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# AS5245

## Programmable Magnetic Rotary Encoder

### AS5245-DB-v1.0 Demoboard

### OPERATION MANUAL

## 1 General Description

The AS5245 is a contactless magnetic angle encoder for accurate measurement up to 360° and includes two AS5145 devices in a punched stacked leadframe. It is a 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. The absolute angle measurement provides instant indication of the magnet's angular position with a resolution of  $0.0879^\circ = 4096$  positions per revolution. This digital data

is available as a serial bit stream and as a PWM signal. An internal voltage regulator allows operation of the AS5245 from 3.3V or 5.0V supplies.



## 2 The AS5245 Demoboard

The AS5245 demoboard is a complete rotary encoder system with built-in microcontroller, USB interface, graphical LCD display and PWM output LED.

The board is USB powered or externally supplied with a 9V battery for standalone operation.

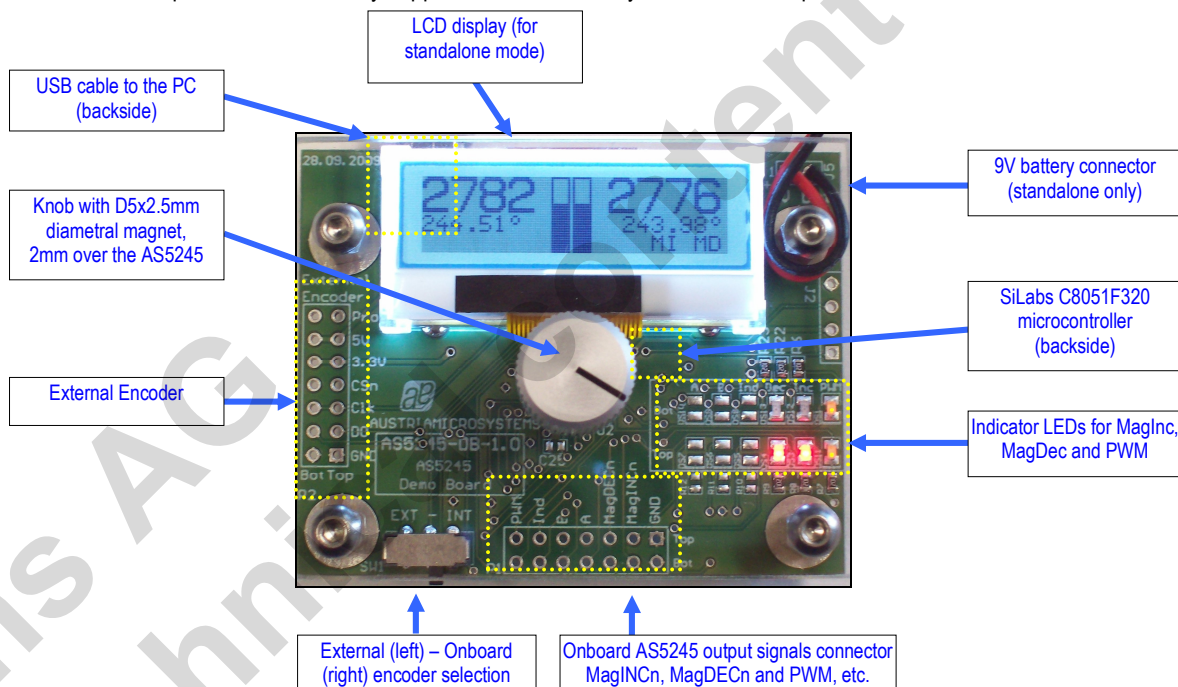


Figure 1: AS5245 Demoboard hardware with mounted magnet knob

### 3 Operating the AS5245 Demoboard

The AS5245 demoboard can be used in several ways:

- **As standalone unit supplied by a 9V battery**

Connect a 9V battery to the battery connector on the top right side of the board. No other connections are required.

- **As standalone unit supplied by an USB port**

Connect the demoboard to a PC using a USB/USB cable (included in demoboard shipment). The board is supplied by the 5V supply of the USB port. No other connections are required. All information are shown on the onboard LCD display.

- **As input device for the AS5000 GUI software**

Connect the demoboard to a PC using a USB/USB cable (included in demoboard shipment). The board is supplied by the 5V supply of the USB port. No other connections are required.

