Product Document

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User Manual – AS5045B-AB-v1.0

AS5045B

12-bit Rotary Position Sensor with Digital Angle (Interface), PWM and ABI output

Table of Contents

Revision History

Revision	Date	Owner	Description
1.0	01.10.2009		Initial revision
1.1	05.07.2013	azen	Updated to new template

1 General Description

The AS5045B is a contactless magnetic rotary encoder for accurate angular measurement over a full turn of 360°. It is system-on-chip, combining integrated Hall elements, analog front end and digital signal processing in a single device.

To measure the angle, only a simple two-pole magnet, rotating over the center of the chip, is required. The magnet may be placed above or below the IC. This is shown in Figure 1.

Figure 1:
Rotary Position Sensor AS5045B + Magnet

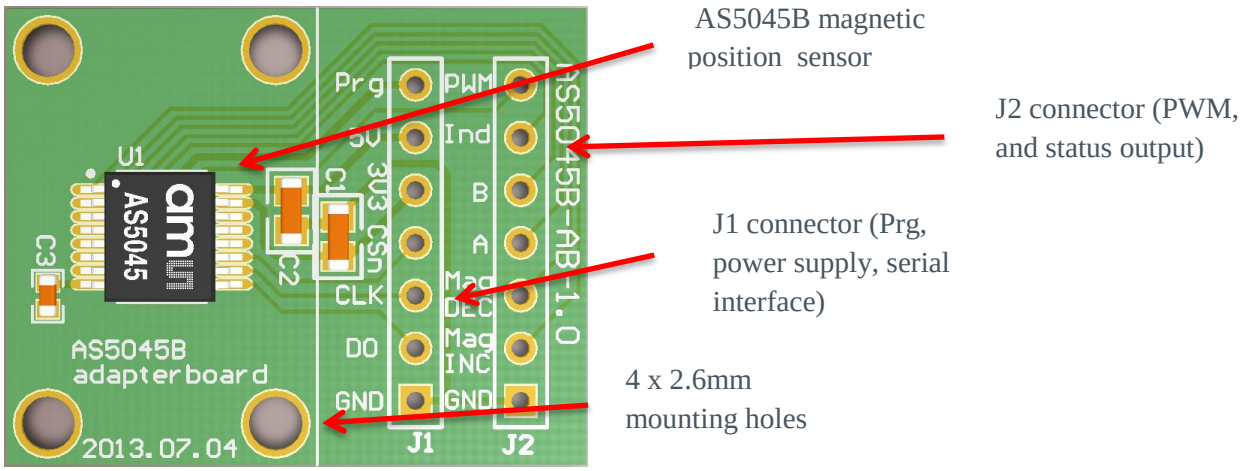
2 The AS5045B adapter board

The AS5045B adapter board is a simple circuit allowing test and evaluation of the AS5045B rotary position sensor quickly without building a test fixture or PCB.

2.1 Board description

The PCB can be used as standalone unit or attached to a microcontroller. The standalone operation requires a 5V power supply only; the magnet's angle can be read on the PWM or analog output.

