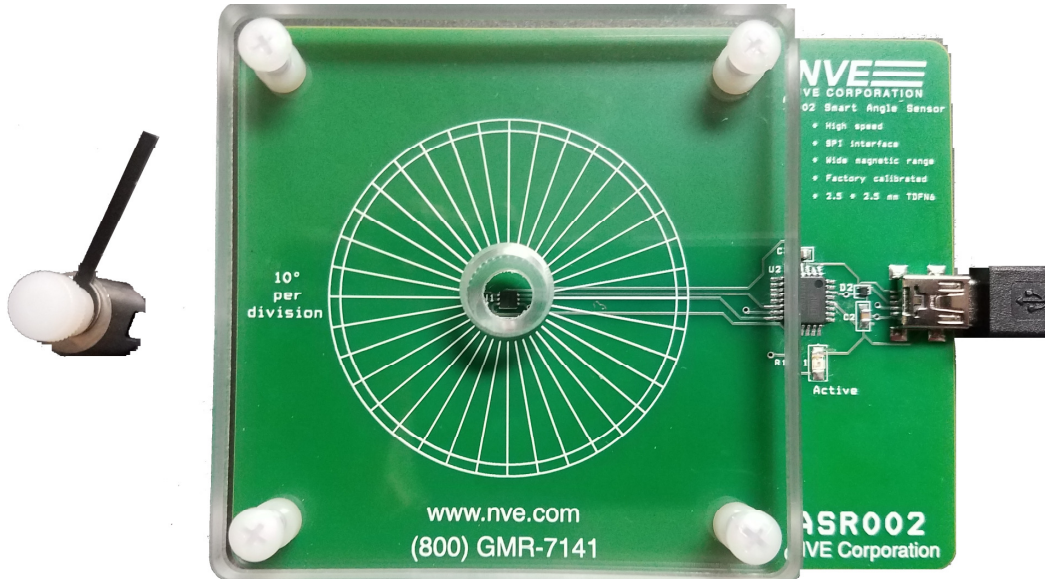


AG954-07E: ASR002 Smart Angle Sensor Evaluation Kit



Summary

The AG954 Evaluation Board provides a clean, efficient user interface for the ASR002-10E Smart Angle Sensor.

The evaluation kit includes:

- A USB-powered Evaluation Board
- An ASR002-10E sensor
- A diametrical magnet, indicator hand, and fixturing for the magnet
- A microcontroller connected to the sensor via SPI
- A regulated 3.3-volt supply to power the ASR002 Sensor
- A USB cable to connect the Evaluation Board to a computer
- A powerful, intuitive graphical user interface

Contents

1. Overview
2. Quick Start
3. The Evaluation Board
4. Magnets and Magnetic Operation
5. User Interface Installation
6. User Interface Operation
 - 6.1. Main
 - 6.2. Settings
 - 6.3. Memory
7. Troubleshooting / FAQs
8. Revision History

1. Overview

This Evaluation Kit Includes:

- An ASR002-10E evaluation board
- Easy to install Windows-compatible software and graphical user interface
- A diametrically magnetized magnet
- USB to mini-B cable

ASR002-10E Features:

- 30 – 200 Oe field operating range for robust airgap and misalignment tolerances
- High-speed SPI interface
- 0.1° resolution
- $\pm 2^\circ$ accuracy
- 12.5 kSps sample rate
- Factory calibrated
- Internal temperature compensation
- 2.2 to 3.6V supply
- 4 mA typical supply current
- -40°C to $+125^\circ\text{C}$
- Ultraminiature 2.5 x 2.5 x 0.8 mm TDFN6 package

2. Quick Start

- 2.1. Connect the Evaluation Board to a computer via the USB cable.
- 2.2. Place a magnet in the holder and the assembly in the Plexiglas pocket:

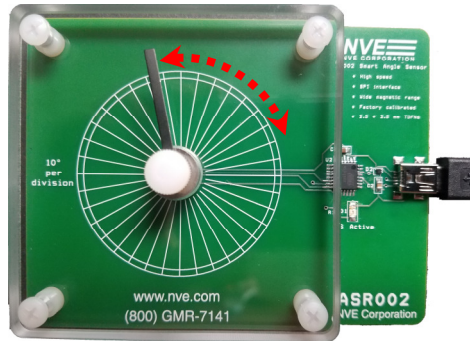


Figure 1. The ASR002 Evaluation Board.

- 2.3. Install the software and launch the application.

