Application Note

AS505xA

Error Monitoring

Content Guide

Revision History

Revision	Date	Owner	Description
1.0	26.11.2012	ekno	Initial Version
1.1	24.01.2013	ekno	added more information of WOW and MODE
1.2	05.03.2013	ekno	Correction of WOW description
1.3	21.11.2013	mzie	Apply corporate template, correction of Error Status Register, general overhaul
1.4	21.10.2014	mzie	Update to new corporate template, adaption to datasheet

1 General Description

The AS5050A and AS5055A offer error monitoring qualities. When an error occurs (e.g.: wrong clock cycle) the IC detects the failure and gives back an error flag on the SPI interface.

This Application note describes the error flag and how to read out the ICs error status. Furthermore the different meanings of error flags which can occur are described and also how to avoid errors in future.

The aim of this application Note is to increase quality of a system during evaluation phase.

2 Detection

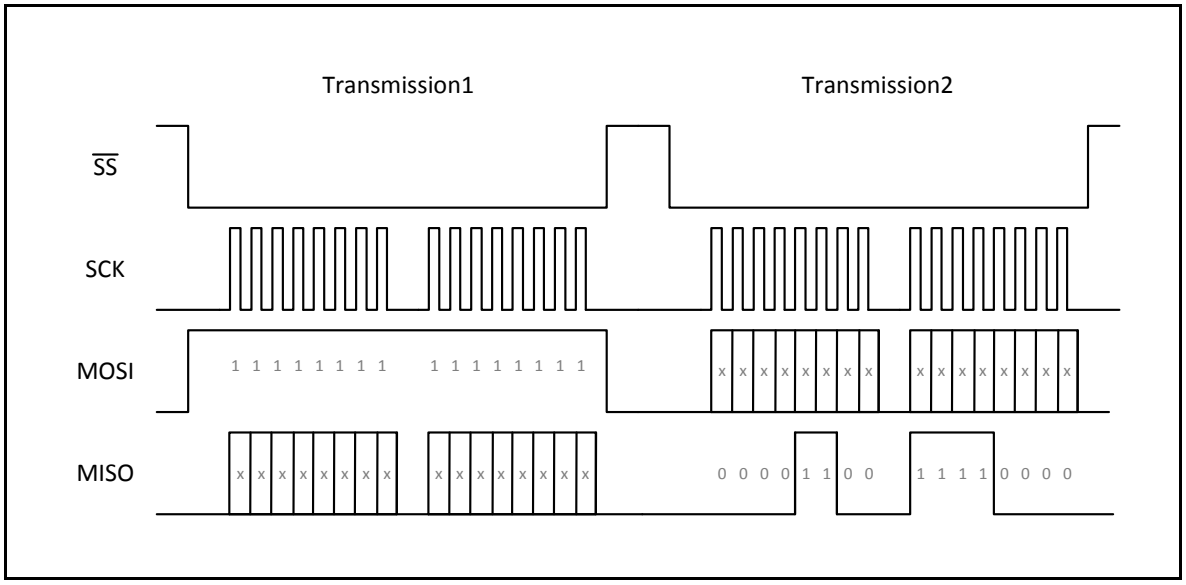

Figure 1: Normal transmission

In the first transmission an ANGULAR DATA command package is sent (MOSI). The IC answers at transmission 2 with an ANGULAR DATA read package (MISO).

The content from a normal ANGULAR DATA command package on MOSI signal is shown in Table 1: ANGULAR DATA command package.

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Description	R/W	Address <14:1>														PAR
Content	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Bit	Name	Description
15	R/W	0=Write, 1=Read
14:1	Address	14 bit address to read or write
0	PAR	Parity bit (even) calculated on the upper 15 bits

Table 1: ANGULAR DATA command package

The content of normal ANGULAR DATA read package on MISO signal is shown in

Table 2: ANGULAR DATA read package. In this case no error occurred.

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Description	Alarm Lo	Alarm Hi	Angle Value <13:2>												EF	PAR
Content	0	0	X	X	X	X	X	X	X	X	X	X	X	X	0	X

Bit	Name	Description
15	Alarm Lo	Alarm flag, which indicates a too low magnetic field (details see chapter “Analysis”)
14	Alarm Hi	Alarm flag, which indicates a too high magnetic field (details see chapter “Analysis”)
13:2	Angle Value	Angular value in binary code
1	EF	Error flag, which indicates that an error occurred (details see chapter “Analysis”)
0	PAR	Parity bit (even = ‘0’ and odd = ‘1’)

Table 2: ANGULAR DATA read package

3 Analysis

3.1 Error flags

3.1.1 Alarm bits

In case one of the Alarm bits is high, a system error occurred. Both alarm bits set to high indicate a major system error.