Figure 2:
AS5045B Adapterboard

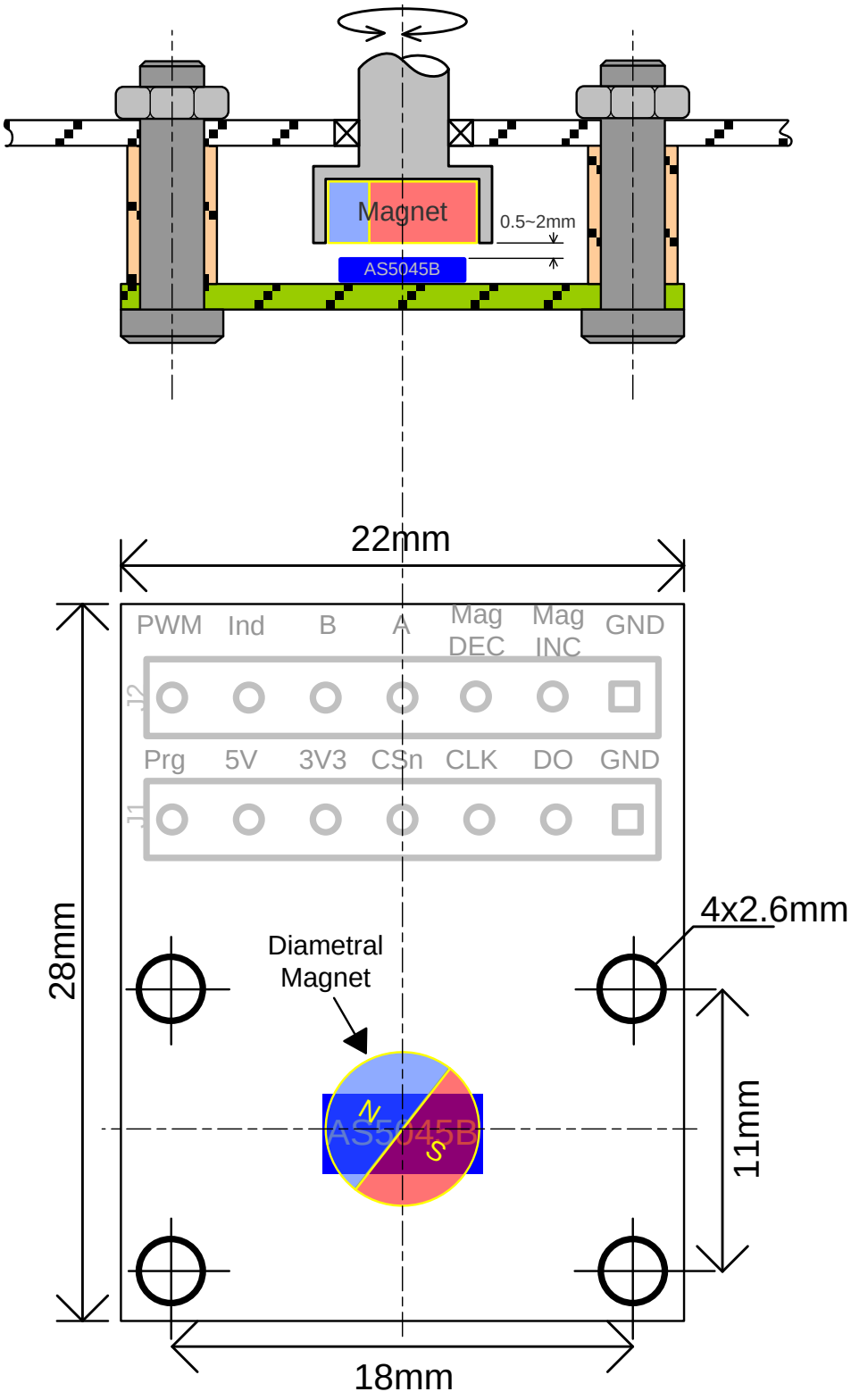


2.2 Mounting the AS5045B adapter board

A diametric magnet must be placed over on under the AS5045B encoder, and should be centered on the middle of the package with a tolerance of 0.5mm.

The airgap between the magnet and the encoder casing should be maintained in the range 0.5mm~2mm. The magnet holder must not be ferromagnetic. Materials as brass, copper, aluminum, stainless steel are the best choices to make this part.

