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is now

ams AG

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

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1 General Overview

The AS5x43 is a contactless magnetic angle encoder for accurate measurement up to 360°.

It is a system-on-chip, combining integrated Hall elements, analog front end and digital signal processing in a single device.

The AS5x43 provides a digital 10-bit as well as a programmable analog output that is directly proportional to the angle of a magnet, rotating over the chip.

The analog output can be configured in many ways, including user programmable angular range, adjustable output voltage range, voltage or current output, etc.

An internal voltage regulator allows operation of the AS5x43 from 3.3V or 5.0V supplies.

2 The AS5x43 Demoboard

The AS5x43 demoboard is a complete rotary encoder system with built-in microcontroller, USB interface, graphical LCD display and Vout output LED.

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

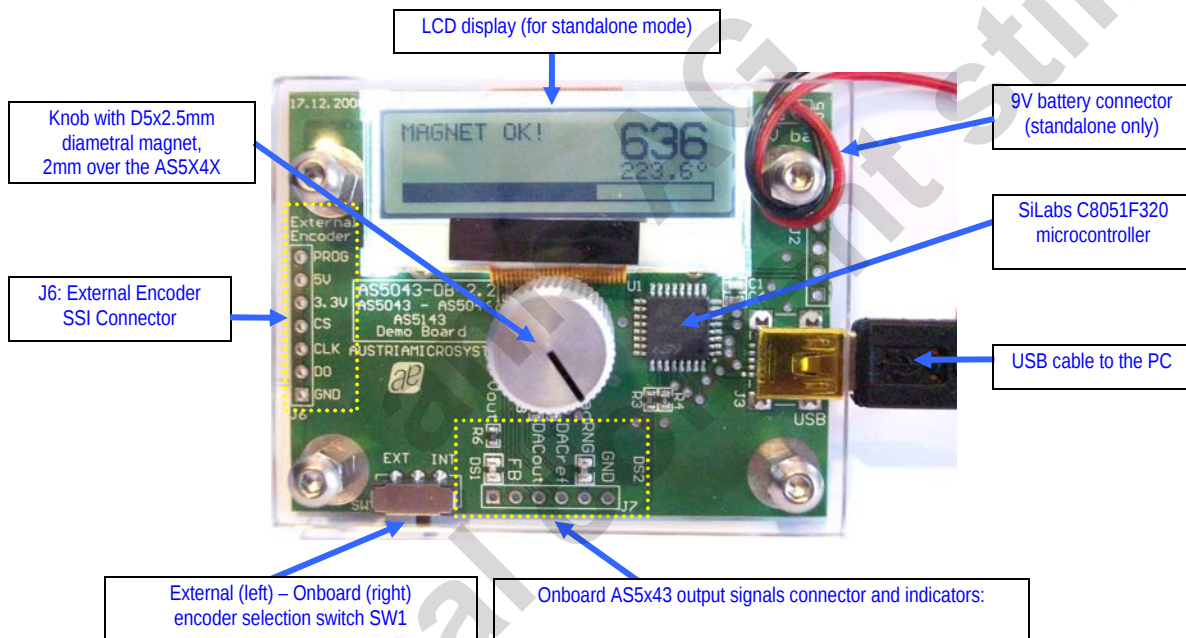


Figure 1: AS5x43 Demoboard hardware with mounted magnet knob

3 Operating the AS5x43 Demoboard

The AS5x43 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 a 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.

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

This configuration uses the same USB hardware connection as above, but additionally the AS5000 Programmer GUI software is running. The LCD display will be turned off and the Angle/Multiturn/AGC will be displayed on the PC screen. Some extra features as pole pair, zero position or AGC 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 and Connectors

3.1.1 Graphic LCD display

The LCD display shows the realtime absolute angle position of the magnet with a resolution of $0.35^\circ = 1024$ positions per revolution (AS5x43) and the absolute value of the angle.

Turning the knob clockwise will increase the angle value until 359.6 then 0.