The LCD display will be turned off and the Angle/Status bits will be displayed on the PC screen (AS5000 GUI). Some extra features as e.g. zero position programming can be achieved. The parameters will not be permanently programmed. All the parameters will be lost when the demoboard is shut down. For a permanent device programming, the "AS5000 Programmer" hardware should be used.

#### 3.1 Hardware Indicators

##### 3.1.1 Graphic LCD display

The LCD display shows the realtime absolute angle position of the magnet with a resolution of  $0.09^\circ = 4096$  positions per revolution and the absolute value of the angle.

Turning the knob clockwise will increase the angle value until  $359.9^\circ$  (value 4095), then  $0^\circ$ .

The magnet status indicator is related to the magnet position. If the magnet is too close or too far away from the encoder, "Magnet out of range" will be displayed.

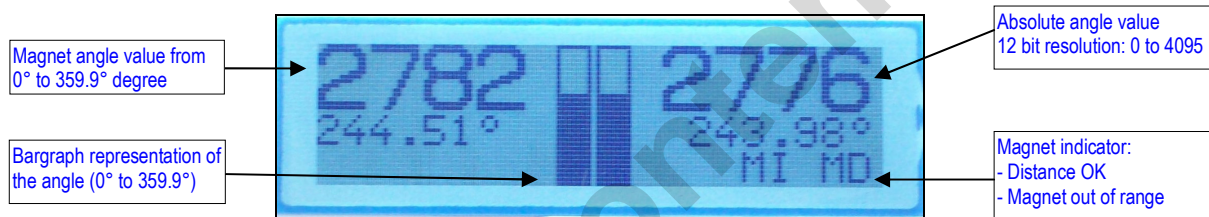


Figure 2: LCD display in standalone mode (9V battery or USB powered without GUI)

##### 3.1.2 PWM LED

The PWM LED is connected to the PWM output of the AS5245. The PWM output is a pulse width that is proportional to the angle of the magnet.

The pulse width varies from  $1\mu\text{s}$  to  $4096\mu\text{s}$  with a repetition rate of 244Hz. Viewing the PWM signal on the LED results in brightness that is proportional to the angle of the magnet. When the angle of the magnet is at  $0^\circ$ , the LED is almost dark, as it is  $1\mu\text{s}$  on and  $4095\mu\text{s}$  off. Turning the knob clockwise towards higher angles increases the brightness of the PWM LED, since the ON-pulse becomes longer and the OFF-pulse becomes shorter.

Likewise, the PWM output can be used as an analog output proportional to the angle, when the PWM signal is filtered by a RC (or active) lowpass filter.

The PWM signal (digital 0 ~ 3.3V) can be directly taken from the connector P1.

##### 3.1.3 MagINCn and MagDECn LED

MagINCn and MagDECn are the magnetic field change indicators (magnetic field strength increase or decrease through variation of the distance between the magnet and the device).

These outputs can be used to detect the valid magnetic field range. If both indicators lit simultaneously (MagINCn = 0 and MagDECn = 0), the magnet is out of range, the airgap between the encoder and the magnet is too high or too low (see Figure 2).

## 3.2 Encoder selection switch

The switch SW1 selects the encoder which communicates with the microcontroller through the SSI bus:

1. Right position (default): Onboard AS5245
  2. Left Position: External AS5245 on P2
- The signals of the synchronous serial interface (DO, CLK, CSn, PROG) and the power supply (3.3V, GND) of an external device can be connected directly to P2. In this configuration, the data of the serial interface are displayed on the GUI or the LCD.

## 4 AS5000 Programmer GUI software

### 4.1 Installing the GUI on the PC

The preliminary software is developed for a Microsoft Windows XP operating system with Service Pack 2. In addition the dotnet (.NET) framework version 2.0 or more must be installed on the PC. This package can be downloaded free of charge from the Microsoft webpage:

<http://www.microsoft.com/downloads/details.aspx?FamilyID=0856eacb-4362-4b0d-8edd-aab15c5e04f5&displaylang=en>

Following Procedure is recommended before starting the GUI:

1. check on your PC if Service Pack 2 is installed
2. install the mentioned .NET package to your computer
3. execute setup.exe
4. Finally start the GUI using the shortcut in the start menu or desktop.

