 kΩ 0603 Chip resistor 16 1 R10 560 kΩ 0603 Chip resistor 17 1 R8 10 MΩ 0603 Chip resistor 18 2 R11, R14 0 Ω 0805 Chip resistor 20 1 R16 1 kΩ 0805 Chip resistor 21 1 U1 AS6040 QFN48 AS6040 UFC ScioSense 22 1 U2 3,0V XC6206	8	2	C12, C32	100 µF/6V3	0805	Chip capacitor
10 2 C19, C22 22 μ/10V 1206 1206ZD226KAT2A AVX 11 1 C7 22 μ/16V 1210 1210YD226KAT2A AVX 12 1 C8 22 mF/25V CKG57 12103D226KAT2A AVX 13 3 R1, R2, R3 4.7 Ω 0603 Chip resistor 14 1 R20 2.7 kΩ 0603 Chip resistor 15 1 R13 5.6 kΩ 0603 Chip resistor 16 1 R10 560 kΩ 0603 Chip resistor 17 1 R8 10 MΩ 0603 Chip resistor 18 2 R11, R14 0 Ω 0805 Chip resistor 19 2 R9, R12 330 Ω 0805 Chip resistor 21 1 U1 AS6040 QFN48 AS6040 UFC ScioSense 22 1 U2 3,0V XC6206 XC6206P302MR-G Torex 23 1 X1 4MHz (8MHz) CERAMIC RESONA	9	1	C29	100 nF C0G	1206	GRM31C5C1E104JA01L Murata
111C722 μ//16V12101210YD226KAT2A AVX121C822 mF/25VCKG5712103D226KAT2A AVX133R1, R2, R34.7 Ω0603Chip resistor141R202.7 kΩ0603Chip resistor151R135.6 kΩ0603Chip resistor161R10560 kΩ0603Chip resistor171R810 MΩ0603Chip resistor182R11, R140 Ω0805Chip resistor192R9, R12330 Ω0805Chip resistor201R161 kΩ0805Chip resistor211U1AS6040QFN48AS6040 UFC ScioSense221U23.0VXC6206XC6206P302MR-G Torex231X14MHz (8MHz)CERAMIC RESONATOR (CSTNE8M00G55A000R0)CSTCR4M00G53-R0 (CSTNE8M00G55A000R0)241X232.768kHzQuartz CrystalKX-327XS Geyer251J17x1x180° 2,542.54 male connector261J22x1x90° 2,542.54 male connector271J42x1x90° 2,542.54 male connector	10	2	C19, C22	22 µF/10V	1206	1206ZD226KAT2A AVX
12 1 C8 22 mF/25V CKG57 12103D226KAT2A AVX 13 3 R1, R2, R3 4.7 Ω 0603 Chip resistor 14 1 R20 2.7 kΩ 0603 Chip resistor 15 1 R13 5.6 kΩ 0603 Chip resistor 16 1 R10 560 kΩ 0603 Chip resistor 17 1 R8 10 MΩ 0603 Chip resistor 18 2 R11, R14 0 Ω 0805 Chip resistor 19 2 R9, R12 330 Ω 0805 Chip resistor 20 1 R16 1 kΩ 0805 Chip resistor 21 1 U1 AS6040 QFN48 AS6040 UFC ScioSense 22 1 U2 3,0V XC6206 XC6206P302MR-G Torex 23 1 X1 4MHz (8MHz) CERAMIC RESONATOR CSTCR4M00G53-R0 (CSTNE8M00G55A000R0) 24 1 X2 32.768kHz	11	1	C7	22 µF/16V	1210	1210YD226KAT2A AVX
133R1, R2, R34.7 Ω0603Chip resistor141R202.7 kΩ0603Chip resistor151R135.6 kΩ0603Chip resistor161R10560 kΩ0603Chip resistor171R810 MΩ0603Chip resistor182R11, R140 Ω0805Chip resistor192R9, R12330 Ω0805Chip resistor201R161 kΩ0805Chip resistor211U1AS6040QFN48AS6040 UFC ScioSense221U23,0VXC6206CSTCR4M00G53-R0 (CSTNE8M00G55A000R0)241X232.768kHzQuartz CrystalKX-327XS Geyer251J1I7x1x180° 2,542.54 male connector261J222x1x180° 2,542.54 male connector271J422x1x90° 2,542.54 male connector	12	1	C8	22 mF/25V	CKG57	12103D226KAT2A AVX