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

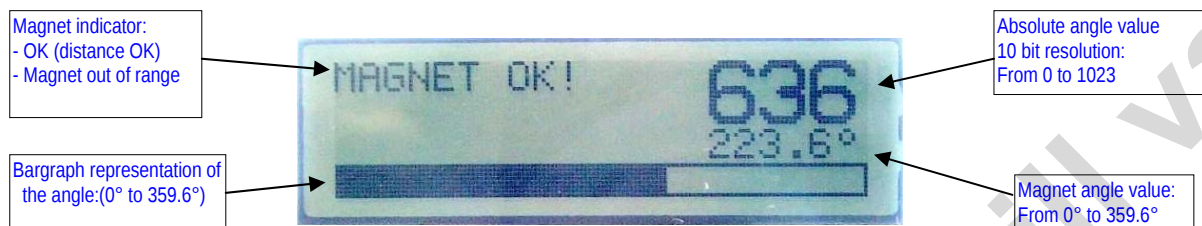


Figure 2: LCD display in standalone mode (9V battery or USB powered without GUI)

3.1.2 Vout LED

This LED is connected to the Vout output of the AS5x43 device.

Vout is the analog output pin, which provides a DC voltage radiometric to the supply voltage of the device or an external voltage source. This DC voltage is proportional to the angle.

By default, the OPAMP Gain setting FB_int_EN (OTP bit) is set to 0. Please take care to add an external resistor network between Vout and FB Pin (see AS5043 Datasheet Figure 14).

3.1.3 DACref

This is the external voltage reference input for the Digital-to-Analog Converter (DAC).

The analog output voltage of Vout is radiometric to the voltage on this pin.

3.1.4 DACout

This is the unbuffered output of the Digital-to-Analog Converter (DAC). This pin may be used to connect an external OPAMP, etc. to the DAC.

3.1.5 FB

Feedback (FB) is the inverting input of the OPAMP buffer stage, where various OPAMP configurations may be set.

3.1.6 MagRNG

The Magnet Field Magnitude RaNGe warning indicates if the magnetic field is outside of the limits.

3.1.7 Encoder selection switch

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

1. Right position (default): Onboard AS5043/AS5143
2. Left Position: External AS5043/AS5143 connected on J6
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 J6. In this configuration, the data of the serial interface are displayed on the GUI or the LCD.

- In standalone mode, regardless to the demoboard type (AS5043 or AS5143), AS5043 and AS5143 can be attached to J6 and evaluated. See figure 3.
- If the GUI is used for operation, additional devices AS5040, AS5140, AS5045 and AS5145 can be connected to J6 and evaluated. In that case, the correct encoder must be selected instead of "Autoselect" in the Device list of the PC software, see chapter **Error! Reference source not found.** figure 4.

