

### **User Guide**

UG000424

# AS6500-DK

### **Development Kit**

Hardware and Graphical User Interface

v1-00 • 2019-Mar-14

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## 1 Introduction

1.1 Kit Content & Ordering Information

Figure 1: Kit Content



Please download the latest software for the kit from https://download.ams.com/SPECIALTY-SENSORS/AS6500

Ordering Code	Part Number	Description
AS6500-QF_DK	221050003	AS6500 Demo Kit including PICOPROG and cables
AS6500-QF_DK_RB	221050002	AS6500 Reference board

## 2 Quick Start Guide

This section describes how to quickly set up the AS6500-DK, establish basic operation and make measurements.

- It is crucial to install the software before connecting the development kit to your computer: https://download.ams.com/SPECIALTY-SENSORS/AS6500
- 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.
- Quick Start for Initial Measurements

From the "**Start**" menu, go to "**All Programs**" and then to the "**ams AG**" directory. Click the "**AS6500 Evaluation Software**" icon to begin execution of the evaluation software. The following screen should appear:

Figure 2 : Opening Page

ams AS6500 Evaluation Software								-	
ile Tools Help									
REFCLK / SPI STOP									
PIN_ENA_STOP			IA_ST	FOP1	<u>∫</u>		Q		
PIN_ENA_STOP	HIT_ENA_STOP2								
PIN_ENA_STOP	3		IA_ST	горз	Ŀ				
PIN_ENA_STOP	4		IA_ST	FOP4	ſ				
HIGH_RESOLUTION off 0 BLOCKWISE_FIFO_READ		CHANNEI	L_CO Dpera	MBINE ation v 0	]		P Commu	Init Res Write Cor Power On I unication	et nfig Reset Status:
	Results	Filter		Offset		Final Result	Mean	100	Std Dev
STOP1	000000	none	$\sim$	0 ps	AO	0 ps		0 ps	0,0 ps
STOP2	000000	none	$\sim$	0 ps	AO	0 ps		0 ps	0,0 ps
STOP3	000000	none	$\sim$	0 ps	AO	0 ps		0 ps	0,0 ps
STOP4	000000	none	$\sim$	0 ps	AO	0 ps		0 ps	0,0 ps
DELTA OFF - STOP1 - STOP1	000000	none	$\sim$	0 ps	AO	0 ps		0 ps	0,0 ps
DELTA OFF - STOP1 - MATH	000000	none	$\sim$	0 ps	AO	0 ps		0 ps	0,0 ps

## am

- First click "**Power On Reset**", "Write Config" and "Init Reset". The lights for the communication status should both become green.
- Enable the channels that are used.
- Check the REFCLK/SPI page settings
- Connect your signal source
- Press "Start Measurement"

At this point, after successful completion of the above steps, a basic operation of the development kit should be possible.

Figure 3: Setup Window

ams AS6500 Evaluation Software							-	- ×
File Tools Help								
REFCLK / SPI STOP								
☑PIN_ENA_STOP	1	⊠HIT_	ENA_S	TOP1			an	
PIN_ENA_STOP		HIT_	ENA_S	TOP2	ᆂ		Stop Measu	rement
PIN_ENA_STOP	3		ENA_S	торз	Ł			
PIN_ENA_STOP	4		ENA_S	TOP4	ſ			
HIGH_RESOLUTION off 0 BLOCKWISE_FIFO_READ COMMON_FIFO_READ		CHANN Norma	IEL_CC I Opera ENA_D	ISABLE	]		Init Re Write Co Power On Communication	ret nfig Reset Status:
	Results	Filter		Offset	_	Final Result	Mean 100	Std Dev
STOP1	00CF9D	none	$\sim$	0 ps	AO	53149 ps	101344 ps	8670,8 ps
STOP2	02A639	none	$\sim$	0 ps	AO	173625 ps	95830 ps	6924,0 ps
STOP3	000000	none	~	0 ps	AO	0 ps	0 ps	0,0 ps
	000000	none	~	0 ps	AO	0 ps	0 ps	0,0 ps
	000000	none	×	Opc	AO	320470 ps	320403 ps	21,1 ps
	000000	none	$\sim$	0 ps	AO	o ps	0 ps	0,0 ps

### 2.1 Manual Driver Installation

If PICOPROG is not displayed correctly then go to the drivers folder, e.g. *C:\Program Files\ams AG\AS6500 Evaluation Software* and install the driver for your operating system manually.



Figure 4: Device Manager

R Devices and	Printers				-		×
$\leftrightarrow \rightarrow \cdot \cdot$	🕆 📆 « All	Co > Devices a	and Printers	∨ Ō Se	arch Devices and	Printers	٩
Add a device	Add a pr	inter				<b>*</b>	?
Printers (6)							- ^
8	Ŵ	\$	8				
Adobe PDF	Fax	Microsoft Print to PDF	Microsoft XPS Document Writer	PSB01 on SSB2103.off ice.amsiag. com	Send To OneNote 16		1
✓ Unspecifie	d (4)						
Apple	Digilent USB Device	UNIPRO	USB Root Hub (USB 3.0)				
	19 items		,				

## **3 Hardware Description**

### 3.1 Introduction

The AS6500-QF\_DK\_RB board, shown in Figure 5, is a basic board for the 4-channel time-to-digital converter AS6500. The reference clock can be applied from external via pin or from the on-board 4 MHz quartz oscillator (X1).