141R202.7 kΩ0603Chip resistor151R135.6 kΩ0603Chip resistor161R10560 kΩ0603Chip resistor171R810 MΩ0603Chip resistor182R11, R140 Ω0805Chip resistor192R9, R12330 Ω0805Chip resistor201R161 kΩ0805Chip resistor211U1AS6040QFN48AS6040 UFC ScioSense221U23,0VXC6206XC6206P302MR-G Torex231X14MHz (8MHz)CERAMIC RESONATOR (CSTNE8M00G55A000R0)CSTCR4M00G53-R0 (CSTNE8M00G55A000R0)241X232.768kHzQuartz CrystalKX-327XS Geyer251J1I7x1x180° 2,542.54 male connector261J222x1x90° 2,542.54 male connector271J42x1x90° 2,542.54 male connector	13	3	R1, R2, R3	4.7 Ω	0603	Chip resistor
15 1 R13 5.6 kΩ 0603 Chip resistor 16 1 R10 560 kΩ 0603 Chip resistor 17 1 R8 10 MΩ 0603 Chip resistor 18 2 R11, R14 0 Ω 0805 Chip resistor 19 2 R9, R12 330 Ω 0805 Chip resistor 20 1 R16 1 kΩ 0805 Chip resistor 21 1 U1 AS6040 QFN48 AS6040 UFC ScioSense 22 1 U2 3,0V XC6206 XC6206P302MR-G Torex 23 1 X1 4MHz (8MHz) CERAMIC RESONATOR (CSTNE8M00G55A000R0) CSTCR4M00G53-R0 (CSTNE8M00G55A000R0) 24 1 X2 32.768kHz Quartz Crystal KX-327XS Geyer 25 1 J1 Image: State	14	1	R20	2.7 kΩ	0603	Chip resistor
161R10560 kΩ0603Chip resistor171R810 MΩ0603Chip resistor182R11, R140 Ω0805Chip resistor192R9, R12330 Ω0805Chip resistor201R161 kΩ0805Chip resistor211U1AS6040QFN48AS6040 UFC ScioSense221U23,0VXC6206XC6206P302MR-G Torex231X14MHz (8MHz)CERAMIC RESONATOR (STNE8M00G55A000R0)CSTCR4M00G53-R0 (CSTNE8M00G55A000R0)241X232.768kHzQuartz CrystalKX-327XS Geyer251J17x1x180° 2,542.54 male connector261J222x1x90° 2,542.54 male connector271J42x1x90° 2,542.54 male connector	15	1	R13	5.6 kΩ	0603	Chip resistor
17 1 R8 10 MΩ 0603 Chip resistor 18 2 R11, R14 0 Ω 0805 Chip resistor 19 2 R9, R12 330 Ω 0805 Chip resistor 20 1 R16 1 kΩ 0805 Chip resistor 21 1 U1 AS6040 QFN48 AS6040 UFC ScioSense 22 1 U2 3,0V XC6206 XC6206P302MR-G Torex 23 1 X1 4MHz (8MHz) CERAMIC RESONATOR (CSTNE8M00G55A000R0) CSTCR4M00G53-R0 (CSTNE8M00G55A000R0) 24 1 X2 32.768kHz Quartz Crystal KX-327XS Geyer 25 1 J1 Transition 2,54 2.54 male connector 26 1 J2 Zx1x180° 2,54 2.54 male connector 27 1 J4 Ztheread 2x1x90° 2,54 2.54 male connector	16	1	R10	560 kΩ	0603	Chip resistor
18 2 R11, R14 0 Ω 0805 Chip resistor 19 2 R9, R12 330 Ω 0805 Chip resistor 20 1 R16 1 kΩ 0805 Chip resistor 21 1 U1 AS6040 QFN48 AS6040 UFC ScioSense 22 1 U2 3,0V XC6206 XC6206P302MR-G Torex 23 1 X1 4MHz (8MHz) CERAMIC RESONATOR (8MHz) CSTCR4M00G53-R0 (CSTNE8M00G55A000R0) 24 1 X2 32.768kHz Quartz Crystal KX-327XS Geyer 25 1 J1 Image: Comparison of the	17	1	R8	10 MΩ	0603	Chip resistor
