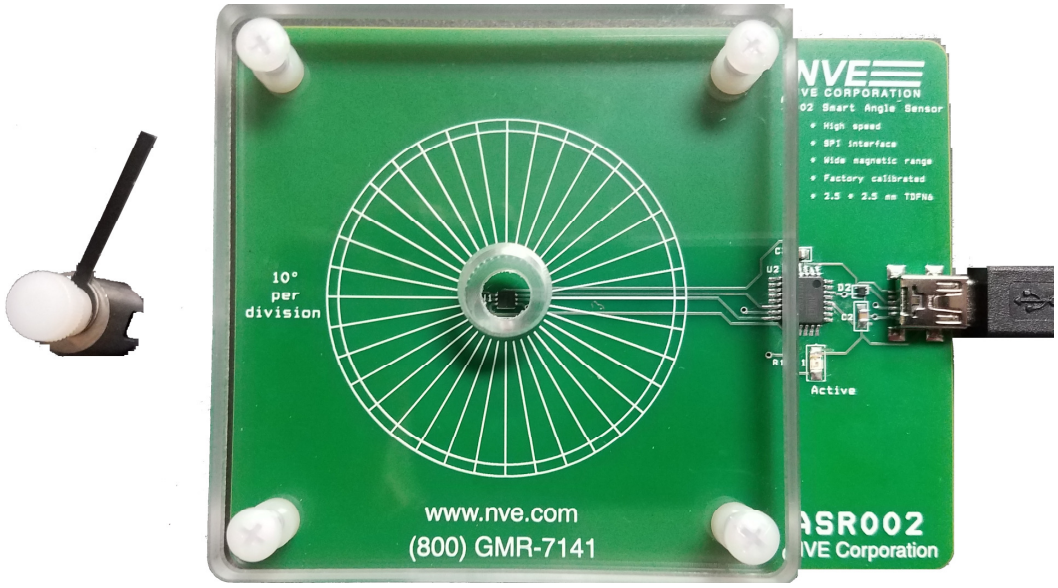
AG956-07E: ASR002 Smart Angle Sensor Evaluation Kit



Summary
The AG956 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

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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:

- 60 – 200 Oe field operating range for robust airgap and misalignment tolerances
- High-speed SPI interface
- 0.1° resolution
- ±2° 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°C
- Ultraminiature 2.5 x 2.5 x 0.8 mm TDFN6 package

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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:

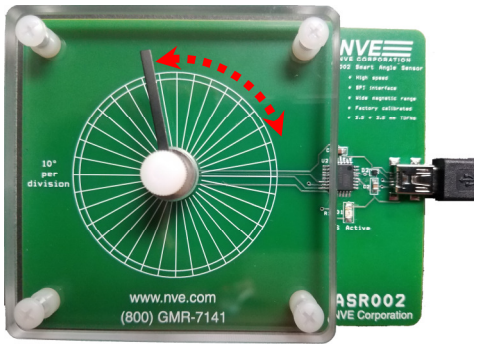

Figure 1. The ASR002 Evaluation Board.

