# AS5245

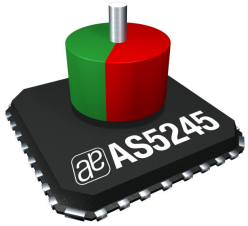
## Programmable Magnetic Rotary Encoder

**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° = 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.

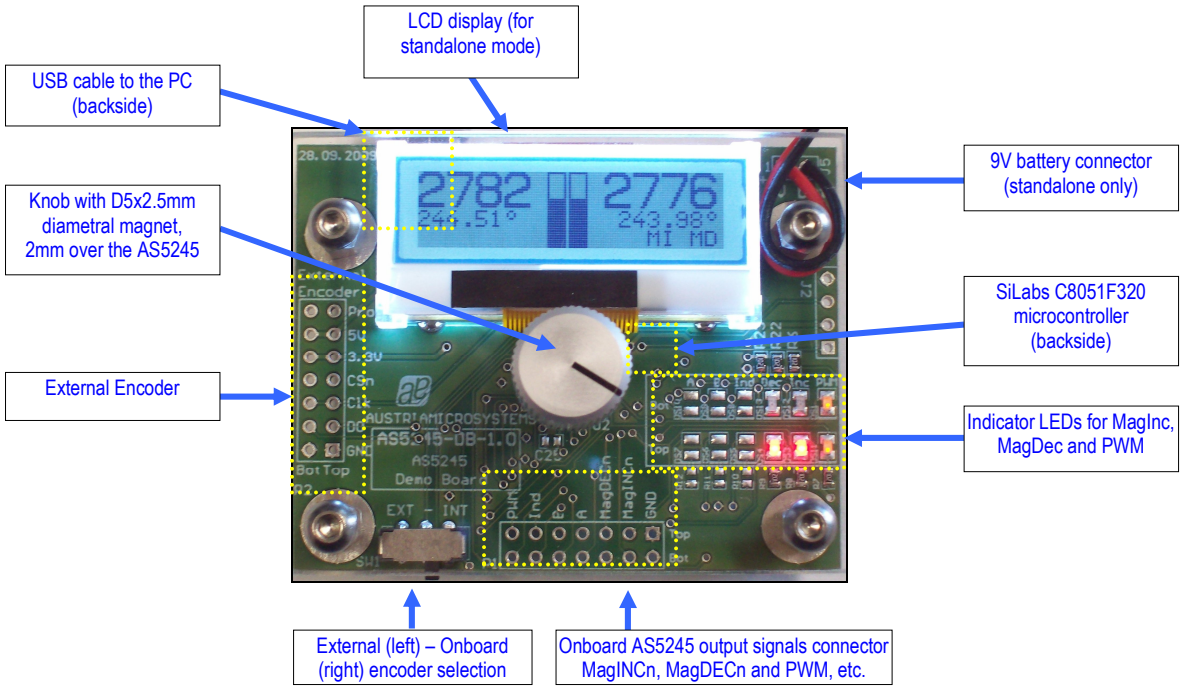



**Figure 1: AS5245 Demoboard hardware with mounted magnet knob**

# 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° = 4096 positions per revolution and the absolute value of the angle.
Turning the knob clockwise will increase the angle value until 359.9° (value 4095), then 0°.

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.

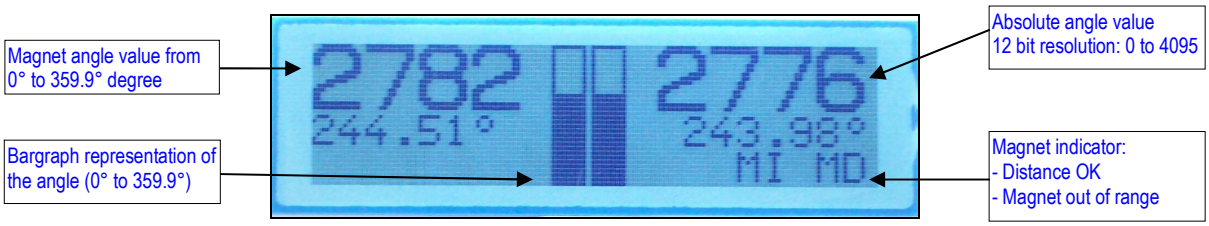



**Figure 2: LCD display in standalone mode (9V battery or USB powered without GUI)**

### 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 1µs to 4096µs 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°, the LED is almost dark, as it is 1µs on and 4095µs 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 MagINc 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.

