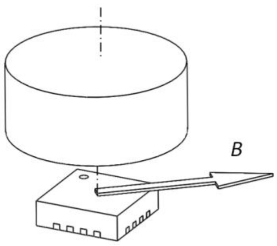
Monolithic Power Systems

Application Note

How to Detect the Field Amplitude with MagAlpha

September 2014

Introduction



The MagAlpha sensor provides the angle of the magnetic vector lying in the chip plane. In this sensor the angle is obtained by detecting the *phase* of a sine wave signal. This phase is then converted through a time-to-digital converter to a digital number, which is the sensor basic output. It turns out that the *amplitude* of this signal is proportional to the amplitude of the magnetic vector. This signal is normally not accessible by the user, but it is possible to read it in test mode. It is useful for users who not only needs the field angle but also some information about the field amplitude. The present note explains how to extract and interpret this signal.

Pin configuration

Pin 10 is dedicated to access front-end signals.

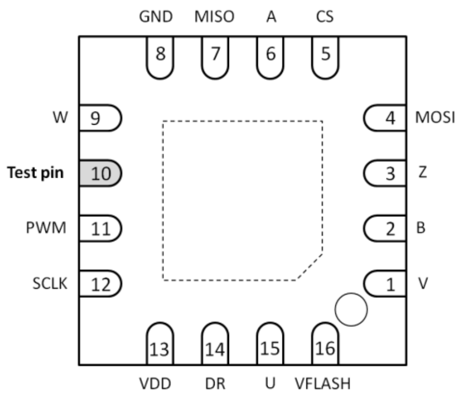


Figure 1: Pin Configuration (top view)

Setting

To access the analog signal of the front-end, the following command needs to be sent via the serial interface:

Hex	*Binary*	*Function*
28	00101000	Enables
04	00000100	Pin 10

This command modifies a test register of the MagAlpha. The content is volatile; therefore this function will be reset in case of power down.

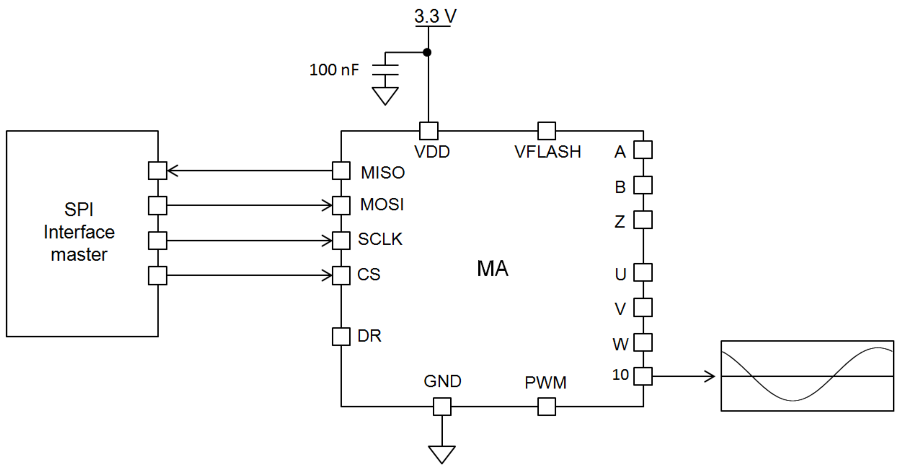


Figure 2: Communication with the MagAlpha through the SPI

A sine wave signal centered at VDD/2, with a frequency of 500 kHz appears on the Pin 10 (see Figure 3). The amplitude A is proportional to the magnetic field strength. By default the signal saturates at 50 mT.

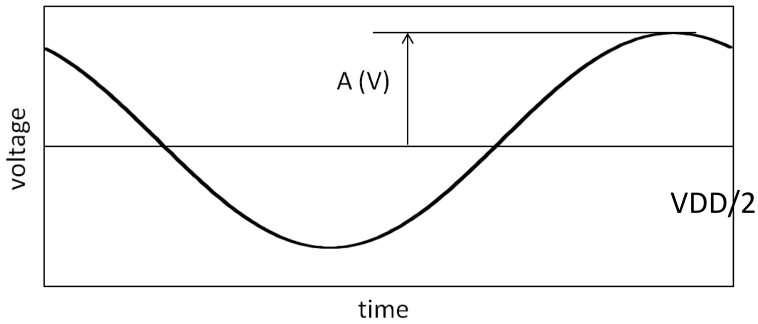


Figure 3: A Sin Wave Signal Form at Pin 10.

For MAgAlpha sensors with side-shaft options, the measurable field range can be extended to 100 mT by decreasing the current biasing of the Hall devices. To activate the “low bias operation” the trimming of both axes X and Y has to be enabled and the current trimming parameter BCT(7:0) has to be changed from 0 (default value) to 192:

Hex	*Binary*	*Function*
2530	00100101 00110000	Enables ETX and ETY
23 C0	00100011 11000000	Set BCT to 192

Note: setting BCT to 192 decreases the current bias by factor of about two. This affects the angle measurement noise level: the resolution decreases by about 1 bit.

Transfer function

In fact A, the amplitude of the sine wave signal, not only depends on the magnetic field strength B, but also, to some extent, to the field angle α: the amplitude A can vary by about ±10 % depending on α. Since the angle dependence is a predetermined function it can be used as a calibration curve for detection with an accuracy better that 10% (see Figure 4).

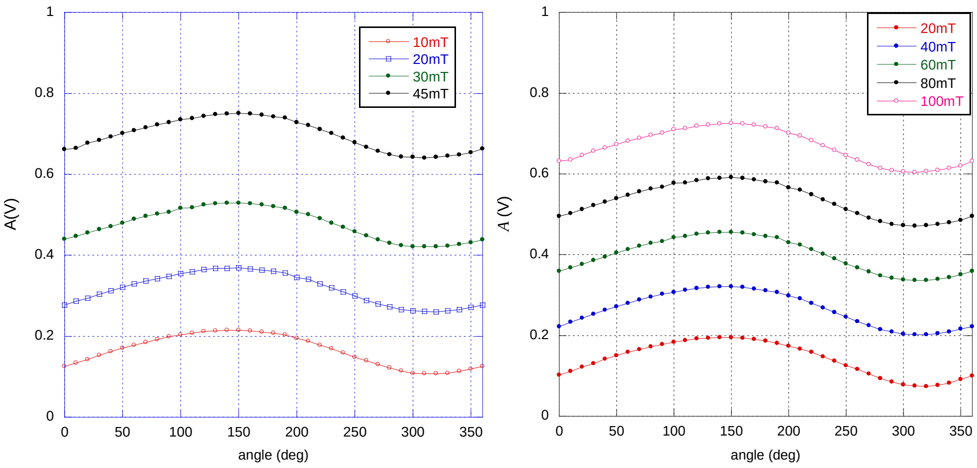


Figure 4: Signal Amplitude on Pin 10 as a Function of α for Various B in Default Setting (left), and in Low Bias Operation (right)

For a coarse field estimation, one can consider just the average over all angles:

$$\bar{A}(B) = \frac{1}{360}\int_0^{360} A(B,\alpha)d\alpha$$

$\bar{A}$ is proportional to B, i.e. $\bar{A}(B) = kB$, up to the saturation field B_{sat}, and constant above.

	k(T/Vpaek)	B_{sat}(mT)
Default setting	0.065	50
Low bias operation	0.15	100