Figure 3:
AS5045B – AB - mounting and dimension



3 AS5045B adapter board and pinout

Figure 4:
AS5045B adapter board connectors and encoder pinout

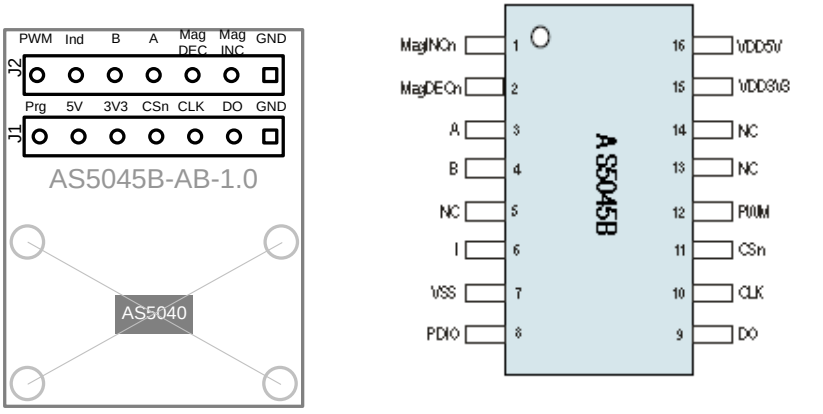


Table 1:
Pin description

Pin# Board	Pin# AS5040	Symbol Board	Type	Description
JP1 - 1	7	GND	S	Supply ground
JP1 - 2	9	DO	DO_T	**D**ata **O**utput of Synchronous Serial Interface
JP1 - 3	10	CLK	DI_ST	**Cl**oc**k** Input of Synchronous Serial Interface; Schmitt-Trigger input
JP1 - 4	11	CSn	DI_PU_ST	**C**hip **S**elect, active low; Schmitt-Trigger input, internal pull-up resistor (~50kΩ) connect to VSS in incremental mode
JP1 - 5	15	3V3	S	3V-Regulator Output
JP1 - 6	16	5V	S	5V Supply
JP1 - 7	8	Prg	DI_PD	OTP **Prog**ramming Input and Data Input for Daisy Chain mode. Internal pull-down resistor (~74kΩ). May be connected to VSS if programming is not used
JP2 - 1	7	GND	S	Supply ground
JP2 - 2	1	MagINC	DO_OD	Magnet Field **Mag**nitude **INC**rease; active low, indicates a distance reduction between the magnet and the device surface.
JP2 - 3	2	MagDEC	DO_OD	Magnet Field **Mag**nitude **DEC**rease; active low, indicates a distance increase between the device and the magnet
JP2 - 4	3	A	DO	*AS5040 – AS5140 – AS5145 (programmed) only* *Mode1.x:* Quadrature **A** channel *Mode2.x:* **L**east **S**ignificant **B**it *Mode3.x:* **U** signal (phase1)

Pin# Board	Pin# AS5040	Symbol Board	Type	Description
JP2 - 5	4	B	DO	*AS5040 – AS5140 – AS5145 (programmed) only* *Mode1.x*: Quadrature **B** channel quarter period shift to channel A. *Mode2.x:* **Dir**ection of Rotation *Mode3.x:* **V** signal (phase2)
JP2 - 6	6	Ind	DO	*AS5040 – AS5140 – AS5145 (programmed) only* *Mode1.x and Mode2.x* : **Index** signal indicates the absolute zero position *Mode3.x*: **W** signal (phase3) *AS5045 – AS5145 (unprogrammed)* *Mode input, connect to VDD5 (Fast mode) or GND (Slow mode); do not change during operation*
JP2 - 7	12	PWM	DO	**P**ulse **W**idth **M**odulation of approx. 1kHz; **LSB** in *Mode3.x*

Pin types:	DO_OD	digital output open drain	S	supply pin
	DI_PD	digital input pull-down	DO_T	digital output /tri-state
	DI_PU	digital input pull-up	ST	schmitt-trigger input
	DI	digital input	DO	digital output