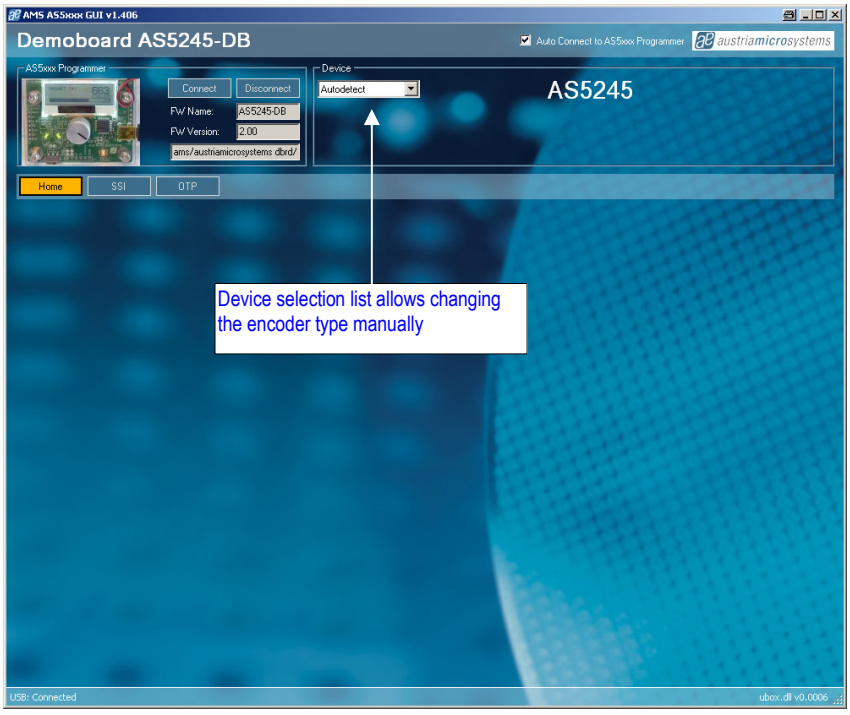



**Figure 3: AS5000 GUI has detected the AS5245 Demoboard**

## 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.

**Figure 4: SSI tab, shows the SSI bus data of the selected encoder**

**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.

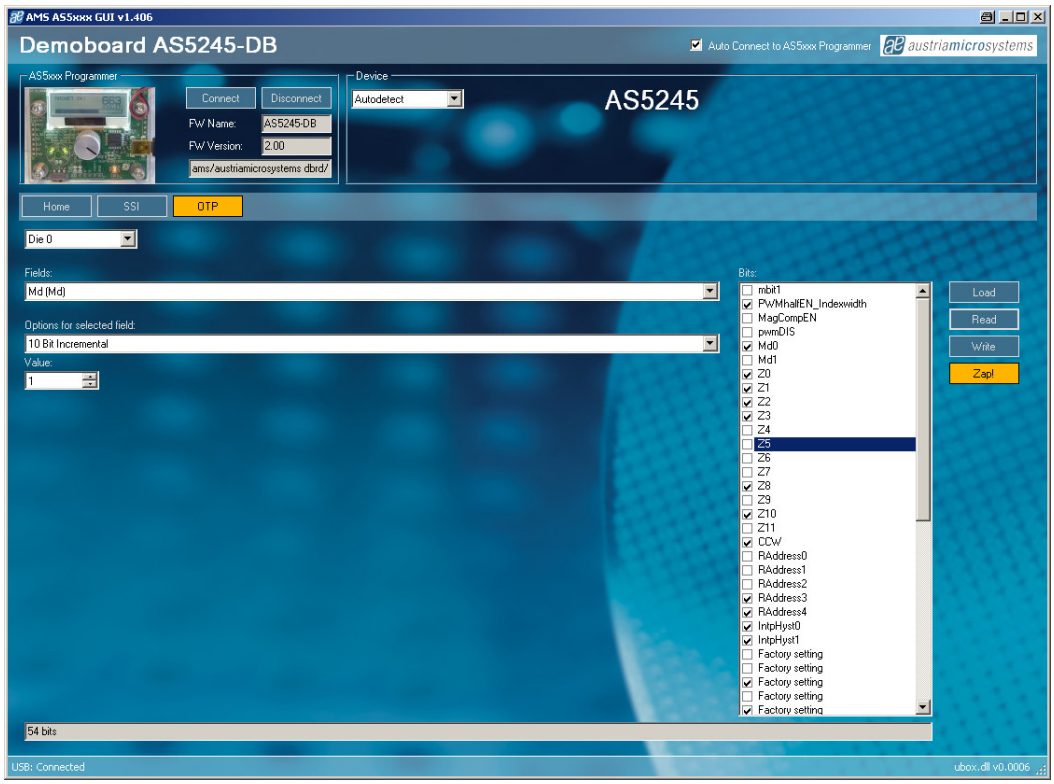



**Figure 5: OTP tab**

**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 Zap! button is used for the AS5000 Programmer only and has no effect on the AS5245 Demoboard.