3. The Evaluation Board

3.1 Board Layout

The evaluation board communicates with a host computer via USB and a Smart Magnetometer via SPI:

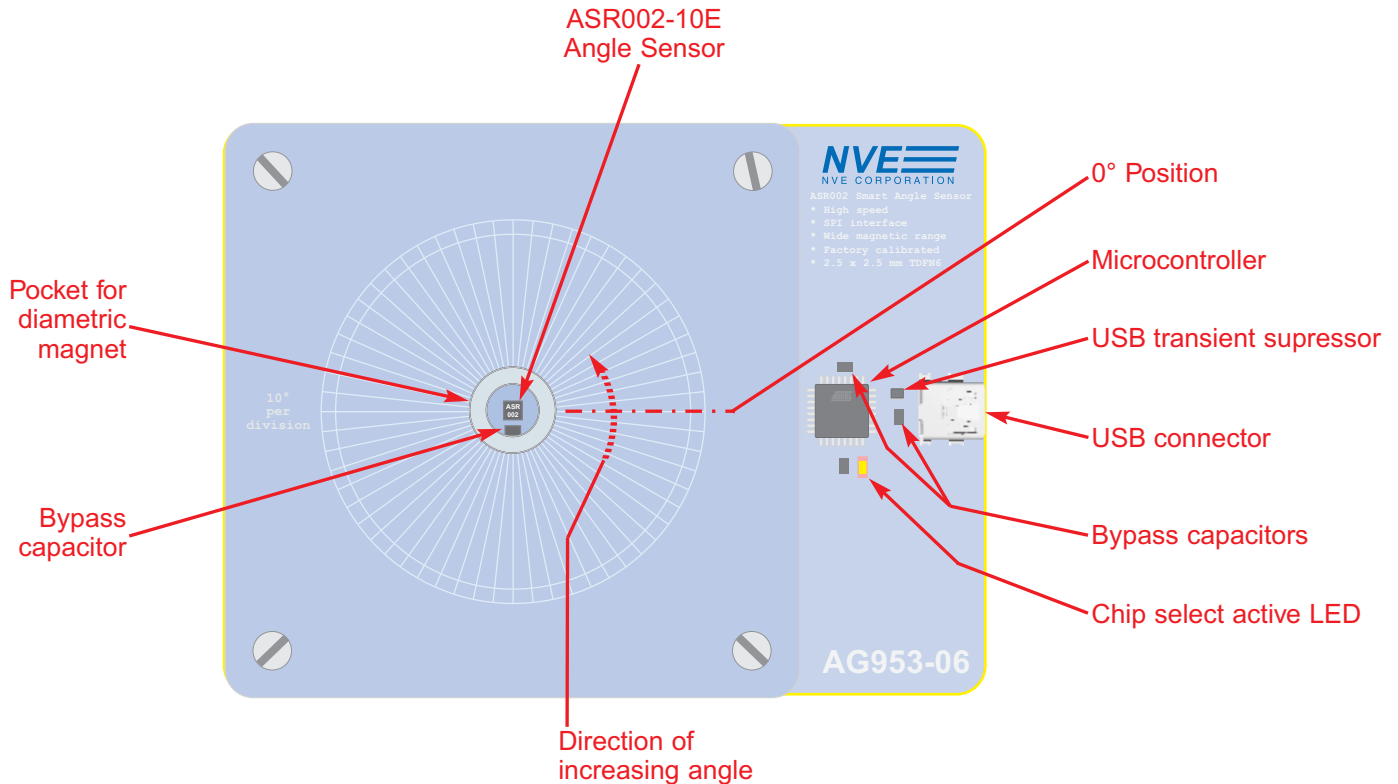


Figure 2. The Evaluation Board (actual size).

Part Number	Designator	Manufacturer	Qty	Description
ASR002-10E	U1	NVE Corporation	1	SMART TMR ANGLE SENSOR, TDFN6
ATMEGA16U2-AU	U2	Microchip Technology	1	IC MCU 8BIT 16KB FLASH 32TQFP
3216LSYCK/J3-PRV/J3-0805	D1	Kingbright	1	LED YELLOW CLEAR 1206 SMD
	R1	Generic	1	RES 3K OHM 1% 1/4W 0805
TPD2E001DRLR	D2	Texas Instruments	1	TVS DIODE 5.5V SOT5
885012207016	C1, C2	Wurth Electronics Inc.	2	CAP CER 0.1UF 10V X7R 0805
3RM21BR71C105KA01I	C3	Murata Electronics North An	1	CAP CER 1UF 16V X7R 0805
690-005-299-043	J1	EDAC Inc.	1	CONN MINI USB RCPT RA TYPE B SM
12426	N/A	NVE Corporation	1	Alnico-5 round horseshoe magnet
	N/A	Generic	1	3ft FLAT USB 2.0 Type A Male to Mini-F