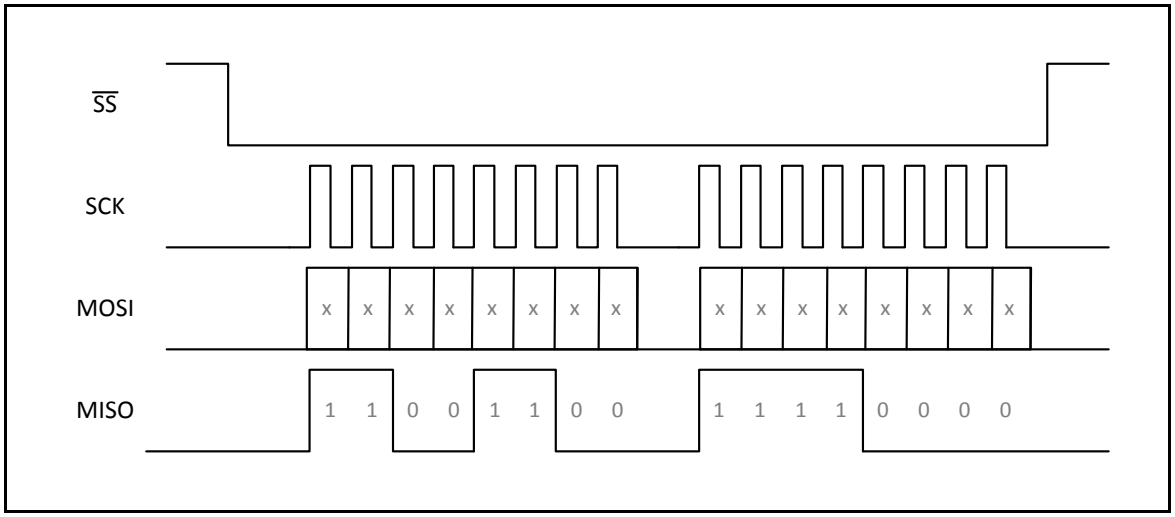

Figure 2: both Alarm bits = high

Alarm Hi	Alarm Lo	Description	AGC value
0	0	AGC level is higher than the minimum value and lower than the maximum value.	>0 and <63
0	1	AGC level is equal or even higher than the maximum level. Magnetic field too weak.	>63
1	0	AGC level is equal or even lower than the minimum level. Magnetic field too strong.	<0
1	1	Indicates of a major system error has occurred or if the WOW flag is active. (Error flags can be read out with the error status register)	

Table 3: Alarm bits

3.1.2 Communication error flag

The Communication Error Flag (EF) occurs when the SPI communication is incorrect.
The error flag remains until the microcontroller sends a CLEAR ERROR FLAG command.

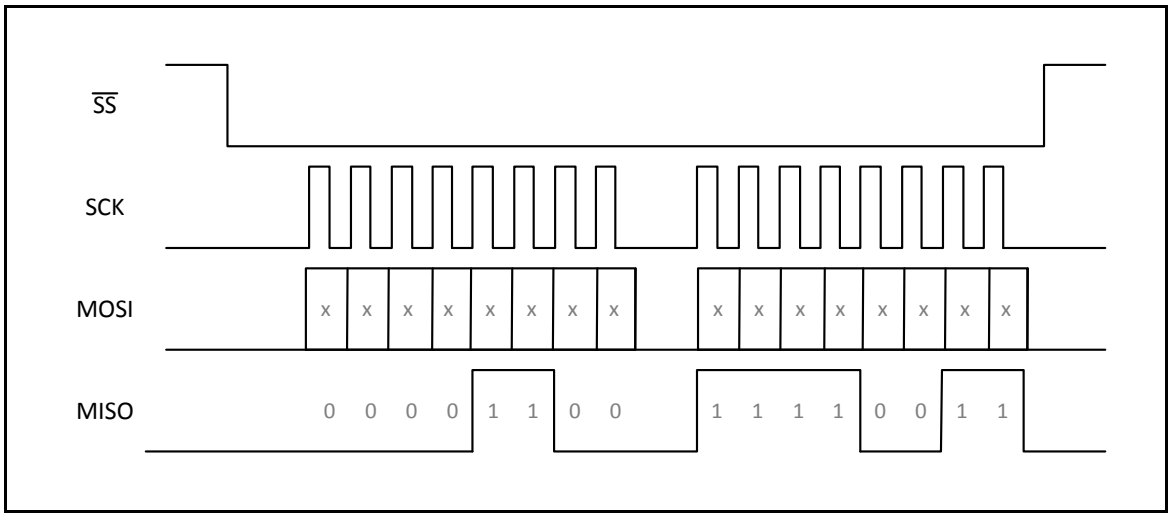

Figure 3: EF = high

3.2 Error Status Register

For all detailed information about the error flags and system monitoring read out the error status register (0x335A). Table 4: Error Status Register (0x335A) shows the Error Status Register.

Bit	Description	Type
13	Error Status DSP	Reserved
12		FIELD_ALARM_LO
11		FIELD_ALARM_HI
10		RANGE
9		CORDICOV
8		ADCOV
7	Error Status System	Reserved
6		Reserved
5		Reserved
4		WOW
3	Error Status SPI	Reserved
2		ADDMON
1		CLKMON
0		PARITY

Table 4: Error Status Register (0x335A)

3.2.1 Description of the error flags

FIELD_ALARM_LO:

AGC level is equal or even higher than the maximum level. Magnetic field is too weak.

FIELD_ALARM_HI:

AGC level is equal or even lower than the minimum level. Magnetic field is too strong.