# 5 AS5245 Demoboard Schematics, Layout and Blockdiagram

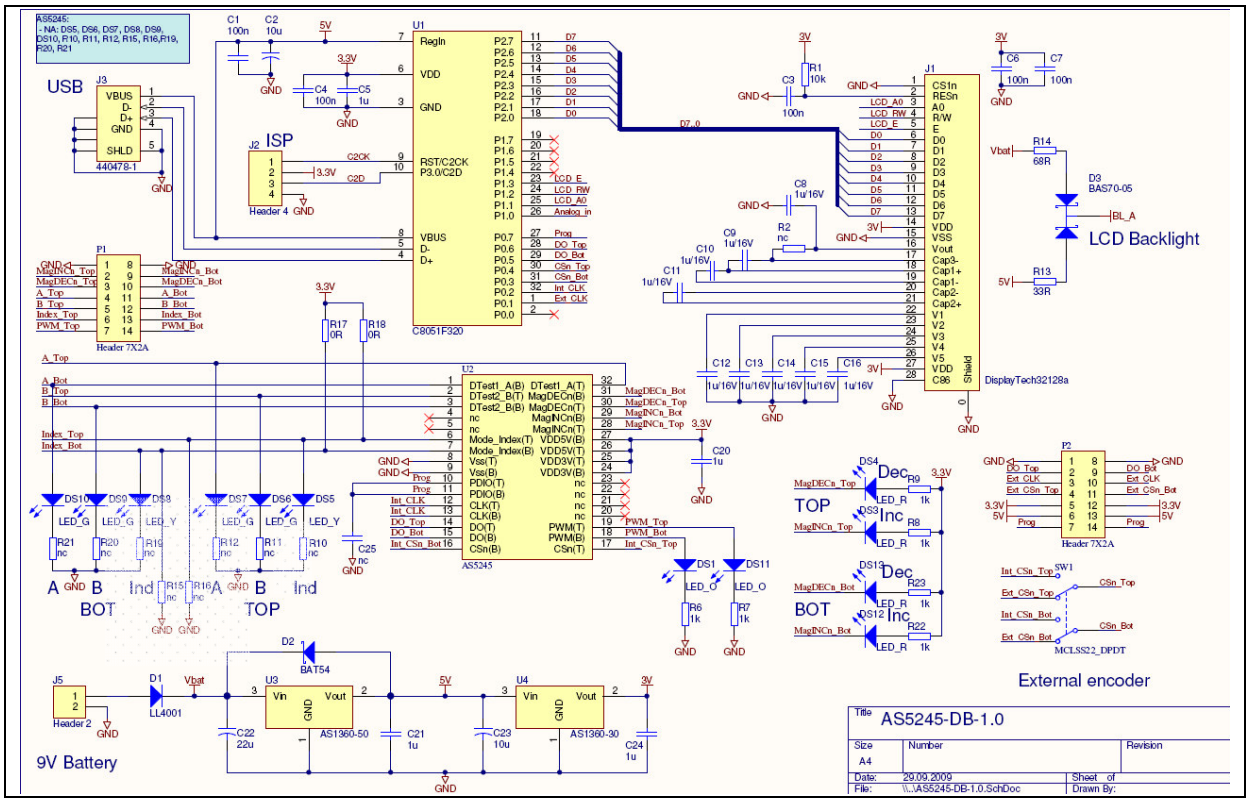



Figure 6: AS5245 Demoboard schematics

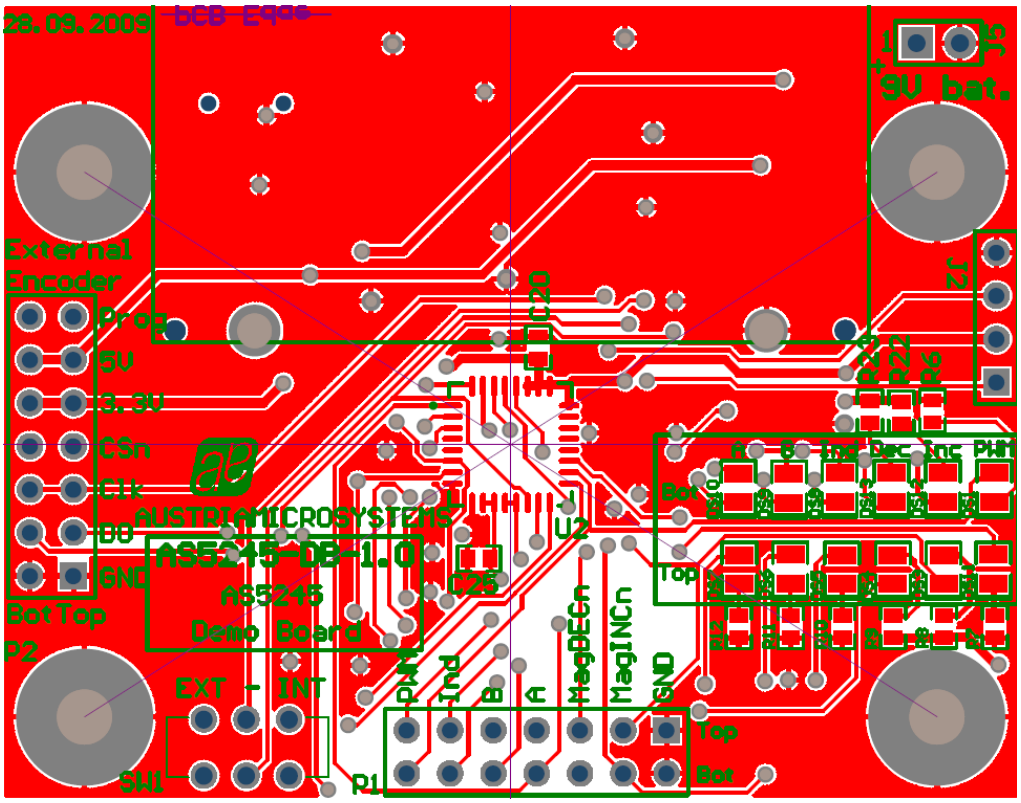



Figure 7: AS5245 Demoboard PCB Layout

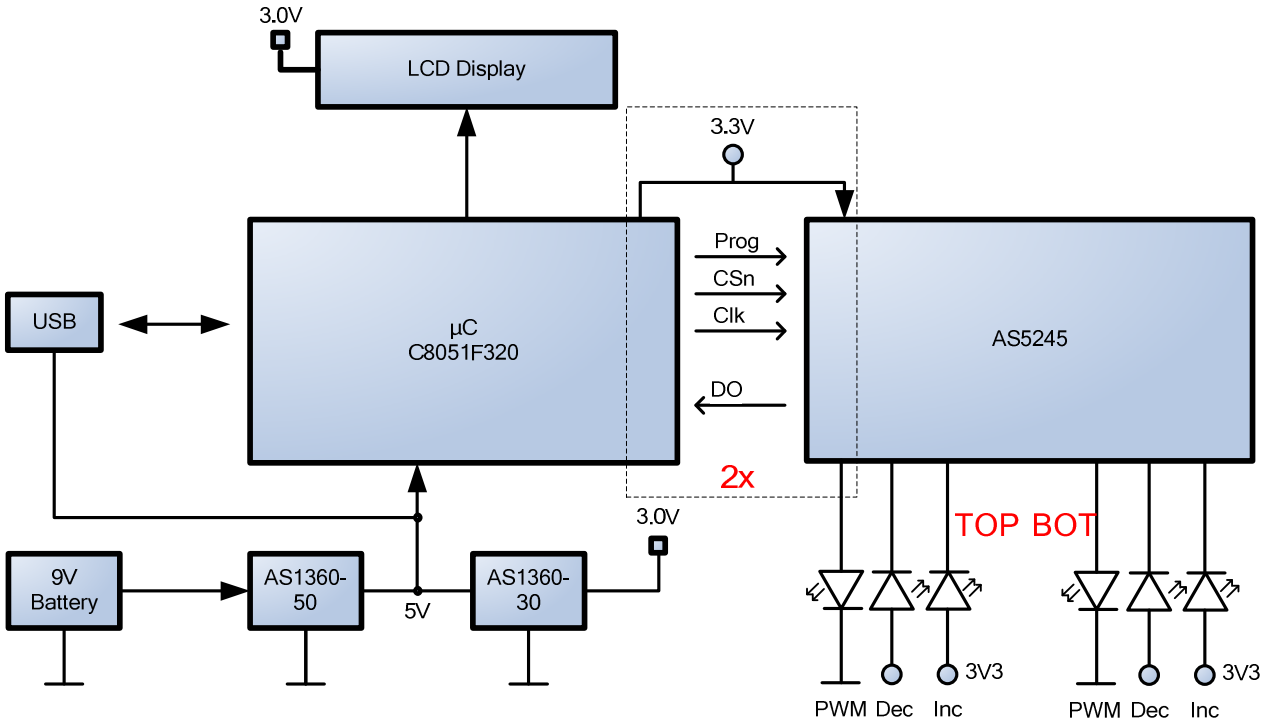



**Figure 8: AS5245 Blockdiagramm**

# Index

1 General Description ..... 1
2 The AS5245 Demoboard ..... 1
3 Operating the AS5245 Demoboard ..... 2
3.1 Hardware Indicators ..... 2
3.1.1 Graphic LCD display ..... 2
3.1.2 PWM LED ..... 2
3.1.3 MagINc and MagDECn LED ..... 2
3.2 Encoder selection switch ..... 3
4 AS5000 Programmer GUI software ..... 3
4.1 Installing the GUI on the PC ..... 3
4.2 The Home tab ..... 3
4.3 The SSI tab ..... 4
4.4 The OTP tab ..... 5
5 AS5245 Demoboard Schematics, Layout and Blockdiagram ..... 6