3.2 Schematic

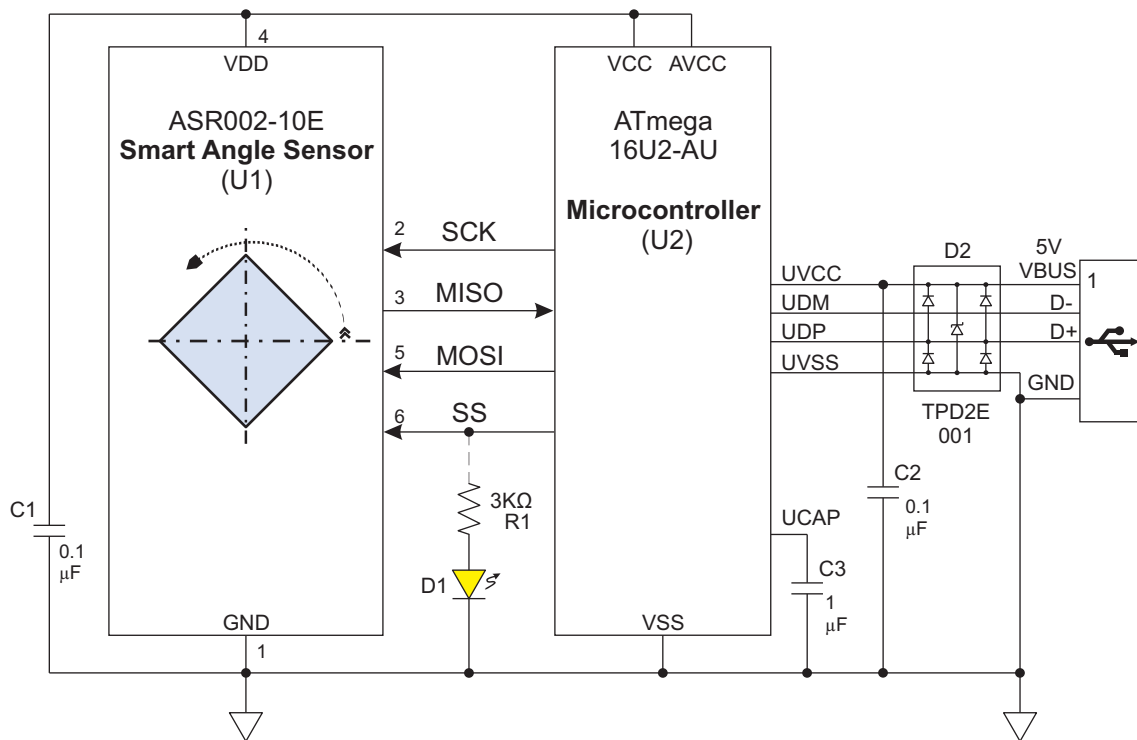


Figure 3. Evaluation Board Schematic.

3.3 Circuit Description

The Angle Sensor

The ASR002 is a six-pin component, with power (VDD and GND); SPI (SCLK, MISO, and MOSI), and Slave Select (SS) pins.

Microcontroller

The ASR002 (U1) is compatible with almost any microcontroller. This board uses a popular ATMEGA16U2 8-bit microcontroller (U2), which has integrated SPI and USB interfaces.

Power

The board is powered by the USB port. The microcontroller has an internal 3.3-volt regulator that powers the sensor.

SPI

SPI links the sensor and microcontroller. The ASR002 is an SPI Slave, and the microcontroller is configured as the Master.

USB Interface

The microcontroller has an integrated USB UART. A Transient Voltage Suppressor (D2) protects the microcontroller.

LED

Yellow LED D1 shows when the sensor chip is selected by the microcontroller's Slave Select (SS) output. A series resistor (R1) sets the LED brightness.

Decoupling Capacitors

The board has 0.1 μF decoupling capacitors (C1 and C2) as recommended for the sensor and USB bus supply, and a 1 μF decoupling capacitor (C3) as recommended for the microcontroller's internal 3.3-volt regulator.

4. Magnets and Magnetics

The Evaluation Kit comes with a versatile and convenient Alnico round horseshoe magnet with a mounting hole. Most customers use lower-cost diametrically-magnetized ferrite disk magnets for production, and NVE stocks three magnet popular ferrite magnets in addition to the Alnico magnet included in this kit:

NVE Part Number	Dia. (mm)	Length (mm)	Typ. sensor distance (mm; 120 Oe nom. field)	Material
12426*	11	11	8	Alnico-5 round horseshoe
12526	8	8	6	C5/Y25 ferrite disk magnet
12527	8	4	5	
12528	4	4	3	

*Included with this kit.

Table 1. Popular magnets for angle sensing.

We also offer machined disk magnet holders that are compatible with this kit.

Our free Web apps can be used to determine the optimum operating separations for other magnet sizes and materials:

<https://www.nve.com/spec/calculators.php>

5. User Interface Software Installation

5.1 System Requirements

The software system requirements are:

- Windows 7 or later
- 100 MB of system memory
- One USB 2.0 port
- Monitor (minimum 800 pixels vertical)

5.2 Software Installation

5.2.1. Download the software installation package from <https://github.com/NveCorporation>

5.2.2. Unzip the download and run *setup.exe* to begin installation.

5.2.3. Follow prompts for installing the NVE software application as well as any supporting National Instruments files.

5.3 USB driver installation

6.3.1. Disconnect any AG954 boards connected to the PC.

6.3.2. Locate the USB driver *NVESmartSensor.inf* in the *drivers* folder of the installation package.

6.3.3. Right click on *NVESmartSensor.inf* and click “Install.”

6.3.4. Restart the computer to complete the installation.

6.3.5. Connect the AG954 board to a USB port.

6.3.6. The connection can be verified by checking for “NVE Smart Sensor” under “Ports (COM & LPT)” in Windows Device Manager.