RANGE:

The Hall element is driven by a current source. In case of higher temperature, the voltage drop over the source decreases. The hall element does not fail, but the accuracy is getting worse. To ensure high system integrity the voltage drop over the current source is monitored.

CORDICOV:

The CORDIC calculates the angle. The error occurs when the input signals of CORDIC are too large. The internal algorithm fails.

ADCOV:

In case of magnet displacement the IC is not able to capture the whole information of the magnetic field. Some information gets cut off, because the values are too high.

WOW:

This is a handshake mechanism to check system integrity. By sending a READ ANGLE command the internal flag (WOW) is set to high. At the end of measurement the WOW is set to low again. In failure case (internal dead lock situation) the WOW flag remains high.

ADDMON:

In case the microcontroller sends a wrong/not existing address, the sensor reacts with setting this flag to high.

CLKMON:

The IC is counting the clock cycles. In case the microcontroller sends too much or less clock samples than standard, the sensor reacts with setting this flag to high.

PARITY:

In case the transmitted parity bit does not match to internally calculated parity bit, the sensor reacts with setting this flag to high.

Note:

While the IC is busy, the WOW flag is set to high. Therefore the alarm bits are also 1! This indicates that the IC is still busy. After the IC was busy, the Alarm bits will automatically set to 0. No “Clear Error Flag” Command is needed.

4 Troubleshooting

4.1 Error Avoidance

FIELD_ALARM_LO:

This means that magnetic field is too weak. Decreasing the air gap or choosing a magnet with higher magnetic field strength can solve this problem.

FIELD_ALARM_HI:

This means that magnetic field is too high. Increasing the air gap or choosing a magnet with lower magnetic field strength can solve this problem.

RANGE:

The main reason of this error is higher temperature. Decreasing the temperature can be a solution, but often not possible. Therefore another solution is increasing the magnetic field. This will lower the voltage drop over the current source of the hall element.

CORDICOV:

This error has several reasons: disturbing external field; magnetic field is too high or large displacement. When there is an external field disturbing the IC, it can help to start the measurement again. Otherwise the external field must be eliminated.

A high magnetic field can occur with a “powerful” magnet or less air gap. In both cases the IC sees a high magnetic field. By changing the air gap or choosing a magnet with another magnetization the error can be avoided.

Large displacement has nearly the same effect like a high intensive magnetic field. Centering the magnet and the IC in the rotation axis can also avoid this error.

ADCOV:

This error flag means that there is a displacement between IC and magnet. The best performance of IC is reached with a centered magnet.

WOW:

When the WOW stays high after 500µs the system integrity is not more given. (Internal dead lock situation).

4.2 Clear Error Flag

If the Communication Error Flag (EF) is set to high because of a communication problem, the flag remains set until it will be cleared by a CLEAR ERROR FLAG command. (0x3380)

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Description	R/W							Address <14:1>								PAR
Content	1	1	1	0	0	1	1	1	0	0	0	0	0	0	0	0

Table 5: CLEAR ERROR FLAG command (0x3380)

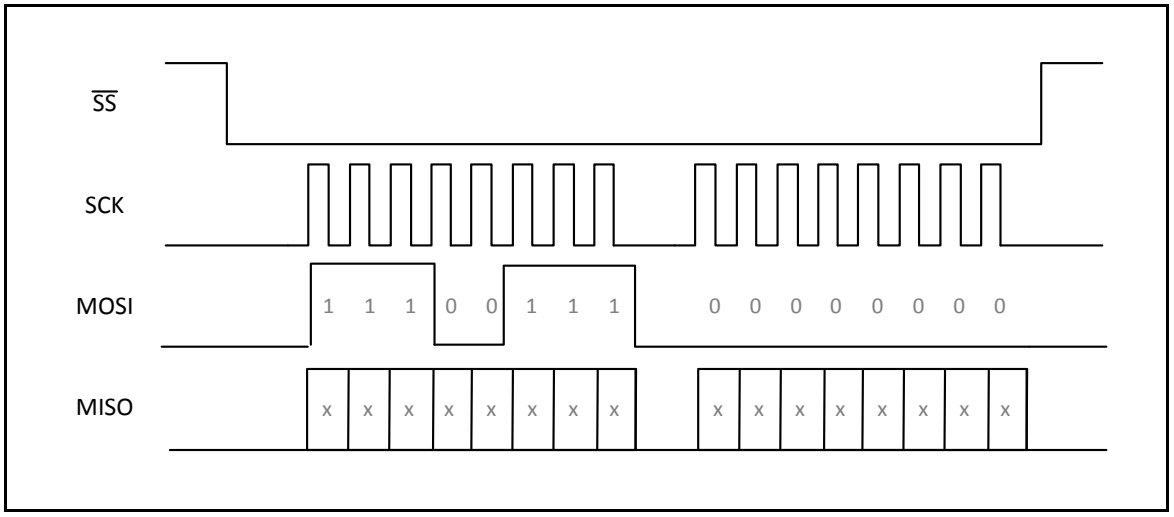

Figure 4: CLEAR ERROR FLAG command (0x3380)

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