Index ..... 8
Revision History ..... 9
Contact ..... 9
Copyright ..... 10

## Revision History

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

## Contact

### Headquarters
austriamicrosystems AG
A 8141 Schloss Premstätten, **Austria**
Phone: +43 3136 500 0
Fax: +43 3136 525 01
industry.medical@austriamicrosystems.com
www.austriamicrosystems.com

### Sales Offices
austriamicrosystems Germany GmbH
Tegernseer Landstrasse 85
D-81539 München, **Germany**
Phone: +49 89 69 36 43 0
Fax: +49 89 69 36 43 66

austriamicrosystems Italy S.r.l.
Via A. Volta, 18
I-20094 Corsico (MI), **Italy**
Phone: +39 02 4586 4364
Fax: +39 02 4585 773

austriamicrosystems France S.A.R.L.
124, Avenue de Paris
F-94300 Vincennes, **France**
Phone: +33 1 43 74 00 90
Fax: +33 1 43 74 20 98

austriamicrosystems Switzerland AG
Rietstrasse 4
CH 8640 Rapperswil, **Switzerland**
Phone: +41 55 220 9008
Fax: +41 55 220 9001

austriamicrosystems UK, Ltd.
88, Barkham Ride,
Finchampstead, Wokingham
Berkshire RG40 4ET, **United Kingdom**
Phone: +44 118 973 1797
Fax: +44 118 973 5117

austriamicrosystems AG
Klaavuntie 9 G 55
FI 00910 Helsinki, **Finland**
Phone: +358 9 72688 170
Fax: +358 9 72688 171

austriamicrosystems AG
Bivägen 3B
S 19163 Sollentuna, **Sweden**
Phone: +46 8 6231 710
austriamicrosystems USA, Inc.
8601 Six Forks Road
Suite 400
Raleigh, NC 27615, **USA**
Phone: +1 919 676 5292
Fax: +1 509 696 2713

austriamicrosystems USA, Inc.
4030 Moorpark Ave
Suite 116
San Jose, CA 95117, **USA**
Phone: +1 408 345 1790
Fax: +1 509 696 2713

