



User Manual – AS5013 Demo Kit

## **AS5013**

# **Two-dimensional Magnetic Position Sensor with Digital Coordinates output**

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## 1. General Description

The AS5013 is a complete Hall Sensor IC for smart navigation key applications to meet the low power requirements and host SW integration challenges for products such as cell phones and smart handheld devices. Due to the on chip processing engine, system designers are not tasked with integrating complex SW algorithms on their host processor thus leading to rapid development cycles.

The AS5013 single-chip IC includes 5 integrated Hall sensing elements for detecting up to  $\pm 2$ mm lateral displacement, high resolution ADC, XY coordinate and motion detection engine combined with a smart power management controller.

The X and Y positions coordinates and magnetic field information for each Hall sensor element are transmitted over a 2-wire I<sup>2</sup>C interface to the host processor.

The AS5013 is available in a small 16-pin 4x4mm QFN package and specified over an operating temperature of -20 to +80°C.

## 2. Package and Board Description

### Demo Kit Contents

The demo kit includes following items listed below in .

Table 1:  
Demo Kit Contents

Pos	Item	Comment
1	AS5013 Demo board	AS5013 Demo in gamepad-shape
2	USB 2.0 cable	
3	USB Stick with Software	

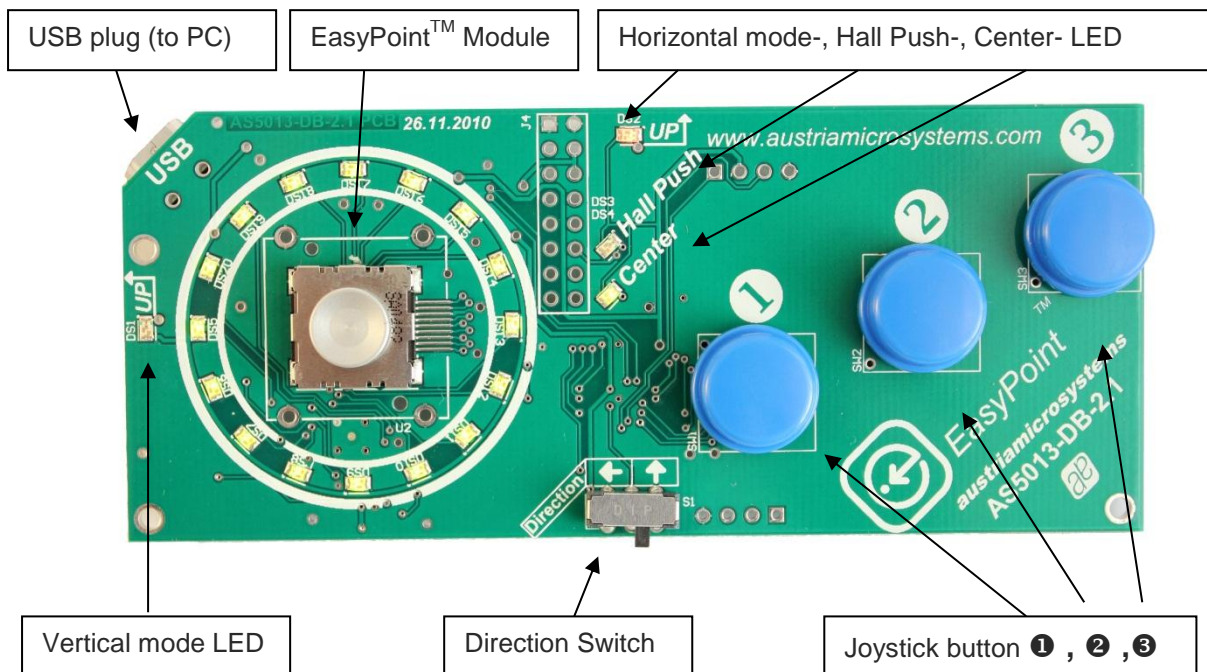
### Board Descriptions

The AS5013 demo board consists of an EasyPoint™ module from Speedtech and an USB interface PCB. The whole system is USB powered.

Once plugged on a PC running Windows, the AS5013 demo board works like a standard three-buttons analog HID joystick, and can be used by any game or application supporting two-axis analog joysticks under Microsoft Windows.

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Figure 1:  
AS5013-DB-2 Demo board



### EasyPoint™ module

Moving the EasyPoint™ knob acts like an analog joystick, sending progressive XY coordinates to Windows via USB.