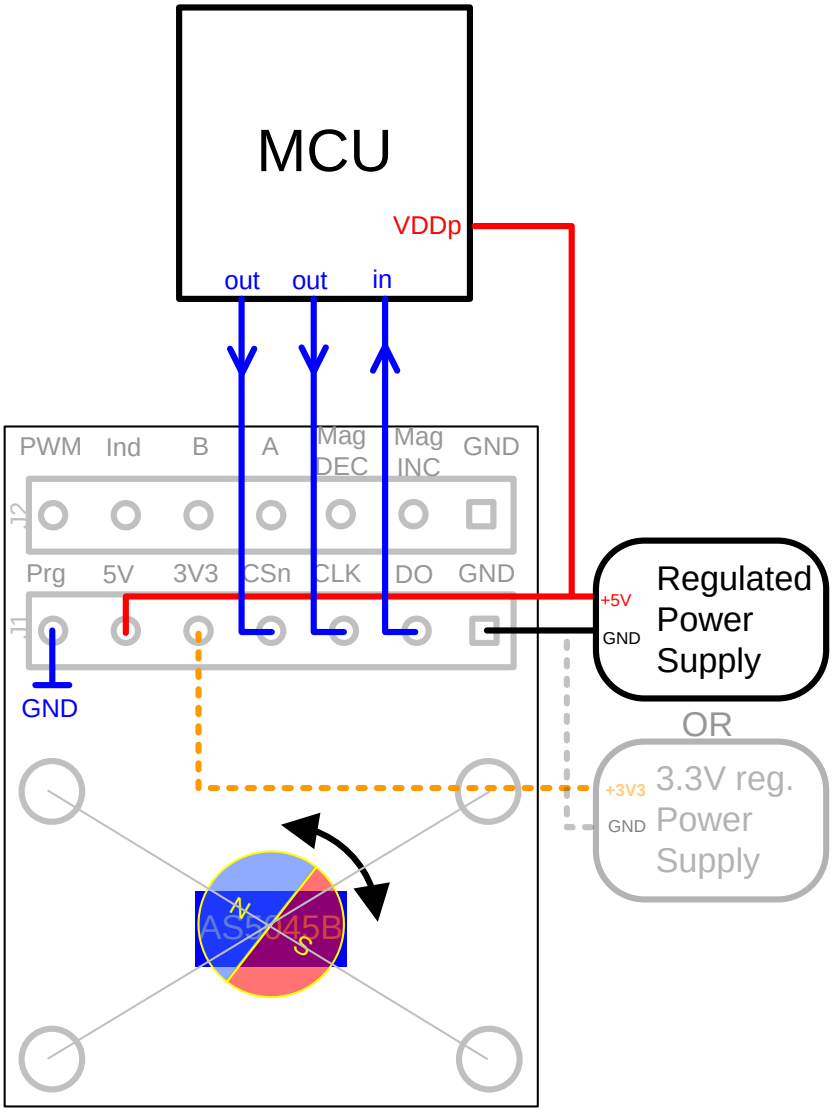
4 Operation cases

The most complete and accurate solution for a MCU to read the angle of a magnet is the serial interface.

4.1 Standalone SSI output mode

The serial word contains 12 bits for AS5045B angle value and some other indicator bits like MagINC, MagDEC, which can be read at the same time.

Figure 5:
Using the analog output with the adapter board



4.2 Standalone PWM output mode

The AS5045B provides a pulse width modulated output (PWM), whose duty cycle is proportional to the measured angle. The PWM signal (J2 pin #7) with a period of 1025us (1us step) and 5V pulse voltage can be connected to the capture/timer input of a microcontroller in order to decode the angle value.