austriamicrosystems AG
Suite 811, Tsimshatsui Centre
East Wing, 66 Mody Road
Tsim Sha Tsui East, Kowloon, **Hong Kong**
Phone: +852 2268 6899
Fax: +852 2268 6799

austriamicrosystems AG
AIOS Gotanda Annex 5th Fl., 1-7-11,
Higashi-Gotanda, Shinagawa-ku
Tokyo 141-0022, **Japan**
Phone: +81 3 5792 4975
Fax: +81 3 5792 4976

austriamicrosystems AG
#805, Dong Kyung Bldg.,
824-19, Yeok Sam Dong,
Kang Nam Gu, Seoul
**Korea** 135-080
Phone: +82 2 557 8776
Fax: +82 2 569 9823

austriamicrosystems AG
Singapore Representative Office
83 Clemenceau Avenue, #02-01 UE Square
239920, **Singapore**
Phone: +65 68 30 83 05
Fax: +65 62 34 31 20

## Copyright

Devices sold by austriamicrosystems are covered by the warranty and patent indemnification provisions appearing in its Term of Sale. austriamicrosystems makes no warranty, express, statutory, implied, or by description regarding the information set forth herein or regarding the freedom of the described devices from patent infringement. austriamicrosystems reserves the right to change specifications and prices at any time and without notice. Therefore, prior to designing this product into a system, it is necessary to check with austriamicrosystems for current information. This product is intended for use in normal commercial applications.

Copyright © 2009 austriamicrosystems. Trademarks registered ®. All rights reserved. The material herein may not be reproduced, adapted, merged, translated, stored, or used without the prior written consent of the copyright owner. To the best of its knowledge, austriamicrosystems asserts that the information contained in this publication is accurate and correct. However, austriamicrosystems shall not be liable to recipient or any third party for any damages, including but not limited to personal injury, property damage, loss of profits, loss of use, interruption of business or indirect, special, incidental or consequential damages, of any kind, in connection with or arising out of the furnishing, performance or use of the technical data herein. No obligation or liability to recipient or any third party shall arise or flow out of austriamicrosystems rendering of technical or other services.

# OCEAN CHIPS
## Океан Электроники
## Поставка электронных компонентов

Компания «Океан Электроники» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

Наши преимущества:

- Поставка оригинальных импортных электронных компонентов напрямую с производств Америки, Европы и Азии, а так же с крупнейших складов мира;
- Широкая линейка поставок активных и пассивных импортных электронных компонентов (более 30 млн. наименований);
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Помощь Конструкторского Отдела и консультации квалифицированных инженеров;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Поставка электронных компонентов под контролем ВП;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- При необходимости вся продукция военного и аэрокосмического назначения проходит испытания и сертификацию в лаборатории (по согласованию с заказчиком);
- Поставка специализированных компонентов военного и аэрокосмического уровня качества (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Actel, Aeroflex, Peregrine, VPT, Syfer, Eurofarad, Texas Instruments, MS Kennedy, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

Компания «Океан Электроники» является официальным дистрибьютором и эксклюзивным представителем в России одного из крупнейших производителей разъемов военного и аэрокосмического назначения «**JONHON**», а так же официальным дистрибьютором и эксклюзивным представителем в России производителя высокотехнологичных и надежных решений для передачи СВЧ сигналов «**FORSTAR**».

AVIC JONHON

**«JONHON»** (основан в 1970 г.)

Разъемы специального, военного и аэрокосмического назначения:

(Применяются в военной, авиационной, аэрокосмической, морской, железнодорожной, горно- и нефтедобывающей отраслях промышленности)

**«FORSTAR»** (основан в 1998 г.)

ВЧ соединители, коаксиальные кабели, кабельные сборки и микроволновые компоненты:

(Применяются в телекоммуникациях гражданского и специального назначения, в средствах связи, РЛС, а так же военной, авиационной и аэрокосмической отраслях промышленности).

FORSTAR®

Телефон: 8 (812) 309-75-97 (многоканальный)
Факс: 8 (812) 320-03-32
Электронная почта: ocean@oceanchips.ru
Web: http://oceanchips.ru/
Адрес: 198099, г. Санкт-Петербург, ул. Калинина, д. 2, корп. 4, лит. А