Figure 5: AS6500-QF\_DK\_RB



### 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 AS6500-QF\_DK\_RB evaluation software starts, a special firmware is written into the PICOPROG to handle the SPI communication with the AS6500-DK. 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 AS6500-QF\_DK\_RB. 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 Main Window

The main windows shows two pages for configuration and result display:

### 4.1.1 Stop Page

On this window major settings are made:

- 1. Selects the input pins that are used in the application
- 2. Enable the internal measurement channels. Each pin refers to minimum one internal channel. Two will be needed in case of channel combination.
- **3.** Select the resolution. High resolution achieves a betters single-shot rms noise, but at the cost of pulse-pair resolution.
- Selects optional channel combination
   This can be for better pulse-pair resolution or for pulse width measurement. Both options demand internally two channels per stop pin.
- 5. Having done the settings, download the configuration and initialize the chip.
- 6. Start the measurement.
- 7. At the bottom the results for the four stop channels are displayed.
- 8. In many cases the differences between the channels are of interest. This can be activated here.



### Figure 6:

Stop F	Page
--------	------

ile Tools Help								
REFCLK / SPI STOP								
✓PIN_ENA_STOP		HIT_ENA_S	TOP1			an		
✓PIN_ENA_STOP	6 Start Measu	rement						
						Init Res	et	
HIGH_RESOLUTION		CHANNEL_CO	OMBINE			5 White Co	afi a	
off v 0 3	4	Normal Oper	ation 🗸 (	0		white Co	ning	
BLOCKWISE FIFO READ						Power On	Reset	
		_				Communication	Status:	
COMMON_FIFO_READ		PIN_ENA_D	ISABLE				₌⊟₌	
							- <u></u>	
	Results	Filter	Offset		Final Result	Mean 🛔 100	Std De	
STOP1	000000	none 🗸	0 ps	AO	74418 ps	103995 ps	3055,9	
STOP2	000000	none 🗸	0 ps	AO	194953 ps	88495 ps	8833,7	
STOP3	000000	none 🗸	0 ps	AO	0 ps	0 ps	0,0	
STOP4	000000	none 🗸	0 ps	AO	0 ps	0 ps	0,0	
DELTA STOP2 - STOP1 MATH	000000	none 🗸	0 ps	AO	320535 ps	320500 ps	34,4	
	000000	none	0 ns	40	0 ns	0.05	0.0	



### 4.1.2 REFCLK/SPI Page

#### Figure 7:

**REFCLK/SPI Page** 

- Teele IIele							
REFCLK / SPI STOP							
	FOSC	200000	ne ne	5 ME	47	Start Measu	rement
			• p3	12 101	12		
1		the reference	clock period	e of I			
☑ REFCLK_BY_XOSC	ן ע	Must fit with	STOP_DATA	BITWIE	отн.		
						Init Res	et
						Write Cor	nfig
PIN_ENA_RSTIDX 3						Write Con Power On	nfig Reset
□PIN_ENA_RSTIDX 3						Write Con Power On	nfig Reset
□ PIN_ENA_RSTIDX 3						Write Con Power On Communication	nfig Reset Status:
□PIN_ENA_RSTIDX 3						Write Con Power On Communication	nfig Reset Status: ====
□PIN_ENA_RSTIDX 3						Write Con Power On <u>Communication</u>	nfig Reset Status: = = =
□ PIN_ENA_RSTIDX 3	Results	Filter	Offset		Final Result	Write Con Power On Communication	nfig Reset Status: = Std Dev
□PIN_ENA_RSTIDX 3	Results 000000	Filter none V	Offset 0 ps	AO	Final Result 74418 ps	Write Con Power On Communication	nfig Reset Status: ====================================
□PIN_ENA_RSTIDX 3 STOP1 STOP2	Results 000000 000000	Filter none v	Offset 0 ps 0 ps	AO	Final Result 74418 ps 194953 ps	Write Con Power On Communication -= Mean \$ 100 103995 ps 88495 ps	nfig Reset Status: ====== Std Dev 3055,9 p 8833,7 p
□PIN_ENA_RSTIDX 3 STOP1 STOP2 STOP3	Results 000000 000000 000000	Filter none v none v	Offset 0 ps 0 ps 0 ps	A0 A0 A0	Final Result 74418 ps 194953 ps 0 ps	Write Con Power On Communication 	nfig Reset Status: ====================================
□PIN_ENA_RSTIDX 3 STOP1 STOP2 STOP3 STOP4	Results 000000 000000 000000 000000 000000	Filter none v none v none v	Offset 0 ps 0 ps 0 ps 0 ps 0 ps	A0 A0 A0	Final Result 74418 ps 194953 ps 0 ps 0 ps	Write Con Power On Communication Mean (100) 103995 ps 88495 ps 0 ps 0 ps	nfig Reset Status: ====================================
□PIN_ENA_RSTIDX 3 STOP1 STOP2 STOP3 STOP4 DELTA STOP2 STOP1 · MA	Results           000000           000000           000000           000000           000000           TH	Filter none v none v none v none v	Offset 0 ps 0 ps 0 ps 0 ps 0 ps 0 ps	A0 A0 A0 A0	Final Result 74418 ps 194953 ps 0 ps 320535 ps	Write Con           Power On           Communication           Image: Communication           I	nfig Reset Status: ====================================

### 4.2 Menu & Support Windows

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.