### Button EP (EasyPoint™ module push)

The EasyPoint™ module push button is used in different ways:

- Mode 0 (default): Button EP emulates the standard HID button I (simultaneously with Button ❶). Thus when using the AS501x evaluation software, button EP emulates the left mouse button
- Mode 1: Button EP is disabled. Button ❶ is still active as standard HID button I.

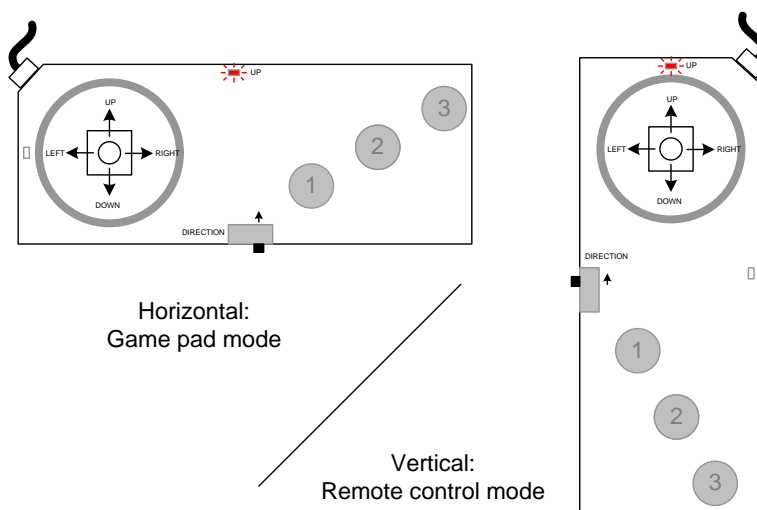
### Buttons ❶, ❷, ❸:

Those switches are standard HID gamepad buttons I, II and III. When using the AS501x evaluation software, button ❶ emulates the left mouse button, and button ❷ emulates the right mouse button.

### Direction Switch

The demo board can be used as a standard game pad when held horizontally, or as a remote control or mobile phone when held vertically. Select the orientation by changing the position of switch SW1. The actual position is indicated by the LEDs DS1 (Vertical) or DS2 (Horizontal).

Figure 2:  
Direction Switch options



When the position SW1 is changed, a zero position calibration is performed: a new zero position will be set, the actual mechanical position of the knob is considered as the coordinate (0,0). This procedure is necessary to compensate an inaccurate centering of the module's knob. The automatic centering calibration is performed each time the demo board is powered on as well.

### Center LED and Hall Push LED

The Center LED is ON when the knob coordinate is exactly (0,0) . This coordinate is after calibration. The Hall Push LED is ON when the EP button of the module is pushed and detected via the hall sensors only. This function doesn't use the dome switch contact of the module, but the magnetic field change on the vertical direction. The Hall push LED is enabled in mode 0, 1 and 2 only. See next chapter for information about the demo board modes.

## 3. How to get the kit running

### First Steps

1. Install the Evaluation Software. The Evaluation Software is located on the USB Stick or can be downloaded from the ams homepage. For detailed instructions refer to the Evaluation Software Manual.

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Software and manual download: <http://www.ams.com/eng/Products/Magnetic-Encoders/EasyPoint-Joystick-Encoder>

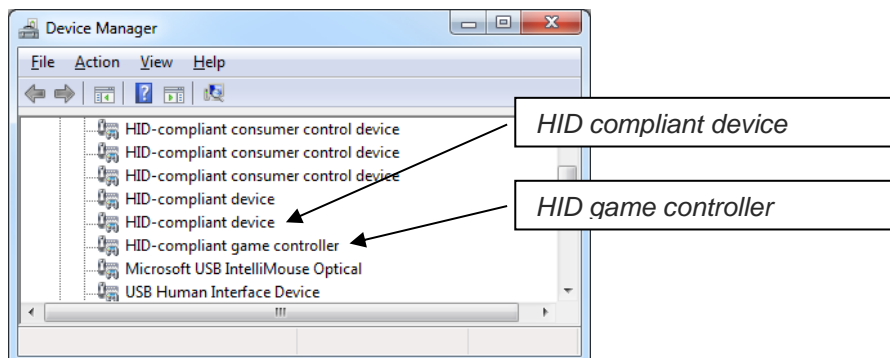
2. Connect the demo board to the PC using the USB cable
3. Start the Mouse Emulator and try the different Plug-Ins. For detailed instructions refer to the Evaluation Software Manual.