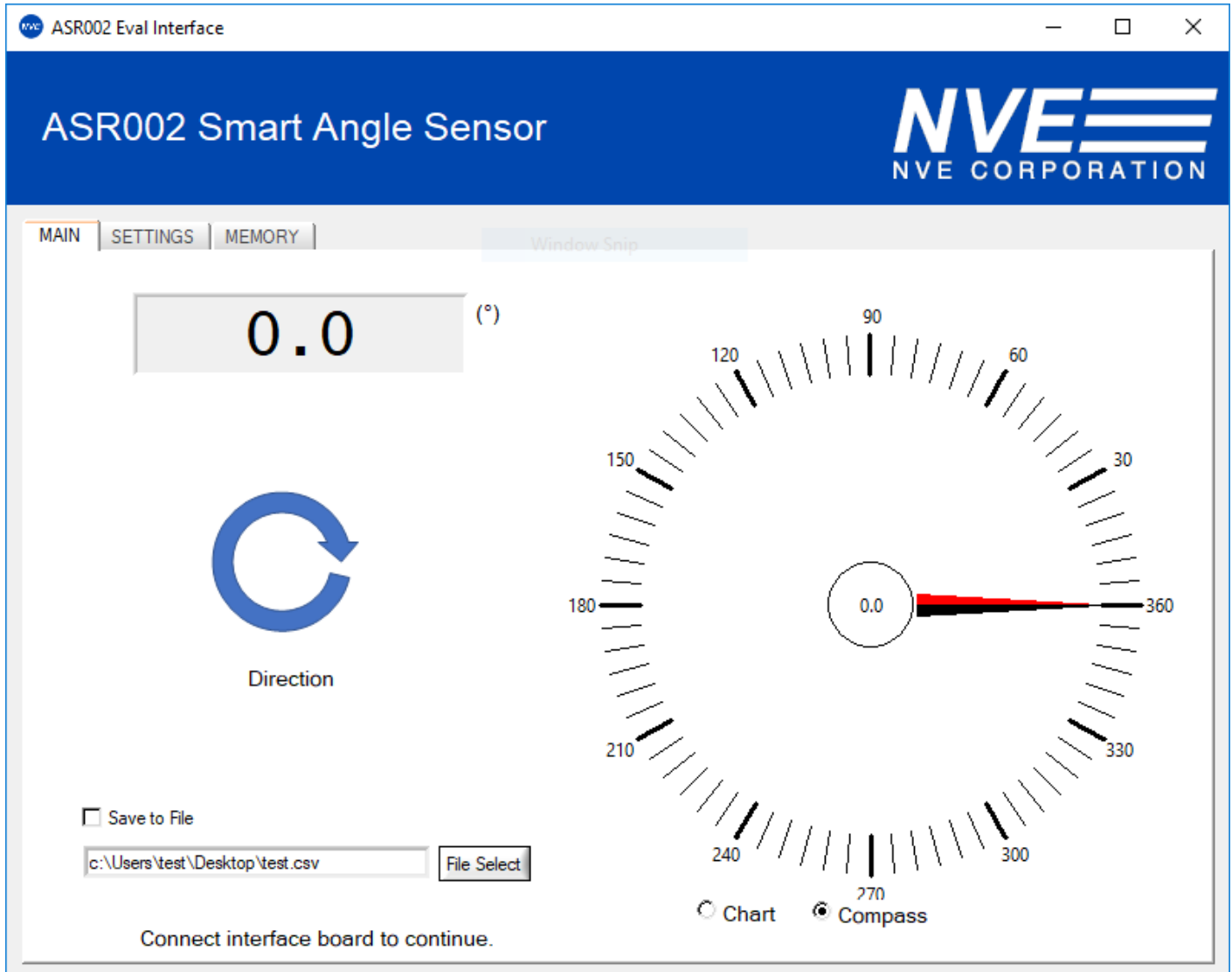
6. User Interface Operation

The User Interface allows reading sensor data, as well as reading and writing the nonvolatile sensor calibration memory.

After starting the application, a single window with three tabbed panels is displayed. The three tabs are:

1. Main – Displays the measured angle in digital and graphical format.
2. Settings – Allows changing the Sensor's Rotation Direction , Zero Angle, and Digital Filter Constant.
3. Memory – Allows reading and writing data and parameters in the Sensor's internal memory.

6.1. Main Tab



Main tab elements are described below:

Digital Display – Displays the sensor output in degrees and tenths. Double right-clicking on the digital angle display changes the its precision.