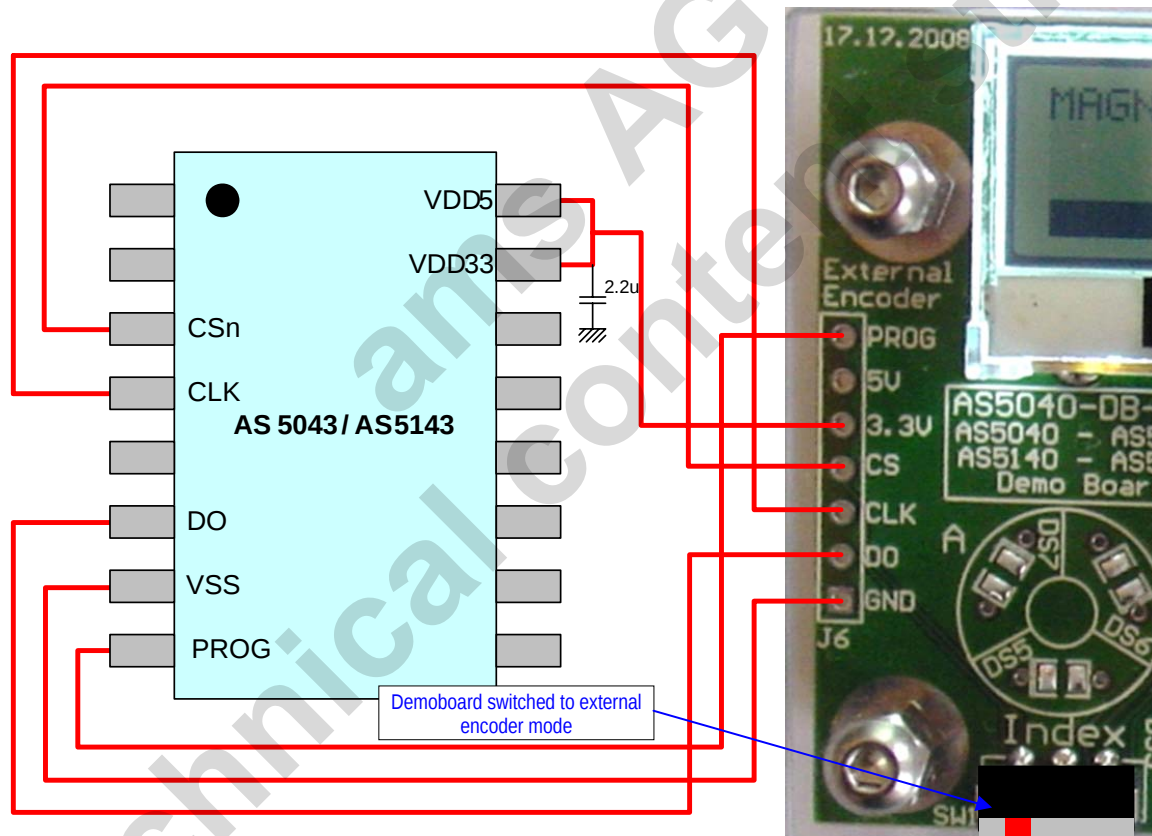


Figure 3: external AS5043/AS5143 connection to the demoboard

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 4 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 displayed in the right top corner. The GUI is divided into three main sections HOME, SSI and OTP.

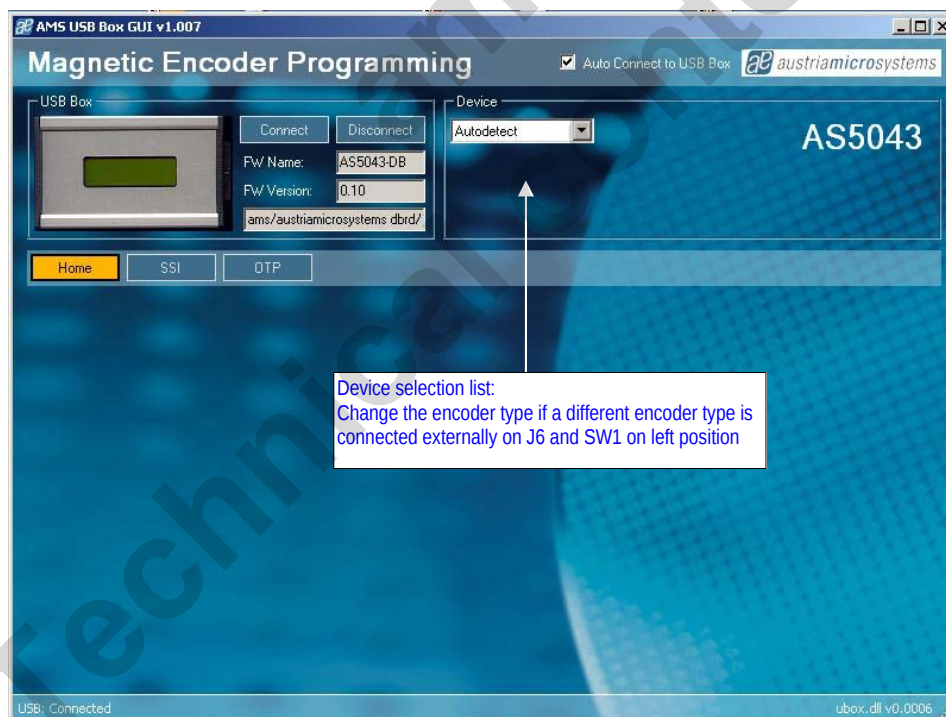


Figure 4: AS5000 GUI detected the AS5043 Demoboard

4.3 The SSI tab

This mode displays in realtime the angle & absolute value, status bits and magnet range status.

By selecting the SSI (serial protocol for AS5040, AS5140, AS5043, AS5143, AS5045, AS5145) tab, the information of the angular position and the status bits appears. See figure 5.



Figure 5: SSI tab, allows access to the AS5x43 registers from the serial bus

Value is the Angle data [D9: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 too close. MagINC and MagDEC are set.