19 2 R9, R12 330 Ω 0805 Chip resistor 20 1 R16 1 kΩ 0805 Chip resistor 21 1 U1 AS6040 QFN48 AS6040 UFC ScioSense 22 1 U2 3,0V XC6206 XC6206P302MR-G Torex 23 1 X1 4MHz (8MHz) CERAMIC RESONATOR (8MHz) CSTCR4M00G53-R0 (CSTNE8M00G55A000R0) 24 1 X2 32.768kHz Quartz Crystal KX-327XS Geyer 25 1 J1 Image: Comparison of the temperature of the temperature of temperatu	18	2	R11, R14	0 Ω	0805	Chip resistor
20 1 R16 1 kΩ 0805 Chip resistor 21 1 U1 AS6040 QFN48 AS6040 UFC ScioSense 22 1 U2 3,0V XC6206 XC6206P302MR-G Torex 23 1 X1 4MHz (8MHz) CERAMIC RESONATOR (8MHz) CSTCR4M00G53-R0 (CSTNE8M00G55A000R0) 24 1 X2 32.768kHz Quartz Crystal KX-327XS Geyer 25 1 J1 Image: Comparison of the	19	2	R9, R12	330 Ω	0805	Chip resistor
211U1AS6040QFN48AS6040 UFC ScioSense221U23,0VXC6206XC6206P302MR-G Torex231X14MHz (8MHz)CERAMIC RESONATOR (8MHz)CSTCR4M00G53-R0 (CSTNE8M00G55A000R0)241X232.768kHzQuartz CrystalKX-327XS Geyer251J1Image: Comparison of the sector o	20	1	R16	1 kΩ	0805	Chip resistor
221U23,0VXC6206XC6206P302MR-G Torex231X14MHz (8MHz)CERAMIC RESONATOR (8MHz)CSTCR4M00G53-R0 (CSTNE8M00G55A000R0)241X232.768kHzQuartz CrystalKX-327XS Geyer251J17x1x180° 2,542.54 male connector261J22x1x180° 2,542.54 male connector271J42x1x90° 2,542.54 male connector	21	1	U1	AS6040	QFN48	AS6040 UFC ScioSense
231X14MHz (8MHz)CERAMIC RESONATOR (CSTNE8M00G55A000R0)CSTCR4M00G53-R0 (CSTNE8M00G55A000R0)241X232.768kHzQuartz CrystalKX-327XS Geyer251J17x1x180° 2,542.54 male connector261J22x1x180° 2,542.54 male connector271J42x1x90° 2,542.54 male connector	22	1	U2	3,0V	XC6206	XC6206P302MR-G Torex
24 1 X2 32.768kHz Quartz Crystal KX-327XS Geyer 25 1 J1 7x1x180° 2,54 2.54 male connector 26 1 J2 2x1x180° 2,54 2.54 male connector 27 1 J4 2x1x90° 2,54 2.54 male connector	23	1	X1	4MHz (8MHz)	CERAMIC RESONATOR	CSTCR4M00G53-R0 (CSTNE8M00G55A000R0)
25 1 J1 7x1x180° 2,54 2.54 male connector 26 1 J2 2x1x180° 2,54 2.54 male connector 27 1 J4 2x1x90° 2,54 2.54 male connector	24	1	X2	32.768kHz	Quartz Crystal	KX-327XS Geyer
26 1 J2 2x1x180° 2,54 2.54 male connector 27 1 J4 2x1x90° 2,54 2.54 male connector	25	1	J1		7x1x180° 2,54	2.54 male connector
27 1 J4 2x1x90° 2,54 2.54 male connector	26	1	J2		2x1x180° 2,54	2.54 male connector
	27	1	J4		2x1x90° 2,54	2.54 male connector