### 4.2 The Home tab

Figure 3 shows the main window of the GUI. On the top left corner, board information's as firmware (FW) version and demoboard name declaration can be found.

By default the GUI is in the auto detection mode. Any connected austriamicrosystems demoboard and programming tool will be automatically detected and the device type is displayed in the right top corner of the main window. The GUI is divided into three main sections HOME, SSI and OTP.

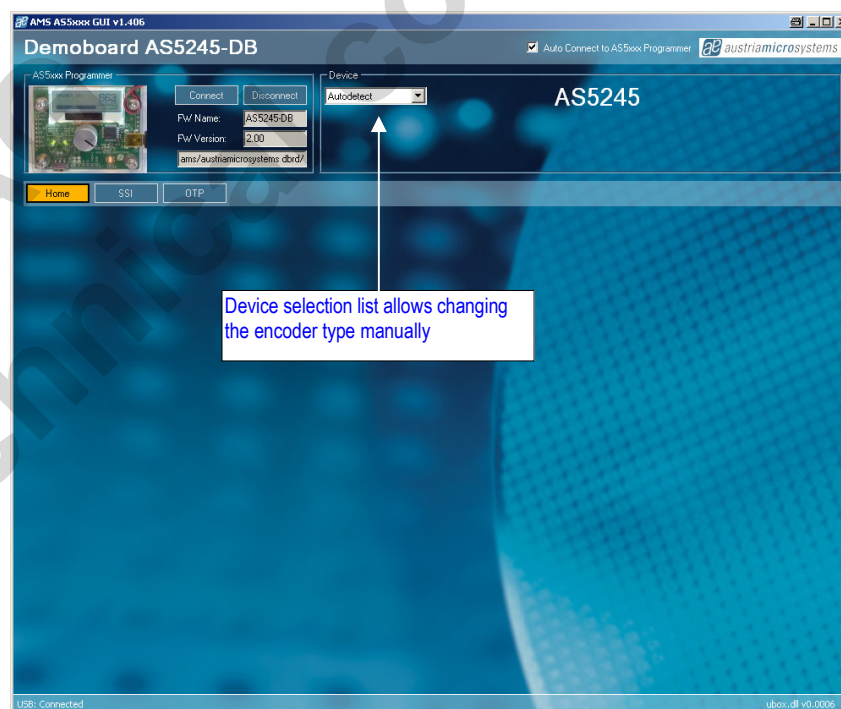


Figure 3: AS5000 GUI has detected the AS5245 Demoboard

### 4.3 The SSI tab

By selecting the SSI (serial protocol for AS5040, AS5140, AS5043, AS5045, AS5145, AS5245) tab, the real time information of the angular position and the status bits are displayed. See figure 4.



**Value** is the Angle data [D11:D0] from the RD\_ANGLE (Read Angle) serial command. This value is continuously updated.

The **Zero Pos.** value represents the Zero Position register. By clicking on the **Set** button, the actual angle "Value" is written into the Zero Position register. Clicking on **Reset** writes the value 0 to the Zero Position register.

The **Magnetic Range Warning** is continuously read from the RD\_ANGLE serial command.

- Green lamp: Magnet in range
- Orange lamp: Magnet too far or close. MagINC and MagDEC are set.
- Red lamp: Magnet too far or close, angle value is invalid and LIN bit is set.  
The red lamp is available only when OTP MagCompEN=1, available from the OTP tab.

The **Status bits information** is taken from the serial stream.

The **Read Interval** can be modified from 10 ms (fastest) to 1 s (slowest).



## 4.4 The OTP tab

The OTP tab is normally used for the AS5000 programmer, but the OTP bits can be changed on the AS5245 demoboard as well.

Options like Zero Position, Pulses per revolution and Incremental Mode Selection can be changed by selecting the function in “Fields”, then changing the parameter in “Options for the selected field” or directly the decimal value of this parameter in “Value”.

Each time a field’s value has been changed, the corresponding OTP bits will be automatically checked in the right window. The button **Write** should be clicked to write the parameter into the AS5245.

The **Read** button reads back the OTP register, and updates the “Field” parameter as well as the OTP bits window.