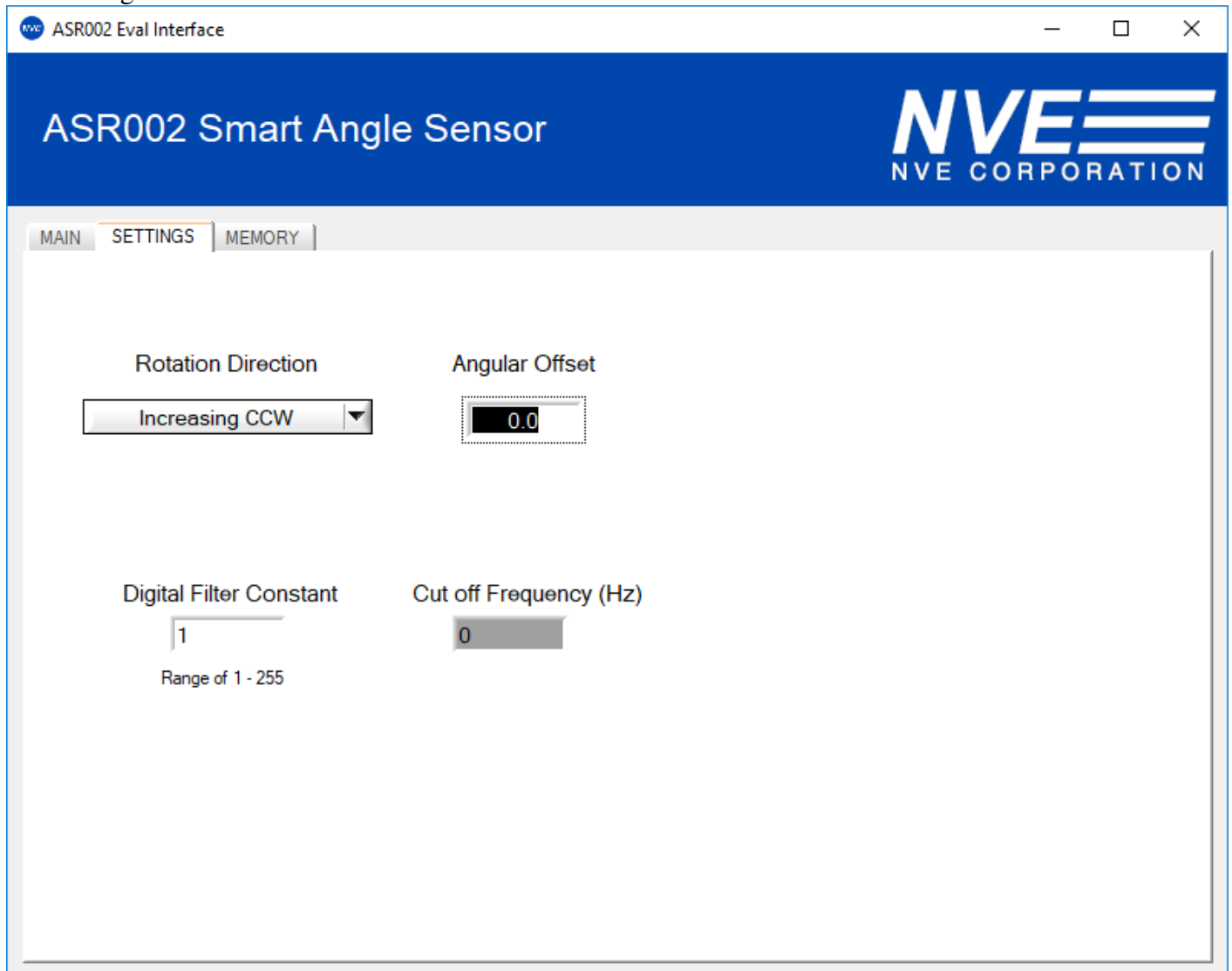
Compass – Displays the measured angle a bar chart using a compass metaphor.

Chart – Displays the measured angle using a “strip chart” metaphor of angle vs. time.

Direction – Displays the Sensor’s measured rotation direction (as viewed looking at the top of the Sensor).

Save to File – Saves a session’s measured angle history to a .csv file. The angle and time are recorded approximately every 0.1 seconds.