### Advanced Steps and Information

The demo board is listed as a composite HID device in the Windows Device Manager:

- Windows detects as a standard *HID-compliant game controller*. This part doesn't need any driver.
- Windows detects as well an *HID-compliant device*. This part doesn't need any driver.

Figure 3:  
Windows Device Manager



### Demoboard modes

The AS5013 Demoboard can be configured in different ways without any software.

**Mode 0:** Without pressing any key, power up the demoboard with the USB cable. HID Joystick button **I** is controlled by the EP button (from the EasyPoint™ module) and Button **1**.

**Mode 1:** Push and hold Button **1** and power up the demoboard with the USB cable. The LED “Center” blinks 4 times. HID Joystick button **I** is controlled by the Button **1** only. EP button is disabled

**Mode 2:** Push and hold Button **2** and power up the demoboard with the USB cable. The LED “Hall Push” blinks 4 times. HID Joystick button **I** is controlled by the Button **1**, and by the “Hall Push” function. EP button is disabled.

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The “Hall Push” is an algorithm running in the demoboard MCU, reading the five Hall Element C1..C5, and determines if the EP button has been pushed, without any electrical contact. The restriction of this mode is that the detection is working when the EasyPoint™ module button is pushed on the center position area.

**Mode 3:** Push and hold Button ③ and power up the demoboard with the USB cable.

The LED “Center” and “Hall Push” blink 4 times simultaneously.

This mode is similar to Mode 0, but the I<sup>2</sup>C communication between the MCU and AS5013 is restricted to XY coordinate exchange only. The Hall Push function is totally disabled.

This mode is used for debug mode, if timing analysis, with e.g. an oscilloscope, is required, and simplifies the readout of signal and timing interpretation.

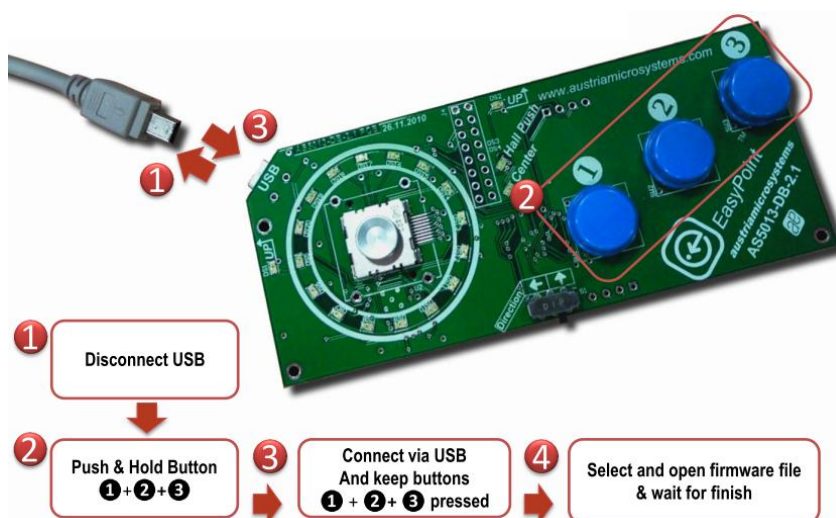
**Firmware update mode:** Push and hold Button ① ② ③ simultaneously and power up the demo board with the USB cable.

All the LEDs are ON. The AS5013 is in “Bootloader mode”. This mode is used to update the firmware of the demo board if a new file is available on the ams website:

### Firmware update:

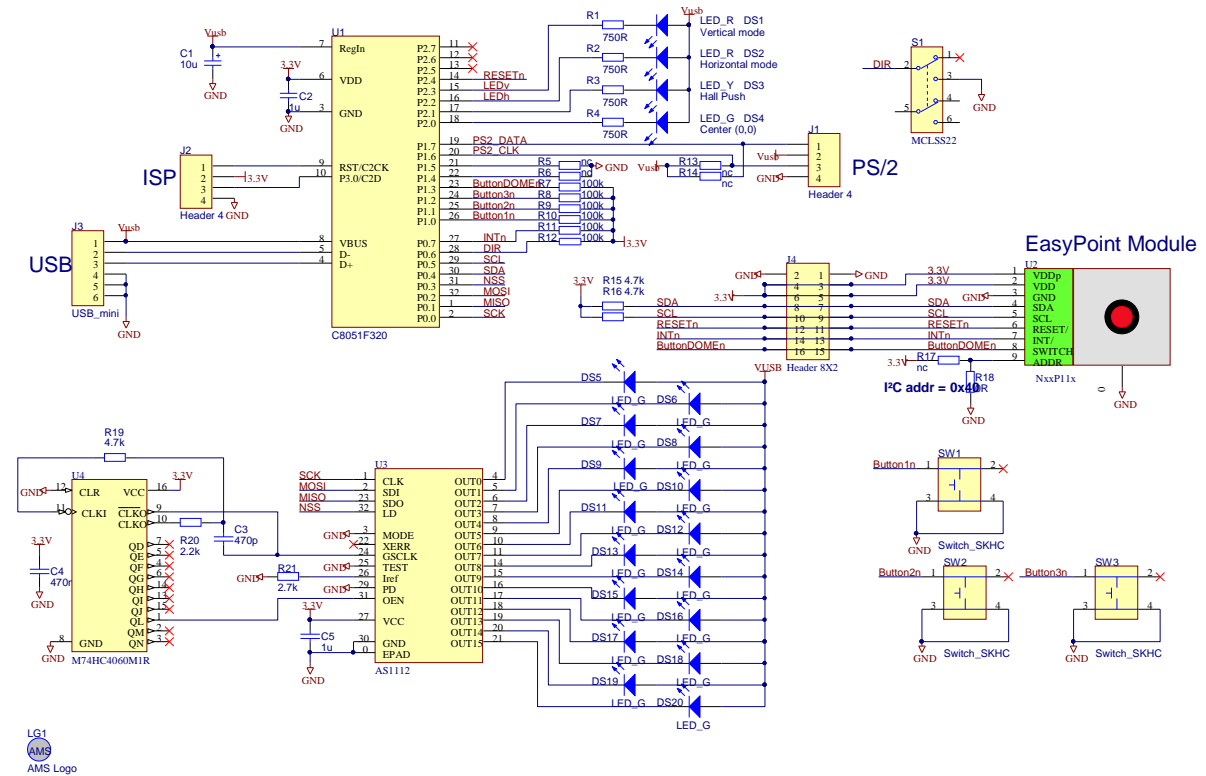
To update the firmware, just open the AS501X Evaluation Software 4.1.6 or newer and connect the demoboard with the USB cable while pressing all three buttons as shown below. A window to choose the firmware file will pop up automatically.

Figure 4:  
Firmware Update Instructions



## 4. Schematics

Figure 5:  
AS5013\_DB\_2.1 Schematics



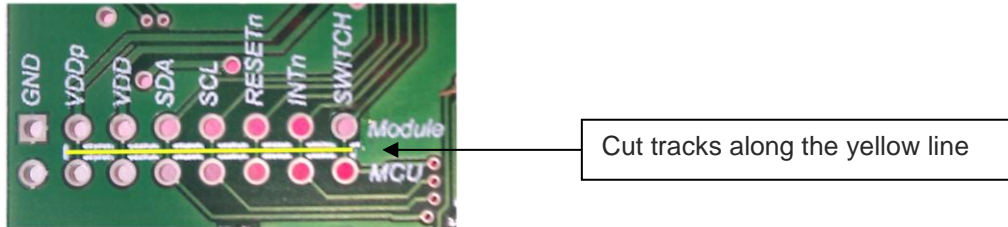
The microcontroller C8051C320 (U1) from SiLabs includes an on-chip USB interface. The firmware is stored in its internal flash memory (16kB).

The whole power supply is taken from the USB bus by the microcontroller, and converts it internally to 3.3V. No external LDO is required. The AS5013 is directly powered (VDD and VDDp) by this 3.3V supply.

Connector J4 is used if an external MCU has to be connected to the AS5013 of the demo board, instead of the C8051F320. In that case, cut the PCB tracks (bottom side) to disconnect the N40P112 module from the MCU.