Figure 6:
Using the PWM output with the adapter board

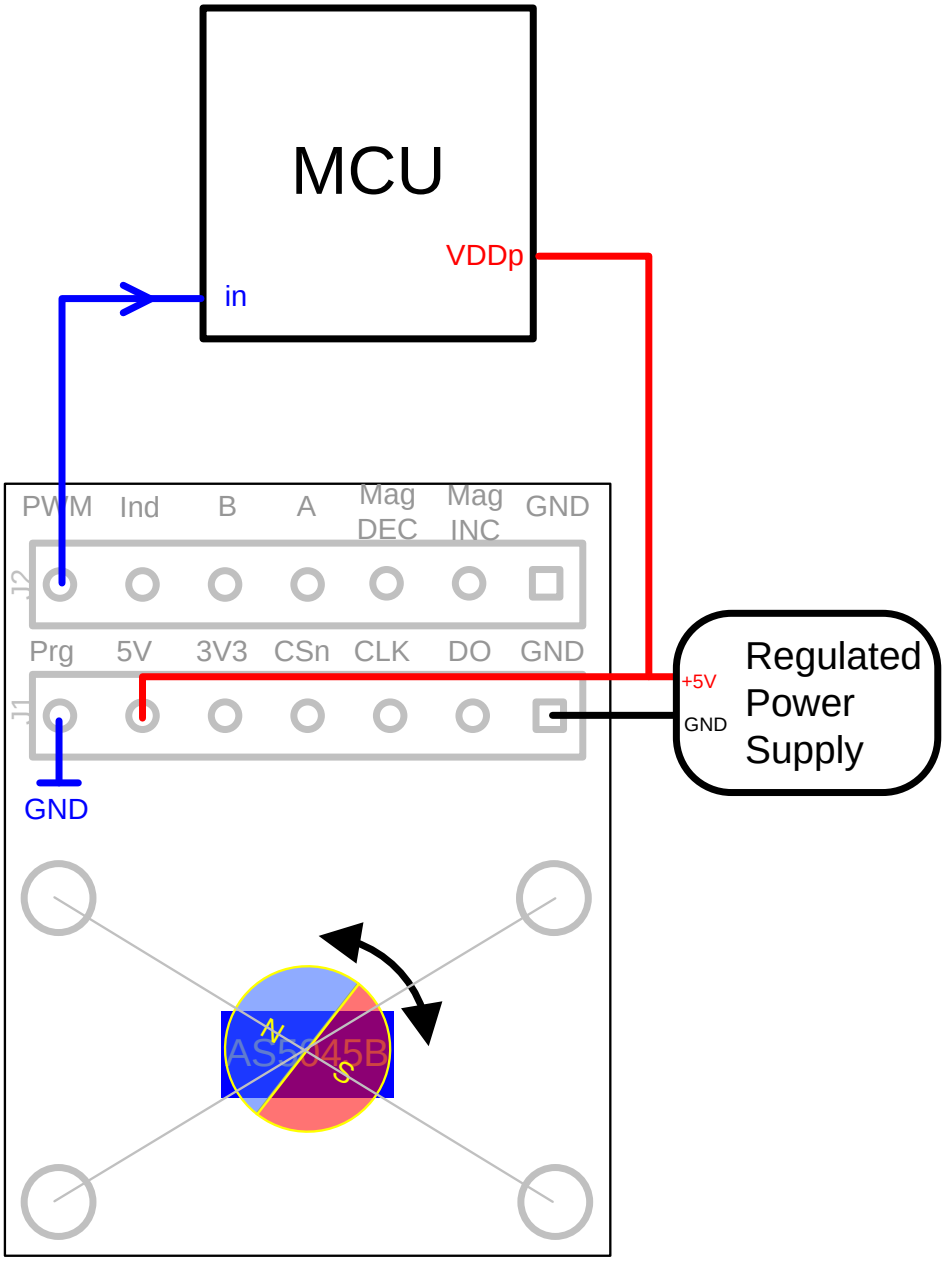
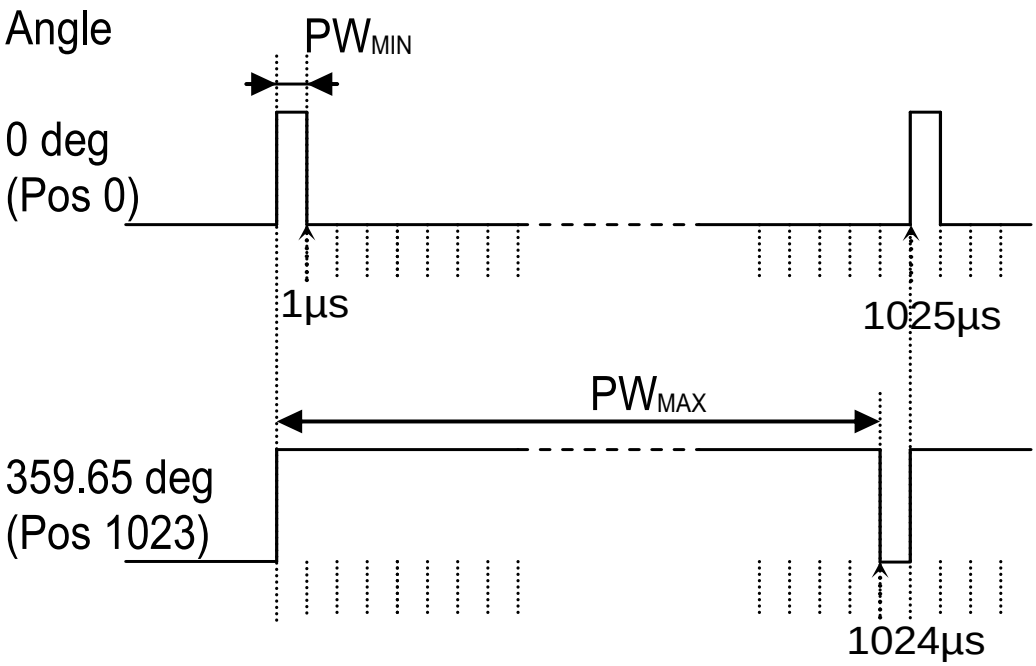