6.2. Settings Tab

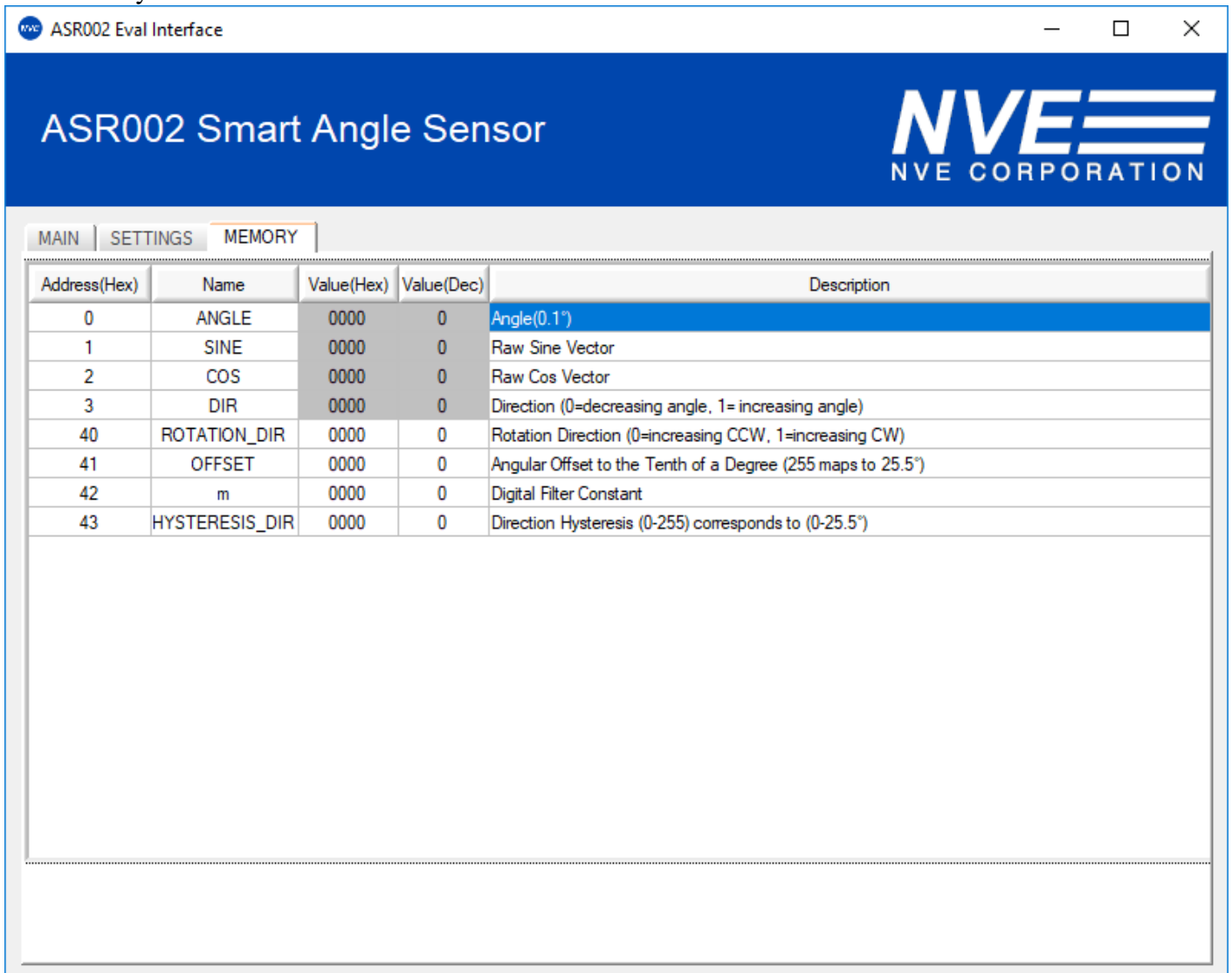


Set Rotation Direction – Sets the Sensor to output to either increasing clockwise or counterclockwise (as viewed looking at the top of the Sensor).

Angular Offset – A value can be entered to change point at which the sensor reads zero.

Digital Filter Constant – Allows setting the Sensor’s digital filter constant within the allowable range of 1 to 255. Larger numbers provide a more heavily filtered output (i.e., a lower cutoff frequency). The calculated cutoff frequency is displayed in the adjacent box ($f_{\text{CUTOFF}} = f_{\text{SAMPLE}} / (2\pi m)$, where $f_{\text{SAMPLE}} = \text{approx. } 12.5 \text{ kSps}$). The factory default for the sensors is “1,” which disables the filter, however the user interface default is with the filter enabled since the evaluation board is intended for lower speeds.

6.3. Memory Tab



Address(Hex)	Name	Value(Hex)	Value(Dec)	Description
0	ANGLE	0000	0	Angle(0.1°)
1	SINE	0000	0	Raw Sine Vector
2	COS	0000	0	Raw Cos Vector
3	DIR	0000	0	Direction (0=decreasing angle, 1= increasing angle)
40	ROTATION_DIR	0000	0	Rotation Direction (0=increasing CCW, 1=increasing CW)
41	OFFSET	0000	0	Angular Offset to the Tenth of a Degree (255 maps to 25.5°)
42	m	0000	0	Digital Filter Constant
43	HYSTERESIS_DIR	0000	0	Direction Hysteresis (0-255) corresponds to (0-25.5°)

The *Memory* tab allows reading and writing the Sensor’s internal memory. Addresses 0 to 3 are Sensor outputs, and can only be read, not written. These outputs are two-byte (16 bit) unsigned integers and are updated in real time. The angle (address 0) is in tenths of a degree, with a range of 0 to 3600 (dec). The raw Sine and Cosine outputs are centered at approximately 2048, with peak-to-peak amplitudes of approximately 1000.