The **Load** button reads back the OTP fuses, and updates the “Field” parameter as well as the OTP bits window.

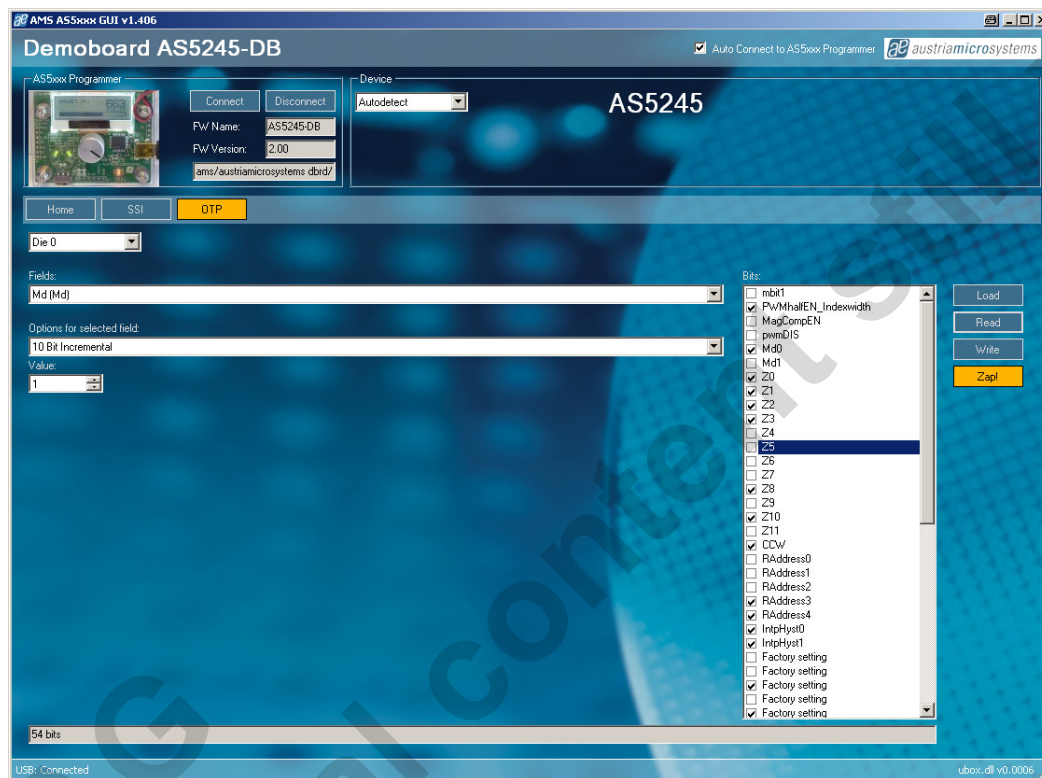


Figure 5: OTP tab

**Field Zero Position:** To zero position value, like on the SSI tab. The zero position value can be changed by checking the Z[11:0] bits, or changing the Value field with a decimal number.