The **Status bits information** are 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 AS5x43 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 AS5x43.

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

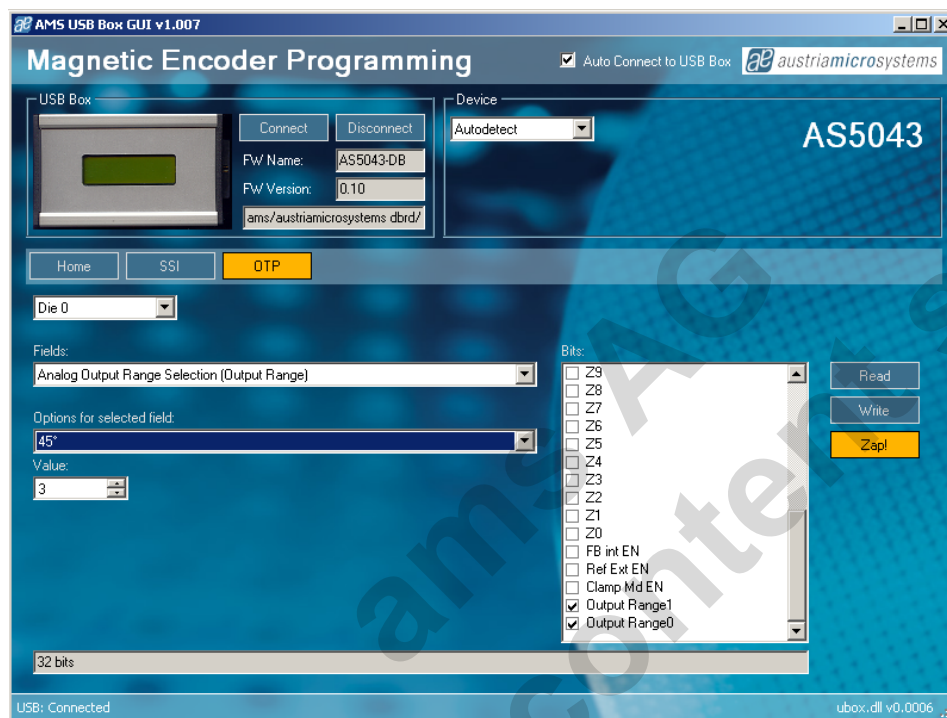


Figure 6: OTP tab

Field Zero Position: To zero position value, like on the SSI tab. The zero position value can be changed by checking the Z[0:9] bits, or changing the Value field with a decimal number.

Field Analog Output Range Selection (Output Range):

The analog output can be configured to 360°, 180°, 90° and 45° angular range.

Note that the **Zap!** button is used for the AS5000 Programmer only and has no effect on the AS5x43 Demoboard.

Important:

If the OPAMP Gain setting FB_int_EN is set to 0 (default), please take care to add an external resistor network between Vout and FB Pin (see AS5043 Datasheet Figure 14).