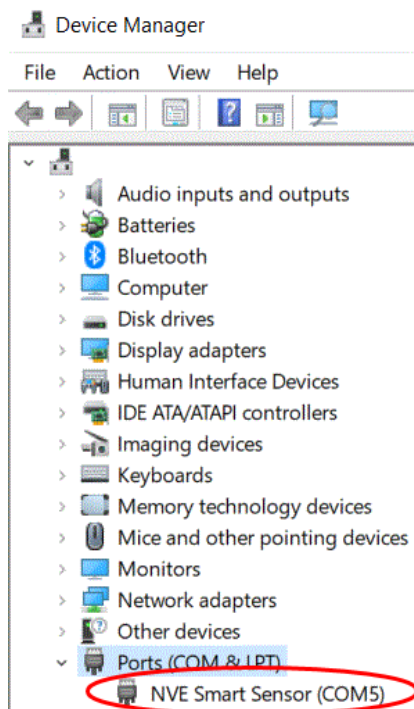
The user-settable parameters are in addresses 0x40 to 0x43, and can be read or written. Parameters can be changed by clicking on the appropriate cell, typing a new number, and hitting “Enter.” The sensor’s parameter memory is nonvolatile, so the settings remain after power is removed.

7. Troubleshooting

➤ No communications

- Basic Steps

- Check the USB cable.
- Verify the USB port under Windows Device Manager:



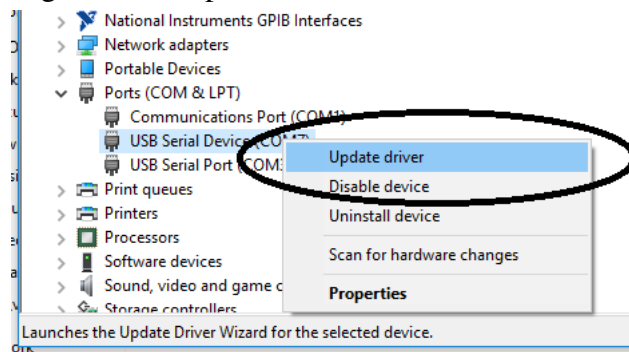
- Reinstall the USB driver.

- Manually set the driver

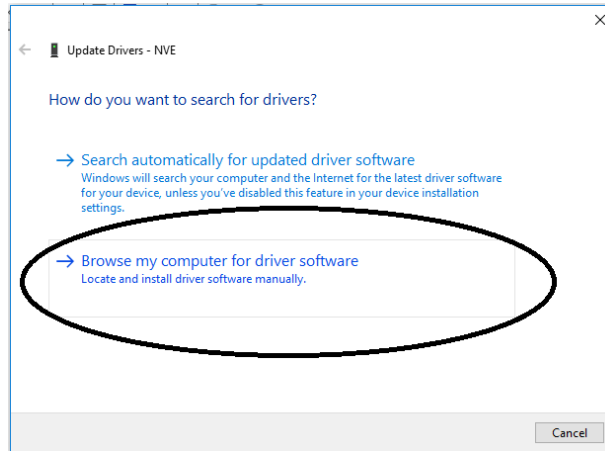
- Use Windows Device Manager to determine how the evaluation board USB is configured.

2a. If the board appears as “USB Serial Device”:

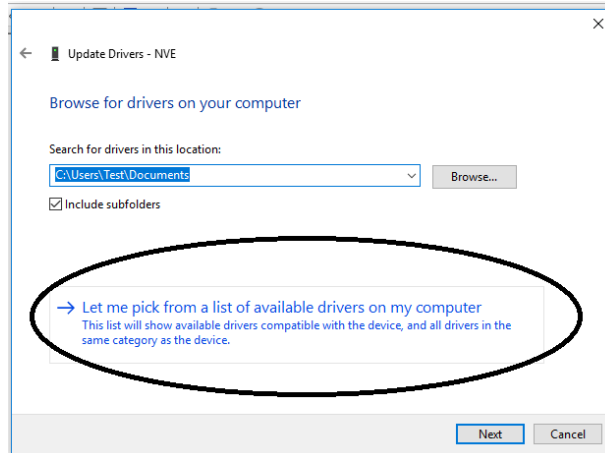
- Right click, “Update Driver”



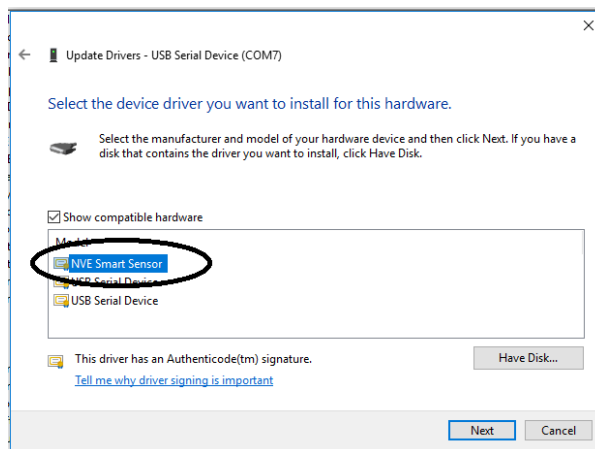
- Choose “Browse my computer for driver software”:



- Choose “Let me pick from a list of available drivers on my computer”:



- Select “NVE Smart Sensor”



2b. If the device does not appear as a “USB Serial Device”:

- Right click “Update Driver.”
- Choose “Browse my computer for driver software.”
- Choose “Let me pick from a list of available drivers on my computer.”
- Select “USB Serial Device.”
- Go to step 2.