**Note:** The **Zapl** button is used for the AS5000 Programmer only and has no effect on the AS5245 Demoboard.

## 5 AS5245 Demoboard Schematics, Layout and Blockdiagram

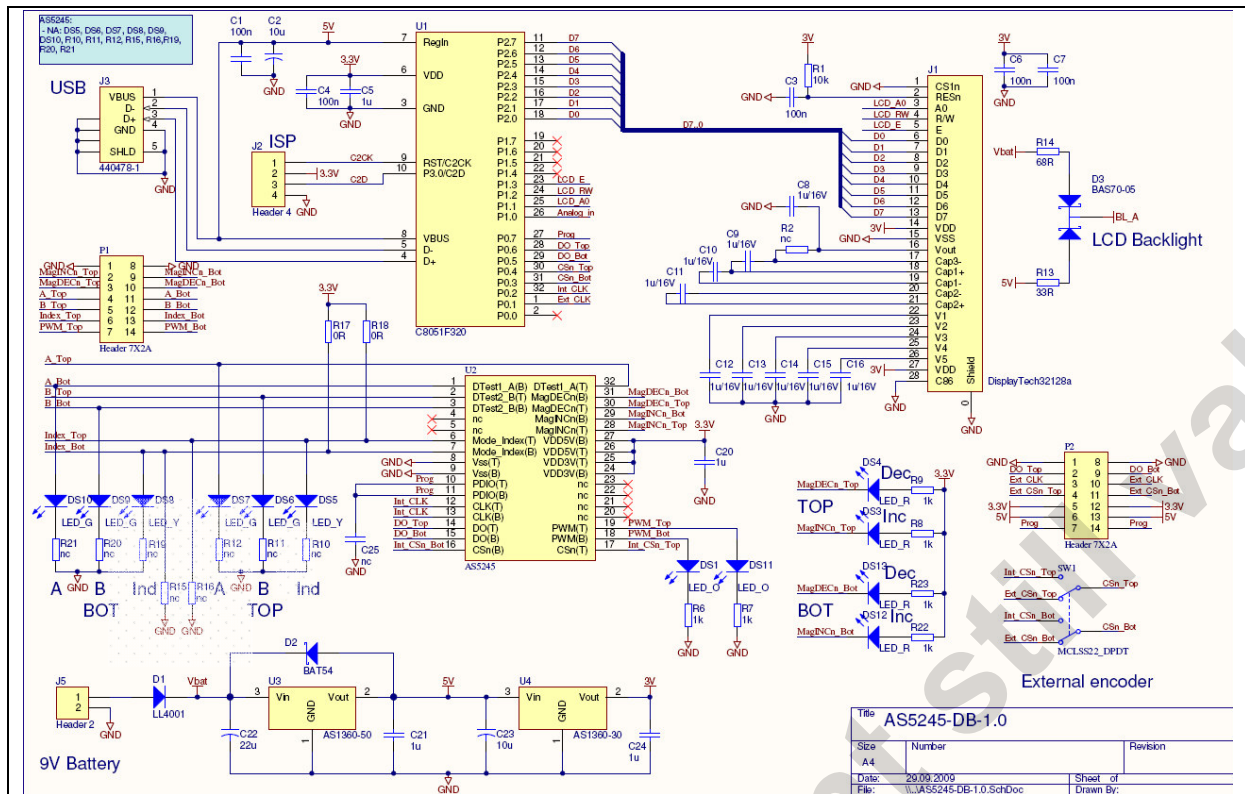


Figure 6: AS5245 Demoboard schematics

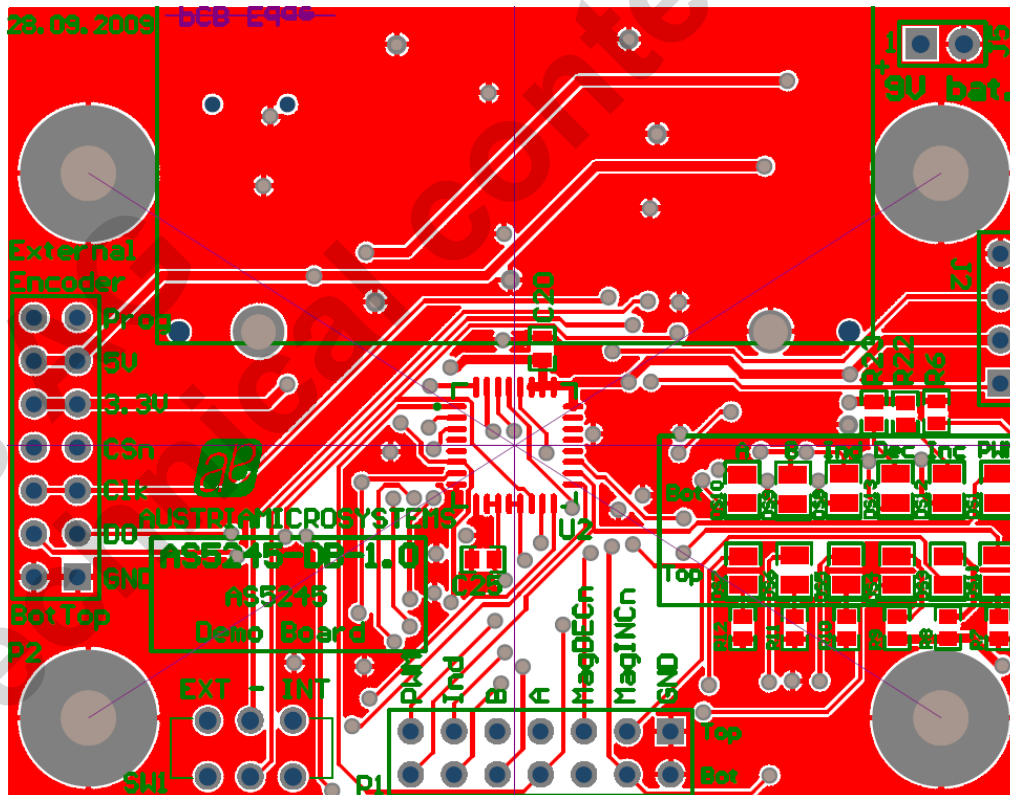


Figure 7: AS5245 Demoboard PCB Layout