8 **Reference Modules and Transducers**

8.1 Modules

ScioSense has a close cooperation with Qingdao iESLab to support customers with complete ultrasonic flow modules for water and gas. For water, iESLab offers pipes made of brass and made of plastic and modules can be ordered un-calibrated or calibrated. The gas meter modules are made of plastic and come un-calibrated, because the final housing will have a major impact on the calibration.

8.1.1 Water Meter Modules

iESLab offers modules for DN15, DN20 and DN25, made of brass or composite.

Figure 40: Water Meter Module, Brass



Figure 41: Ordering Information

Ordering Code	Description	Part Number	Markup Information ⁽¹⁾
	With brass pipeline (with calibration parameter)	IA-UWM-1-GP30-DNxx	IA-UWM-1-GP30-DNxx- YYMMDD-SSSS
	With brass pipeline (without calibration parameter) [®]	IA-UWM-2-GP30-DNxx	IA-UWM-2-GP30-DNxx- YYMMDD-SSSS
	With Composite Material (with calibration parameter)	IA-UWM-3-GP30-DNxx	IA-UWM-3-GP30-DNxx- YYMMDD-SSSS
	With Composite Material (without calibration parameter)	IA-UWM-4-GP30-DNxx	IA-UWM-4-GP30-DNxx- YYMMDD-SSSS

(1) YYYY = year, MM = month, DD = day, SSSSSS = product serial number that day



Figure 42: Measurement Characteristics

Nominal Diameter (DN)	15	20	25
Starting Flow (m ³ /h)	0.002	0.003	0.005
Minimum Flow Rate Q ₁ (m ³ /h)	0.010	0.016	0.025
Transitional Flow Rate Q ₂ (m ³ /h)	0.016	0.025	0.040
Permanent Flow Rate Q ₃ (m ³ /h)	2.5	4.0	6.3
Overload Flow Rate Q ₄ (m ³ /h)	3.125	5.0	7.875
Flow Range Ratio (Q ₃ /Q ₁)	400、250 (default)		
Accuracy Class	Class 2		
Temperature Classes	$T50^{\circ}$ / T30(default)		
Sample Rate	8Hz~32Hz, 8Hz (default)		
Maximum Admissible Pressure	1.6MPa / 1.0MPa		а
Pressure Loss Range	<63KPa / <40KPa		
Flow data storage	Accum	ulation flow(90) days)

8.1.2 Gas Meter Modules

Those residential and industrial modules come with tubes made of plastic and the electronics are based on AS6031.

Figure 43: Gas Meter Module brass





Figure 44:

Ordering Information

Ordering Code	Description	Part Number	Markup Information ⁽⁾
	Gas meter module residential	IA-UGM-1	IA-UGM-1-YYYYMMDD- SSSSSS
	Gas meter module industrial and commercial	IA-UGM-2	IA-UGM-2-YYYYMMDD- SSSSSS

(1) YYYY = year, MM = month, DD = day, SSSSSS = product serial number that day

Figure 45:

Measurement Characteristics

Application	Residential	Commercial & Industrial	
Flow Range	G1.6 to G4	G6 to G25	
Flow Range Ratio	R250	R350	
Accuracy Class	Class 1.5	Class 1.5	
Temperature Range	-25°C to 55°C		
Pressure Range	60 to 150 kPa		
Sampling Frequency	0.5 to 16 Hz @ working mode		
Outputs	Temperature, pressure (optional), flow under working condition and stand condition		
Auto-calibration for Gas	Yes		
Compensation	Temperature and pressure		
Power Consumption	< 50µA @ 8 Hz sampling rate		

Contact information:

Qingdao iESLab Electronic Co., Ltd. 17th Floor, Building A2-3, Hanyu Jingu, High-tech Zone, Jinan City, Shandong, China http://www.qd-ies.com

MR.Yang Shuo Mobile:+ 86 131-7665-5636 Email: yangshuo@ieslab.cn ysieslab@qq.com WeChat: deltonys

8.2 Transducers

For transducers we can recommend products from Zhejiang Jiakang Electronics Co., Ltd.:



Figure 46:

Zhejiang Jiakang Ultrasonic Transudcers

Part number	Frequency	Part number
Gas Meters		
PSC500K018060H2AD2-B1	f: 500 ± 10 kHz Cp 470 pF ± 10% Top -35 to 70 °C	
PSC200K018102H3AD0-B1	f: 200 ± 10 kHz Cp 2000 pF ± 20% Top -35 to 70 °C	2.5 2.5 2.5 0 0 0 0 0 0 0 0 0 0 0 0 0
PSC200K018102H3AD1-B1	f: $200 \pm 10 \text{ kHz}$ Cp $430 \text{ pF} \pm 20\%$ Top $-35 \text{ to } 70 \text{ °C}$ Angle 12° (average) Q $2.9 \pm 0.3 \text{ g}$	
PSC200K016191H2AD1-B1	f: 200 ± 10 kHz Cp 600 pF ± 20% Top -35 to 70 °C Angle > 6° (half angle)	19.1
Water Meters	·	·
PSC1.0M020100H2AD0- B0/PSC1.0M020107H2AD0-B0	f: $1.0 \pm 0.1 \text{ MHz}$ R1MHz100 to 350 ΩCp1300 pF ± 20%Top-40 to 85 °CS>800mV(@ 2Vpp, 110mm)	
PSC1.0M019168H2AD2-B0	f: $1.0 \pm 0.1 \text{ MHz}$ R1MHz150 to 400 ΩCp1000 pF ± 20%Top-40 to 85 °CS>700mV(@ 2Vpp, 110mm)	



Part number	Frequency	Part number
PSC1.0M020160H2AD1-B0	f: $1.0 \pm 0.1 \text{ MHz}$ R1MHz $150 \text{ to } 350 \Omega$ Cp $1200 \text{ pF} \pm 20\%$ Top $-40 \text{ to } 85 ^{\circ}\text{C}$ S > 800mV (@ 2Vpp, 110 mm)	
PSC1.0M014083H2AD2-B0	f: $1.0 \pm 0.1 \text{ MHz}$ R1MHz 500 to 1500 Ω Cp 600 pF ± 20% Top -40 to 85 °C S >450mV (@ 2Vpp, 110mm)	●14.8±0.1 ●14.8±0.1 ●14.8±0.1 ●10 ●10 ●10 ●10 ●10 ●10 ●10 ●10 ●10 ●1
PSC1.0M022300H2AD4-B0	f: $1.0 \pm 0.1 \text{ MHz}$ R1MHz $150 \text{ to } 500 \Omega$ Cp $1300 \text{ pF} \pm 20\%$ Top $-40 \text{ to } 85 ^{\circ}\text{C}$ S >700mV (@ 2Vpp, 110mm)	
PSC2.0M014083H2AD2-B0	f: 2.0 ± 0.1 MHz R1MHz 100 to 400 Ω Cp 1200 pF ± 20% Top -40 to 85 °C S >450mV (@ 2Vpp, 110mm)	<u>314.8±01</u>
PSC2.0M018223H2AD2-B0	f: $2.0 \pm 0.1 \text{ MHz}$ R1MHz $150 \text{ to } 500 \Omega$ Cp $1100 \text{ pF} \pm 20\%$ Top -40 to 85 °C S >200mV (@ 3Vpp, 140mm)	
PSC4.0M018223H2AD2-B0	f: $4.0 \pm 0.2 \text{ MHz}$ R1MHz 30 to 150 Ω Cp 2050 pF ± 20% Top -40 to 85 °C S >200mV (@ 3Vpp, 140mm)	

Tstrg = -40 to 85°C for all parts

9.

Contact data:

Zhejiang Jiakang Electronics Co., Ltd. No.1188 Jiahang Road, Jiaxing City, Zhejiang Province, China http://www.jkelec.com/ dym@jkelec.com T. 13967380228 ayq@jkelec.com T. 13857347855



Overseas markets: sally.ma@jkelec.com M+15906738799



9 Revision Information

Changes from previous version to current revision v1-00	Page
First release	all
Update on 3 rd party modules	Sec. 8

• Page and figure numbers for the previous version may differ from page and figure numbers in the current revision.

• Correction of typographical errors is not explicitly mentioned.



10 Legal Information

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