8. Revision History

SB-00-082-A	Change
December 2018	<ul style="list-style-type: none">• Initial Release

Datasheet Limitations

The information and data provided in datasheets shall define the specification of the product as agreed between NVE and its customer, unless NVE and customer have explicitly agreed otherwise in writing. All specifications are based on NVE test protocols. In no event however, shall an agreement be valid in which the NVE product is deemed to offer functions and qualities beyond those described in the datasheet.

Limited Warranty and Liability

Information in this document is believed to be accurate and reliable. However, NVE does not give any representations or warranties, expressed or implied, as to the accuracy or completeness of such information and shall have no liability for the consequences of use of such information.

In no event shall NVE be liable for any indirect, incidental, punitive, special or consequential damages (including, without limitation, lost profits, lost savings, business interruption, costs related to the removal or replacement of any products or rework charges) whether or not such damages are based on tort (including negligence), warranty, breach of contract or any other legal theory.

Right to Make Changes

NVE reserves the right to make changes to information published in this document including, without limitation, specifications and product descriptions at any time and without notice. This document supersedes and replaces all information supplied prior to its publication.

Use in Life-Critical or Safety-Critical Applications

Unless NVE and a customer explicitly agree otherwise in writing, NVE products are not designed, authorized or warranted to be suitable for use in life support, life-critical or safety-critical devices or equipment. NVE accepts no liability for inclusion or use of NVE products in such applications and such inclusion or use is at the customer's own risk. Should the customer use NVE products for such application whether authorized by NVE or not, the customer shall indemnify and hold NVE harmless against all claims and damages.

Applications

Applications described in this datasheet are illustrative only. NVE makes no representation or warranty that such applications will be suitable for the specified use without further testing or modification.

Customers are responsible for the design and operation of their applications and products using NVE products, and NVE accepts no liability for any assistance with applications or customer product design. It is customer's sole responsibility to determine whether the NVE product is suitable and fit for the customer's applications and products planned, as well as for the planned application and use of customer's third party customers. Customers should provide appropriate design and operating safeguards to minimize the risks associated with their applications and products.

NVE does not accept any liability related to any default, damage, costs or problem which is based on any weakness or default in the customer's applications or products, or the application or use by customer's third party customers. The customer is responsible for all necessary testing for the customer's applications and products using NVE products in order to avoid a default of the applications and the products or of the application or use by customer's third party customers. NVE accepts no liability in this respect.

Limiting Values

Stress above one or more limiting values (as defined in the Absolute Maximum Ratings System of IEC 60134) will cause permanent damage to the device. Limiting values are stress ratings only and operation of the device at these or any other conditions above those given in the recommended operating conditions of the datasheet is not warranted. Constant or repeated exposure to limiting values will permanently and irreversibly affect the quality and reliability of the device.

Terms and Conditions of Sale

In case an individual agreement is concluded only the terms and conditions of the respective agreement shall apply. NVE hereby expressly objects to applying the customer's general terms and conditions with regard to the purchase of NVE products by customer.

No Offer to Sell or License

Nothing in this document may be interpreted or construed as an offer to sell products that is open for acceptance or the grant, conveyance or implication of any license under any copyrights, patents or other industrial or intellectual property rights.

Export Control

This document as well as the items described herein may be subject to export control regulations. Export might require a prior authorization from national authorities.

Automotive Qualified Products

Unless the datasheet expressly states that a specific NVE product is automotive qualified, the product is not suitable for automotive use. It is neither qualified nor tested in accordance with automotive testing or application requirements. NVE accepts no liability for inclusion or use of non-automotive qualified products in automotive equipment or applications.

In the event that customer uses the product for design-in and use in automotive applications to automotive specifications and standards, customer (a) shall use the product without NVE's warranty of the product for such automotive applications, use and specifications, and (b) whenever customer uses the product for automotive applications beyond NVE's specifications such use shall be solely at customer's own risk, and (c) customer fully indemnifies NVE for any liability, damages or failed product claims resulting from customer design and use of the product for automotive applications beyond NVE's standard warranty and NVE's product specifications.

An ISO 9001 Certified Company

NVE Corporation
11409 Valley View Road
Eden Prairie, MN 55344-3617 USA
Telephone: (952) 829-9217
www.nve.com
e-mail: sensor-info@nve.com

©NVE Corporation
All rights are reserved. Reproduction in whole or in part is prohibited without the prior written consent of the copyright owner.

SB-00-082—AG954 Evaluation Kit Manual

January 2019