Figure 7:

PWM duty cycle depending on magnet position

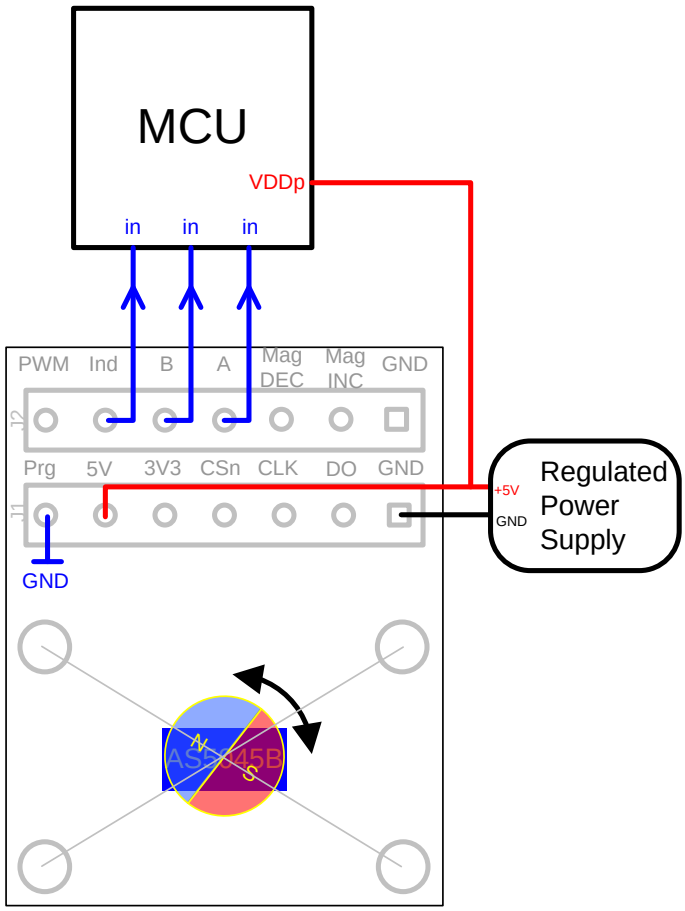


4.3 Standalone incremental Output

Three different incremental output modes are possible with quadrature A/B being the default mode (two-channel quadrature, step / direction incremental signal (LSB) and the direction bit in clockwise (CW) and counter-clockwise (CCW) direction.

The pre-programmed version AS5045B provides a 12bit incremental output.

