Application Note: AS5048B - I2C sensor readout

AS5048B

14-bit Rotary Position Sensor with Digital Interface

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Revision History

Revision	Date	Owner	Description
1.0	03.28.2013	rph	Initial Version
1.1	26.06.2013	rph	Updated Averaging Description

1. General Description

This Application Note explains how to communicate with the AS5048 14-bit Rotary Position Sensor. There are two versions of the AS5048 available:

Table 1:

AS5048 versions

Ordering Code	Digital Angle Interface
AS5048A	SPI
AS5048B	I2C

Find more information on our webpage:
http://ams.com/eng/Products/Magnetic-Position-Sensors

2. Reading the AS5048B using I2C

The next code lines demonstrate how the AS5048B can be read using the I²C interface of the application microcontroller.

```
#define readings 6

unsigned char buffer[readings];

for(i = 0; i < readings; i++)
{
      buffer[i] = I2C_Read8_AS5048B(0x40, 0xFA+i);
}
AGC=buffer[0];
error_status=buffer[1]&0x0F;
MAG=(buffer[2]<<6)+(buffer[3]&0x3F);
ANG=(buffer[4]<<6)+(buffer[5]&0x3F);
```

3. Sensor Output Averageing

The code example below shows an easy averaging algorithm to reduce noise of the angular output for angular values within one rotation and with no zero crossing of the output data.

Note: As 360° is the same as 0° this would cause an averaging error. To perform averaging of output data with more than one rotation refer to “Mean of circular quantities”.

Example:

```
#define average 100
for (count = average; count; count--)
{
            data = sensor_read(); //reading,computing sensor output
            position += data;
}
position = position / average;
```

4. Setting the Zero Position

The Zero Position of the angle output can be set individually depending on the application requirements. Following code examples show how to set the Zero Position.

Example:

```
I2C_Write8(0x40,0x16,0x00); // Reset Zero Position high byte
I2C_Write8(0x40,0x17,0x00); // Reset Zero Position low byte

for(i = 0; i < 6; i++) // Readout Position
{
      buffer[i] = I2C_Read8_AS5048B(0x40, 0xFB+i); // start reading at
      Error Register 0xFB
}

error_status=(buffer[0]&0x0F);

if(error_status==1) // No Error
{
      ANG=(buffer[3]<<6)+(buffer[4]&0x3F); // Calculate Angle
      I2C_Write8(0x40,0x16,buffer[3]); // Write Zero Position high byte
      I2C_Write8(0x40,0x17,buffer[4]); // Write Zero Position low byte
}
else printf ("\n\n     ERROR  ");
```

5. I2C Register Map

The available registers for I2C communication of the AS5048B are listed in Figure 1.

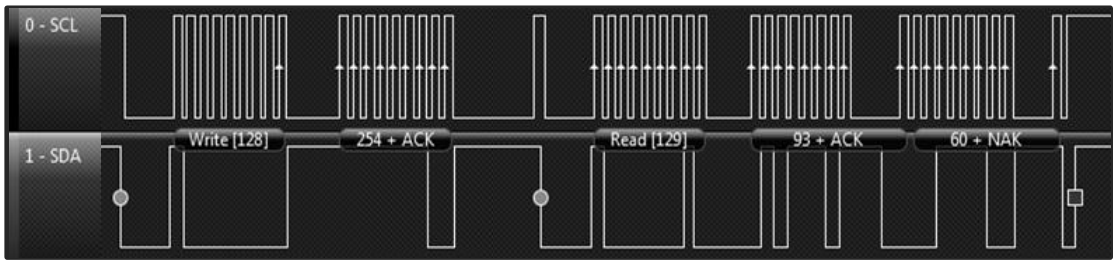
Figure 1:
I2C Register Map

	Address dec	Name	Access Type	Bit Nr.	Symbol	Default	Description
Control OTP	3	Programming Control	R/W	7	not used	0	Programming control register. Programming must be enabled before burning the fuse(s). After programming is an verification mandatory. See programming procedure.
				6	Verify		
				5	not used		
				4			
				3	Burn		
				2	reserved		
				1			
				0	Programming Enable		
Programmable Customer settings	21	I²C slave address	R/W + Program	7	not used	n.a.	I²C slave address slave address consist of 5 programable bits (MSBs) and the hardware setting of Pins A1 and A2 I²C address <4> is by default not programmed and due to the inversion defined as '1'
				:	:	:	
				5			
				4	I²C address<4>	internally inverted	
				:	:	:	
				0	I²C address<0>	0	
	22	OTP Register Zero Position Hi	R/W + Program	7	Zero Position <13>	0	Zero Position value high byte
				:	:	:	
				0	Zero Position <6>	0	
	23	OTP Register Zero Position Low 6 LSBs	R/W + Program	7	not used	n.a.	Zero Position remaining 6 lower LSB's
				6			
				5	Zero Position <5>	0	
				:	:	:	
				0	Zero Position <0>	0	
Readout Registers	250	Automatic Gain Control	R	7	AGC value<7>	1	Automatic Gain Control value. 0 decimal represents high magnetic field 255 decimal represents low magnetic field
				:	:	:	
				0	AGC value<0>	0	
	251	Diagnostics	R	7	not used	n.a.	Diagnostic flags
				:			
				4			
				3	Comp High	0	
				2	Comp Low	0	
				1	COF	0	
				0	OCF	1	
	252	Magnitude	R	7	Magnitude<13>	0	Magnitude information afer ATAN calculation
				:	:	:	
				0	Magnitude<6>	0	
	253		R	7	not used	n.a.	
				6			
				5	Magnitude<5>	0	
				:	:	:	
				0	Magnitude<0>	0	
	254	Angle	R	7	Angle<13>	0	Angle Value afer ATAN calculation and zero position adder
				:	:	:	
				0	Angle<6>	0	
	255		R	7	not used	n.a.	
				6			
				5	Angle<5>	0	
				:	:	:	
				0	Angle<0>	0	

6. Output registers read-cycle

For further reference, a logic plot showing the readout of the output registers 0xFE and 0xFF is shown below.

Figure 2:
Output registers read-cycle



7. Ordering Information

Table 2:
Ordering Information

Ordering Code	Description	comments
AS5048B-EK-AB-STM1.0	AS5048B Eval-Kit for stepper motor	I2C interface

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Contact Information

Headquarters

ams AG
Tobelbader Strasse 30
8141 Unterpremstaetten
Austria
T. +43 (0) 3136 500 0
For Sales Offices, Distributors and Representatives, please visit:
http://www.ams.com/contact