



**austriamicrosystems AG**

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**ams AG**

The technical content of this austriamicrosystems application note is still valid.

**Contact information:**

**Headquarters:**

ams AG  
Tobelbaderstrasse 30  
8141 Unterpremstaetten, Austria  
Tel: +43 (0) 3136 500 0  
e-Mail: [ams\\_sales@ams.com](mailto:ams_sales@ams.com)

Please visit our website at [www.ams.com](http://www.ams.com)

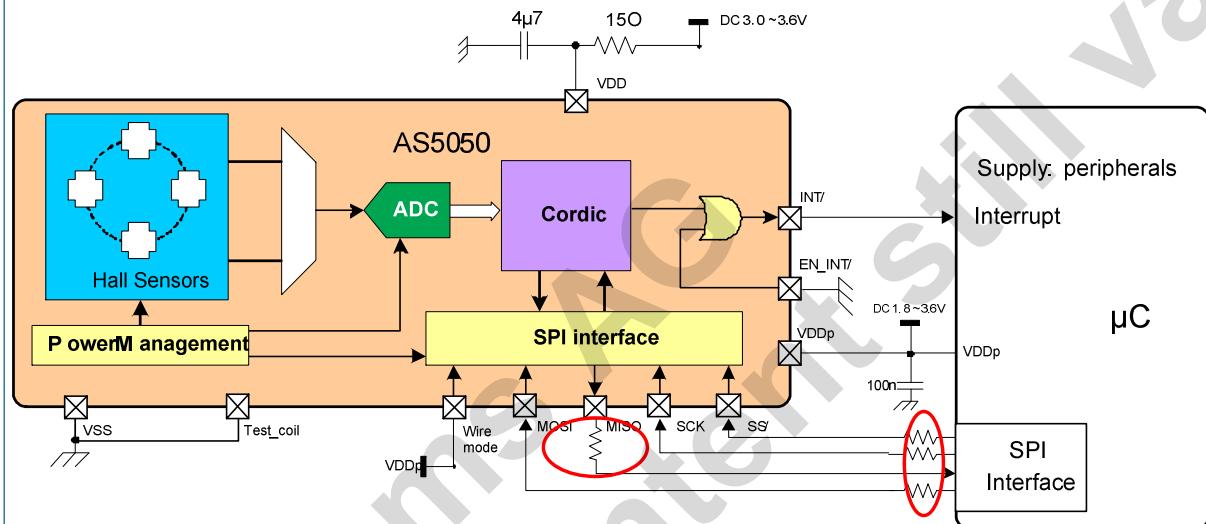
# SPI over long distances

## AS5050 /AS5055

AN5000\_SPI\_Interface  
Application Note

The application note shows you how you can reduce the communication error with SPI over long distances.

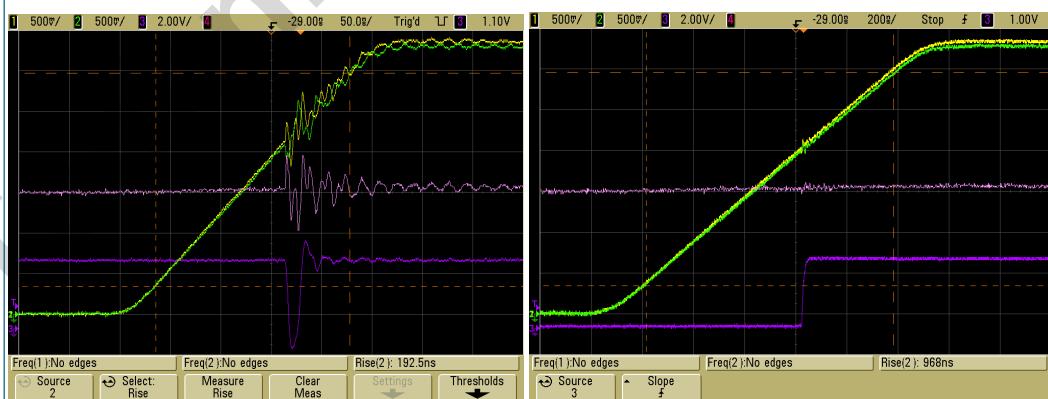
### General Setup for AS5050



Additional to the resistors you have to set 100pF capacitance on both ends of the MOSI, MISO, SCK and SS tracks.