Figure 8:
Using the Incremental output with the adapter board



4.4 Daisy chain mode

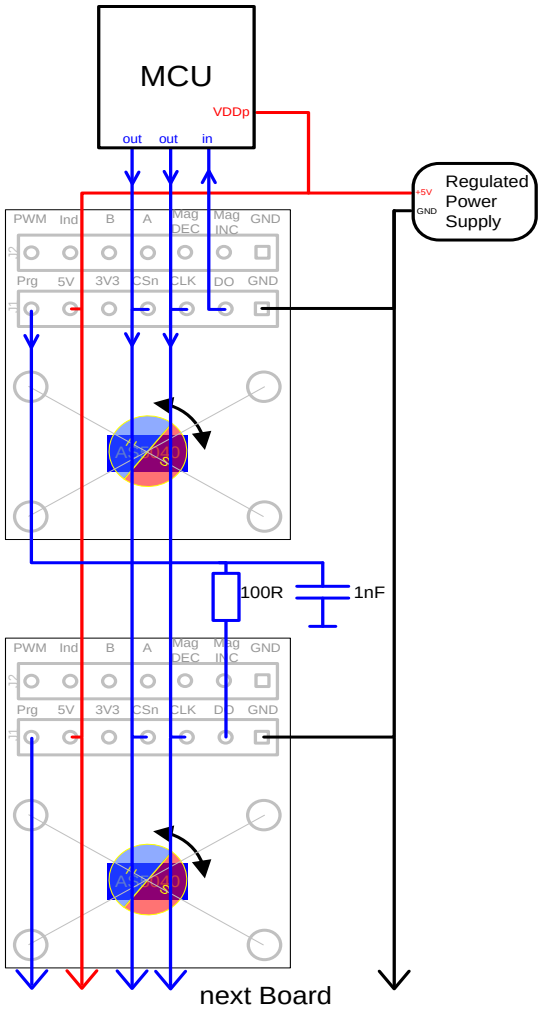
By using more than one adapter board, a setup in daisy chain mode is possible.

Note: In this mode capacitor C3 (Fig.12) must be disconnected when using the 1nF capacitor shown in Fig.9. or directly replaced by this capacitor.

The serial data of all connected devices is read from the DO pin of the first device in the chain. The Prog pin of the last device in the chain should be connected to VSS. The length of the serial bit stream increases with every connected device (board) by n * (16+1) bits.

Due to R = 100R and C = 1nF, the CLK is limited the maximum 1MHz.

Figure 9:
Using Daisy-Chain mode with the adapter board



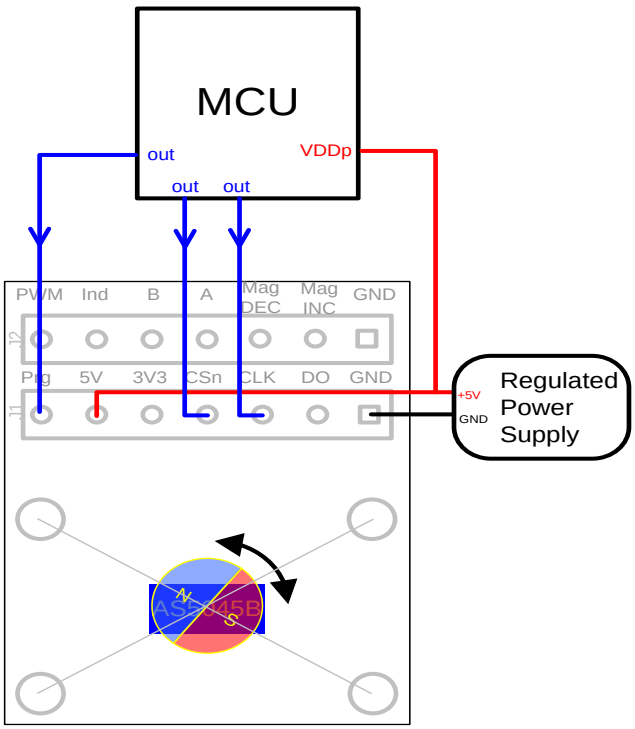
5 Programming the AS5045B

After power-on, programming the AS5045B is enabled with the rising edge of CSn with Prog = high and CLK = low. 16 bit configuration data must be serially shifted into the OTP register via the Prog-pin. The first “CCW” bit is followed by the zero position data (MSB first - 12 bit for AS5045B) and some mode settings (please refer to datasheet). Data must be valid at the rising edge of CLK.

After writing data into the OTP register it can be permanently programmed by rising the Prog pin to the programming voltage V_{PROG} of 7.3-7.5V. 16 CLK pulses must be applied to program the fuses.

For exiting the programming mode, the chip must be reset by a power-on-reset. The programmed data is available after the next power-up.