### 4.2.1 File

Load Config

This dialog box allows the path selection of a configuration file, covering the register settings, necessary for a proper configuration of the AS6500. 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
- Save Graph Data

Allows to store the measurement data as they are stored in the data buffer for the graphical display. It is possible to store the STOP data only or the STOP together with the reference numbers.

Figure 8: File Menu

ams AS6500 Evaluation Softw	are	
File Tools Help		
Load Config Ctrl+O Save Config Ctrl+S		
Save Graph Data 🛛 🕨 🕨	only STOPs Ct	trl+Shift+S
Close Ctrl+W	STOPs + REFNOs	
	REFOSC	REFCLK_DIVISION

#### Close

Close all open windows of the AS6500-QF\_DK Evaluation software.

### 4.2.2 Tools

- Run Measurement
   Some function on "Otort/Otor Measurement" hutten in "Measurement" tok
  - Same function as "Start/Stop Measurement" button in "Measurement" tab of main window. Graph...
    - Opens the window for a graphical display of the measurement data



#### Figure 9: Graph Window



Registers

Opens a separate window for the display and setting of the configuration registers and the display of the read registers.

#### Figure 10: Configuration Registers

### Figure 11: Result Registers

III Registers	- 🗆 🗙	III Registers -
Configuration Registers Results		Configuration Registers Results
- Frontpanel Software A	S6500	- Reference Indexes / Stops
Register addr.         Registers (hec)           [03] [02] [01] [01] :         *         440076393           [07] [06] [05] [04] :         *         D32063800           [17] [01] [08] :         *         D3206331           [15] [14] [13] [12] :         *         70F1CCCC           [19] [18] [17] [16] :         *         00000004	Register addr.         Registers (hex)           [03] [02] [01] [00] :         ×         00000000           [07] [06] [05] [04] :         ×         00000000           [17] [10] [00] :         ×         00000000           [15] [14] [13] [12] :         ×         00000000           [19] [18] [17] [16] :         ×         00000000           Read Regstr.         Read Regstr.	Ref. Indexes (dec.)         Stops (dec.)           Channel 1:         4 11009913         Channel 1:         4 9383           Channel 2:         4 11009914         Channel 2:         4 129819           Channel 3:         4 0         Channel 3:         4 0           Channel 4:         4 0         Channel 4:         4 0
	00 00 cc cc ( 1 ) 0 0 00 00 00	Read Results

## 5 Schematics, Layers and BOM

#### Figure 12:

AS6500-QF\_DK\_RB Schematics



Document Feedback



Figure 13: AS6500-QF\_DK\_RB Layout & Assembly



Figure 14: Bill of Materials for AS6500-QF\_DK\_RB

ltem	Qty	Reference	Value	Part Desc	Туре
1	1	U1	AS6500	QFN40	AS6500 TDC ams
2	1	U6	3.0 V	ADP163AUJZ	Linear regulator, Analog Devices
3	1	X1	5 MHz	KX-20	Quartz crystal Geyer
4	3	C8, C10, C12	100 nF	0805	Chip capacitor
5	2	C34,C35	15 pF	0805	Chip capacitor
6	5	C2,C4,C7,C9,C11	22 µF	0805	Chip capacitor
7	2	R19,R110	0 Ω	0805	Chip resistor

Item	Qty	Reference	Value	Part Desc	Туре
8	2	R10,R51	100 Ω	0805	Chip resistor
9	7	R22,R23,R24,R25,R26,R27,R28	100 kΩ	0805	Chip resistor
10	9	R1,R18,R20,R29,R30,R31,R32,R33	1 ΜΩ	0805	Chip resistor
11	4	R21,R61,R64,R65	1.1 MΩ	0805	Chip resistor
12	1	R5	604 kΩ	0805	Chip resistor
13	1	R12	60.4 kΩ	0805	Chip resistor
14	1	R4	910 kΩ	0805	Chip resistor
15	1	R8	10 MΩ	0805	Chip resistor
16	1	J6	7 x 1 x 90°		2.54
17	1	J1	2 x 1 x 90°		2.54
18	1	J2	5 x 1 x 180°		2.54

## 6 **Revision Information**

Changes from previous version to current revision v1-00	Page
First edition	All
<ul> <li>Page and figure numbers for the previous version may differ from page and figure numbers.</li> </ul>	mbers in the current revision.

Correction of typographical errors is not explicitly mentioned.

## 7 Legal Information

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