Over long cable distances there could be the problem, that the MISO Signal is disturbing the SCK Signal. To eliminate this issue you have to know some general routing and setup basics for the SPI.

**General:** Over long cable distances you will have coupling capacitance between the signals. On the AS5050/AS5055 the MISO pin is disturbing the SCK with a kind of a crosstalk on the SCK. This means the SCK will generating more clocks inside the device and the communication is failing (wrong timing). On a distance of 15cm you will see a very big voltage drop on the MISO on the device side. This drop disturbs the SCK Signal. With a serial resistor close on the MISO Pin on the AS5050/AS5055 you will reduce this issue on the SCK and MISO to a minimum (Figure 3)



(Figure 2) Channel 1 = SCK; Channel3 =MISO

(Figure 3) Channel 1 = SCK; Channel3 =MISO

a) **Ribbon cable / signal routing:**

Over long distances the coupling capacitance between the different Signals could be very big. With a "wrong" routing (Figure 4) there is the possibility that the MISO-Signal is disturbing the SCK-Signal. To reduce this issue a simple modification of the routing is enough (Figure 5)

MOSI \_\_\_\_\_  
 MISO \_\_\_\_\_  
 SCK \_\_\_\_\_  
 VSS \_\_\_\_\_  
 VDD \_\_\_\_\_  
 SS \_\_\_\_\_

(Figure 4)

MOSI \_\_\_\_\_  
 MISO \_\_\_\_\_  
**VSS** \_\_\_\_\_  
 SCK \_\_\_\_\_  
 VDD \_\_\_\_\_  
 SS \_\_\_\_\_

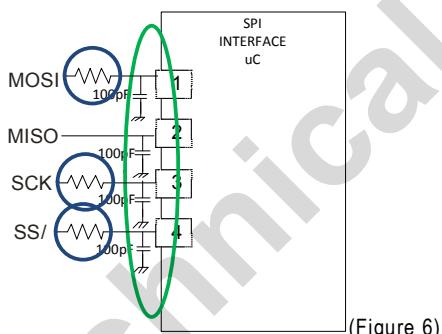
(Figure 5)

With VSS between MISO and SCK there is an isolation which reduces the disturbance

b) **Filter on the uC**

With a filter close to the driving output we reduce the disturbance to a minimum. You need the resistor for communication noise and EMV as well. On the uC MOSI, SCK and SS are the driving outputs. (Figure 6) A resistor on the MISO pin has no influence!

Required Resistor on the OUTPUT is 100Ohm to 1kOhm. Required capacitance is 100pF



(Figure 6)

Place resistors close as possible to the MOSI, SCK and SS pins. With a 100pF capacitance on each pin to GND you will reduce the noise.

### c)Filter on the AS5050/AS5055

On the sensor side you have to place a resistor close to the MISO pin. Resistors on the other Inputs have no influence. With a 100pF capacitance on each pin to GND you will reduce the noise and the coupling capacitance between MISO and SCK (Figure7)

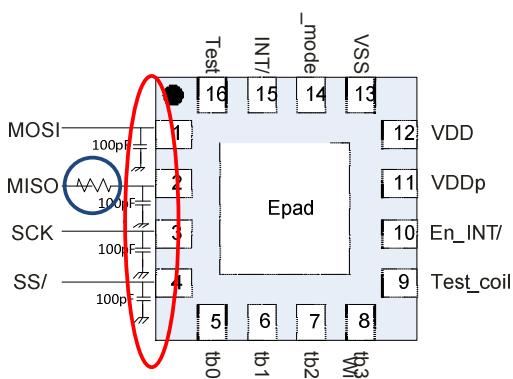


Figure 7

**Very important: Set the resistor close as possible to the MISO Pin. Set also the 100pF Cap close as possible to the MISO PIN.**

Set capacitance close as possible to MOSI, SCK and SS PIN.

## Revision History

Revision	Date	Description
1.0	Sept. 2011	First release

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## Contact Information

### Headquarters

austriamicrosystems AG

A-8141 Schloss Premstaetten, Austria

Tel: +43 (0) 3136 500 0

Fax: +43 (0) 3136 525 01

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