Figure 10:
Programming the AS5045B

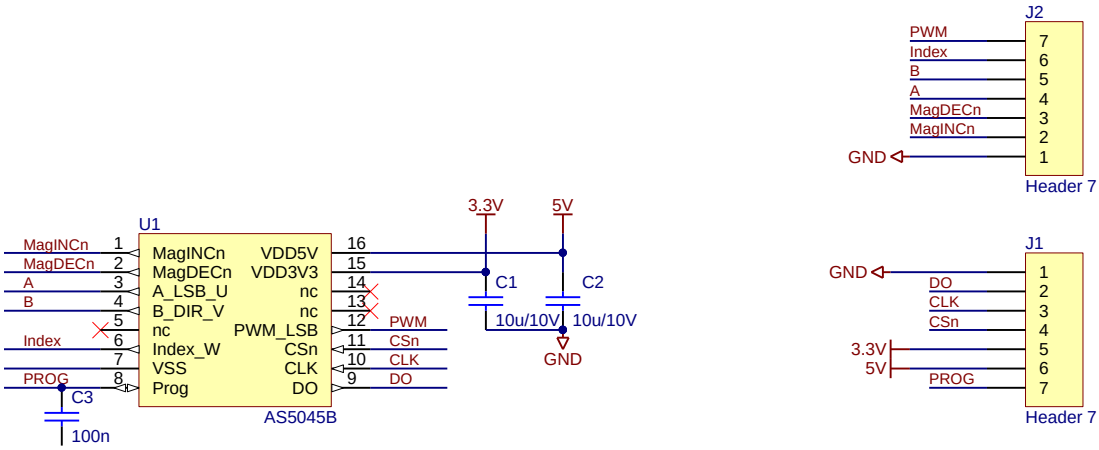


6 AS5045B-AB-Hardware

Following the schematic and layout of the Adapterboard can be found.

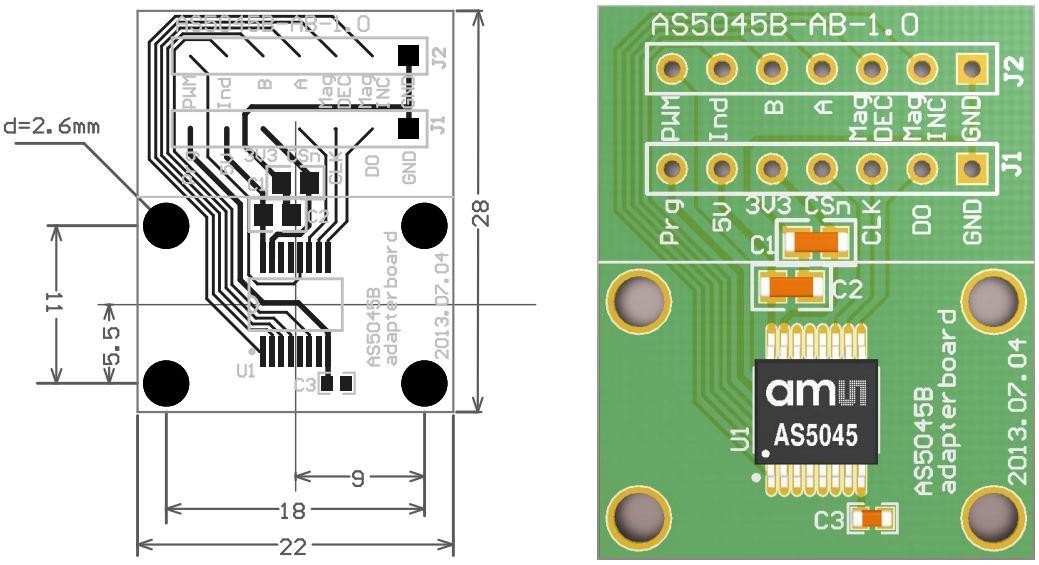
6.1 AS5045B-AB-1.0 Schematics

Figure 11:
AS5045B-AB-1.0 adapterboard schematics



6.2 AS5045B – AB – 1.0 PCB layout

Figure 12:
AS5045B-AB-1.0 adapter board layout



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