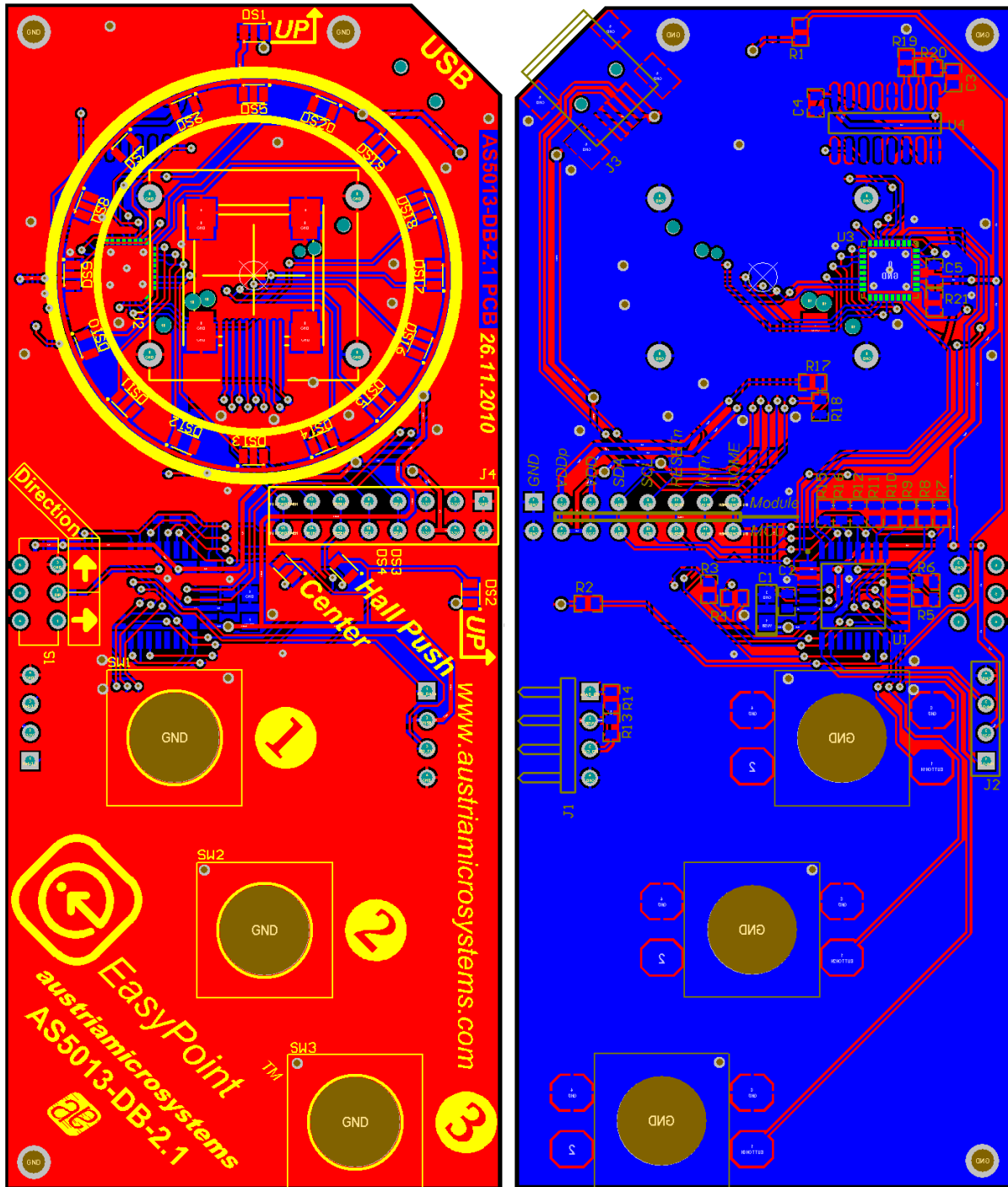
Figure 6:  
Disconnecting the Module from the MCU



Connector J1 is not used and connector J2 is used for ISP programming of the microcontroller only. All the switches (dome switch: Button EP, Button I, Button II, Button III) are connected directly to the microcontroller. The unique I<sup>2</sup>C serial bus (SCL, SDA) controlled by the C8051 microcontroller is used for the EasyPoint™ module (AS5013). The interrupt output INTn is connected directly to the MCU interrupt input.

## 5. Layout

Figure 7:  
PCB Top and Bottom View



PCB Top view

PCB Bottom view

## 6. Ordering Information

Table 2:  
Ordering Information

Ordering Code	Description	comments
AS5013-DB-2	AS5013 Demo Kit	AS5013 Demo board in gamepad-shape

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## Contact Information

### Headquarters

ams AG  
Tobelbader Strasse 30  
8141 Unterpemstaetten  
Austria  
T. +43 (0) 3136 500 0  
For Sales Offices, Distributors and Representatives, please visit:  
<http://www.ams.com/contact>