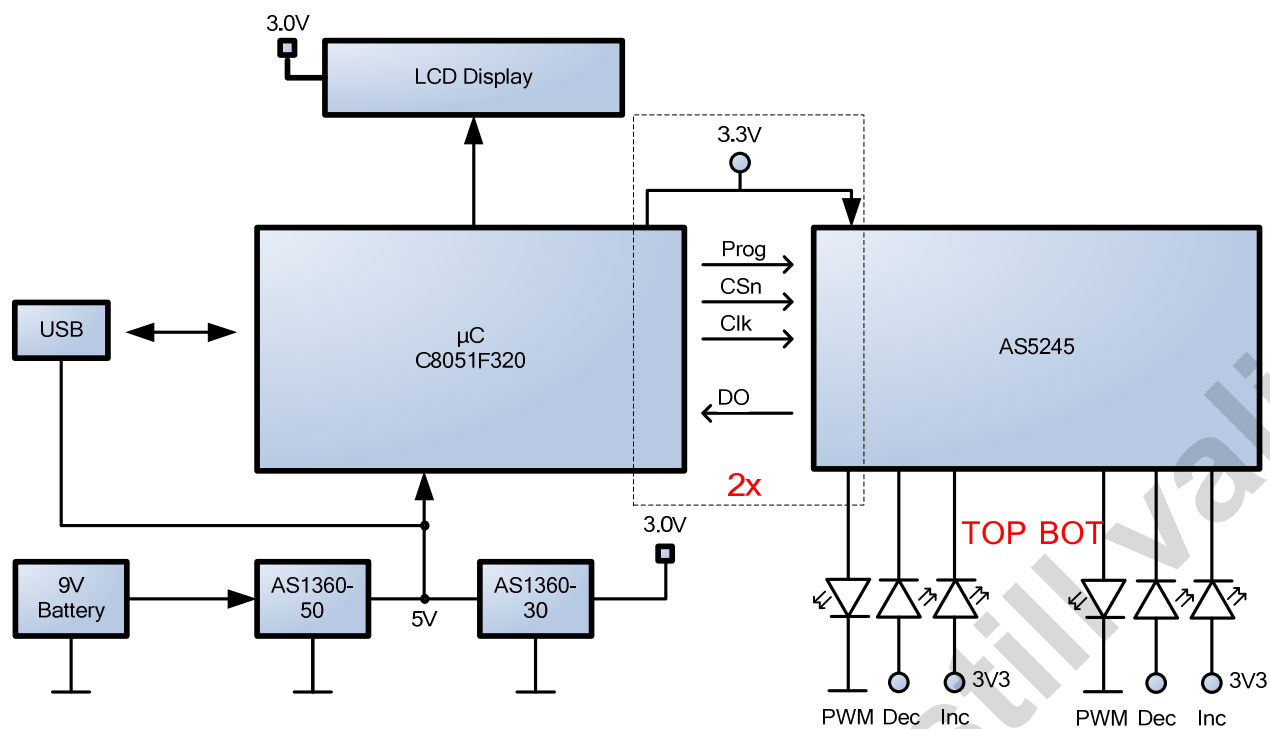


Figure 8: AS5245 Blockdiagramm



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## Revision History

Revision	Date	Description
1.0	October 14, 2009	Preliminary version
1.1	December 04, 2009	Final version

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