5 AS5x43 Demoboard, Schematics, Blockdiagramm

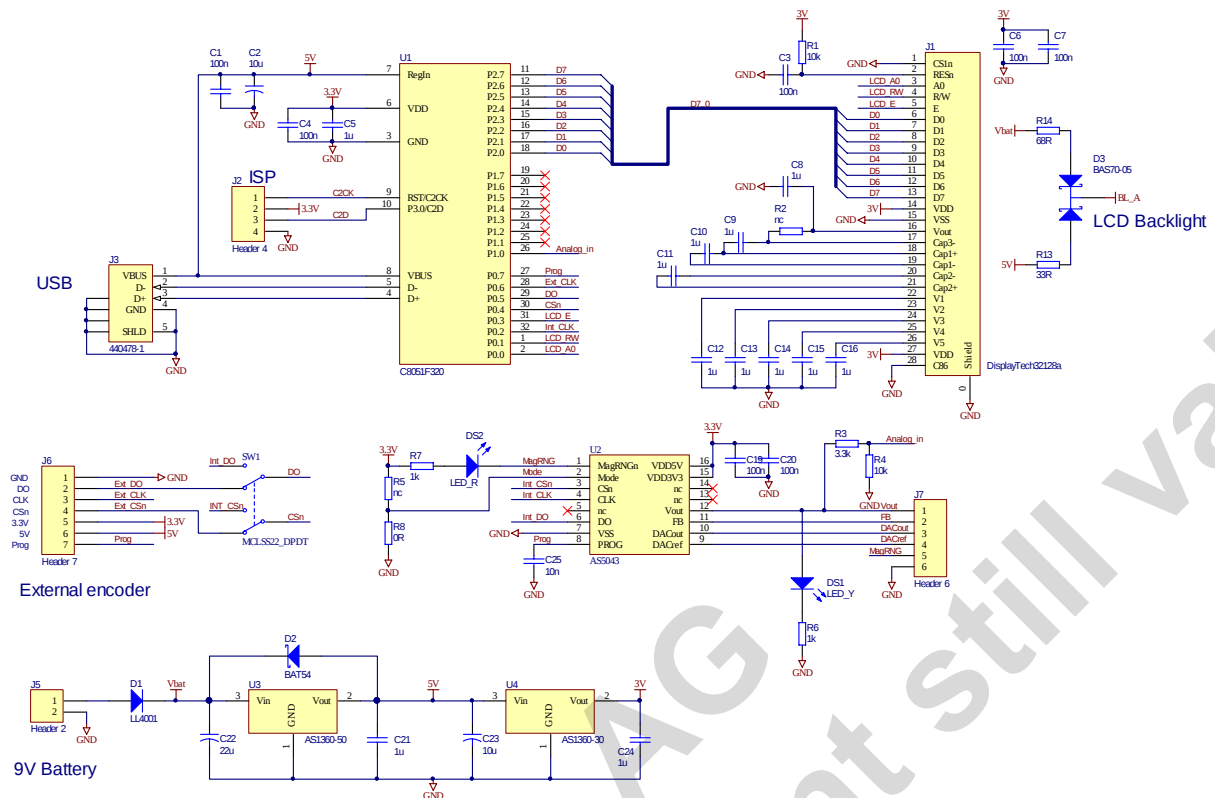


Figure 7: AS5x43 Demoboard schematics

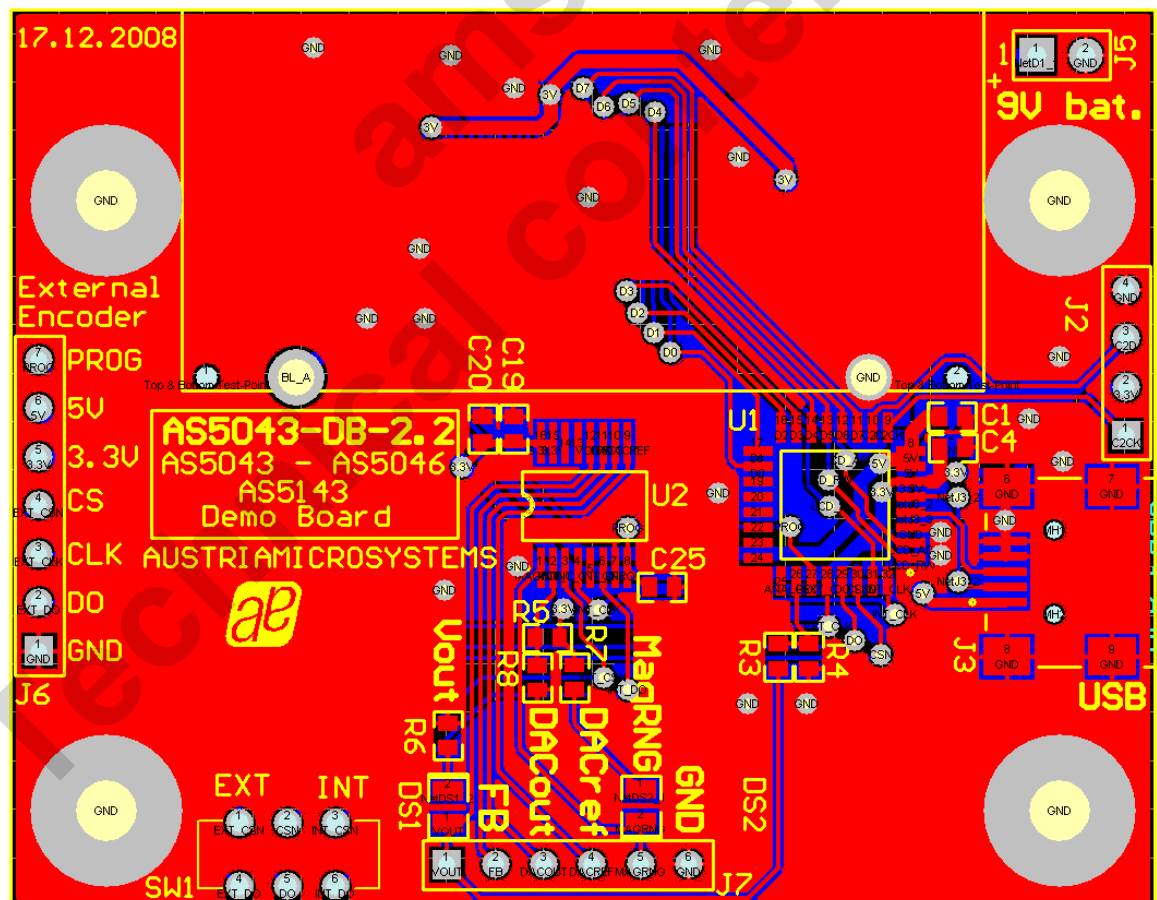


Figure 4: AS5x43 Demoboard PCB Layout

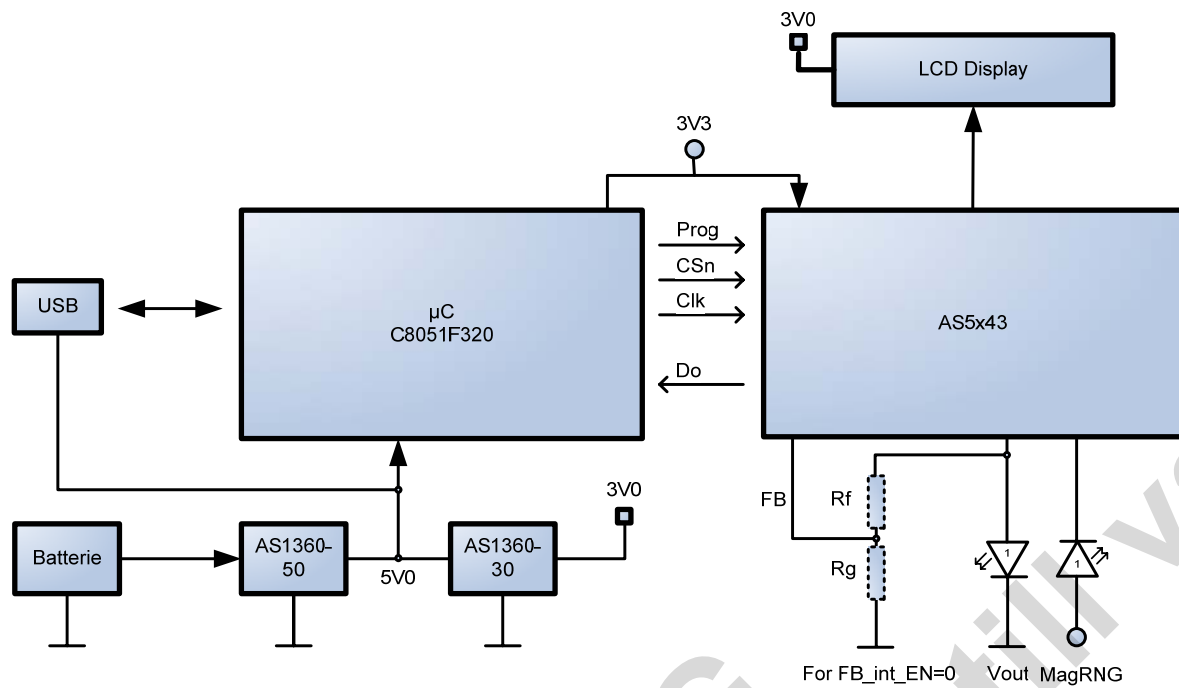


Figure 9: AS5x43 Blockdiagramm

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Revision History

Revision	Date	Description	
R1.0	June.17, 2009	First version	

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