2.3. Install the software and launch the application.

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3. The Evaluation Board

3.1 Board Layout

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

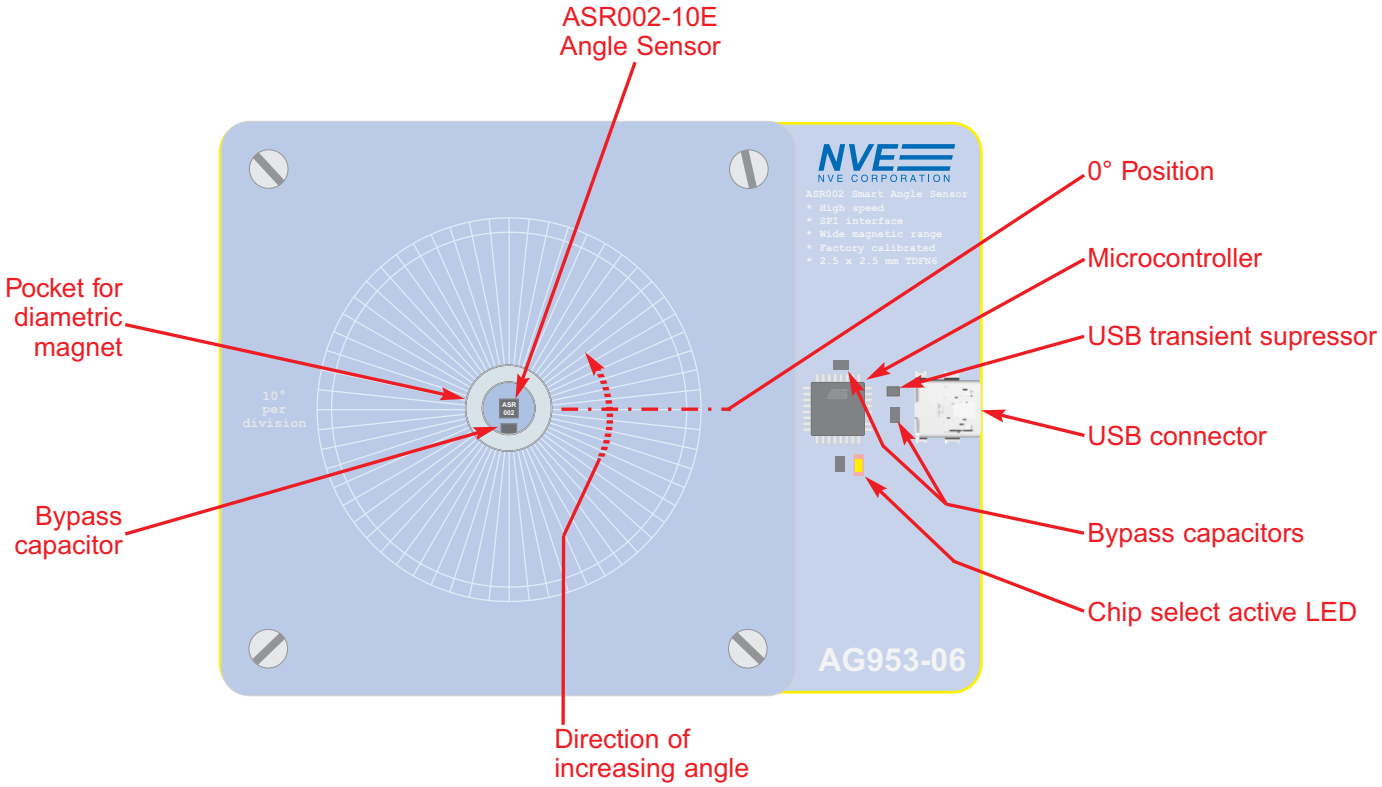

Figure 2. The Evaluation Board (actual size).

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-	D1	Kingbright	1	LED YELLOW CLEAR 1206 SMD
0805	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
GRM21BR71C105KA01I	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-B

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3.2 Schematic

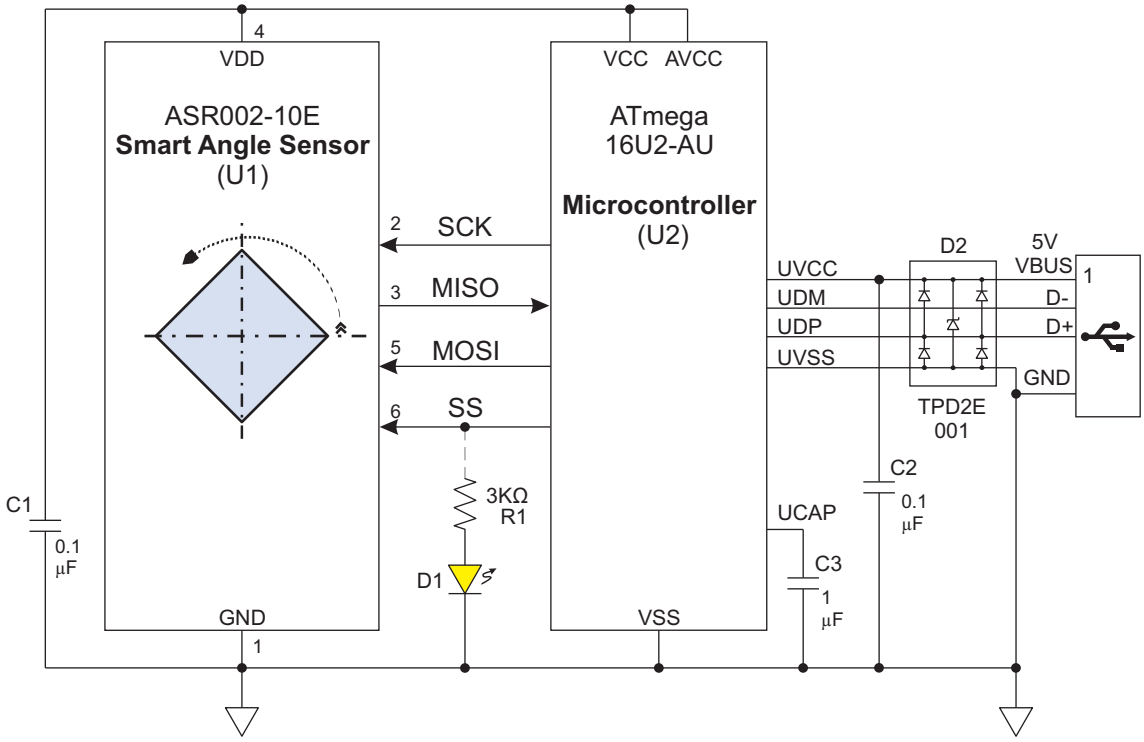

Figure 3. Evaluation Board Schematic.

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 power 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.

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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.

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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 AG956 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 AG956 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.

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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.

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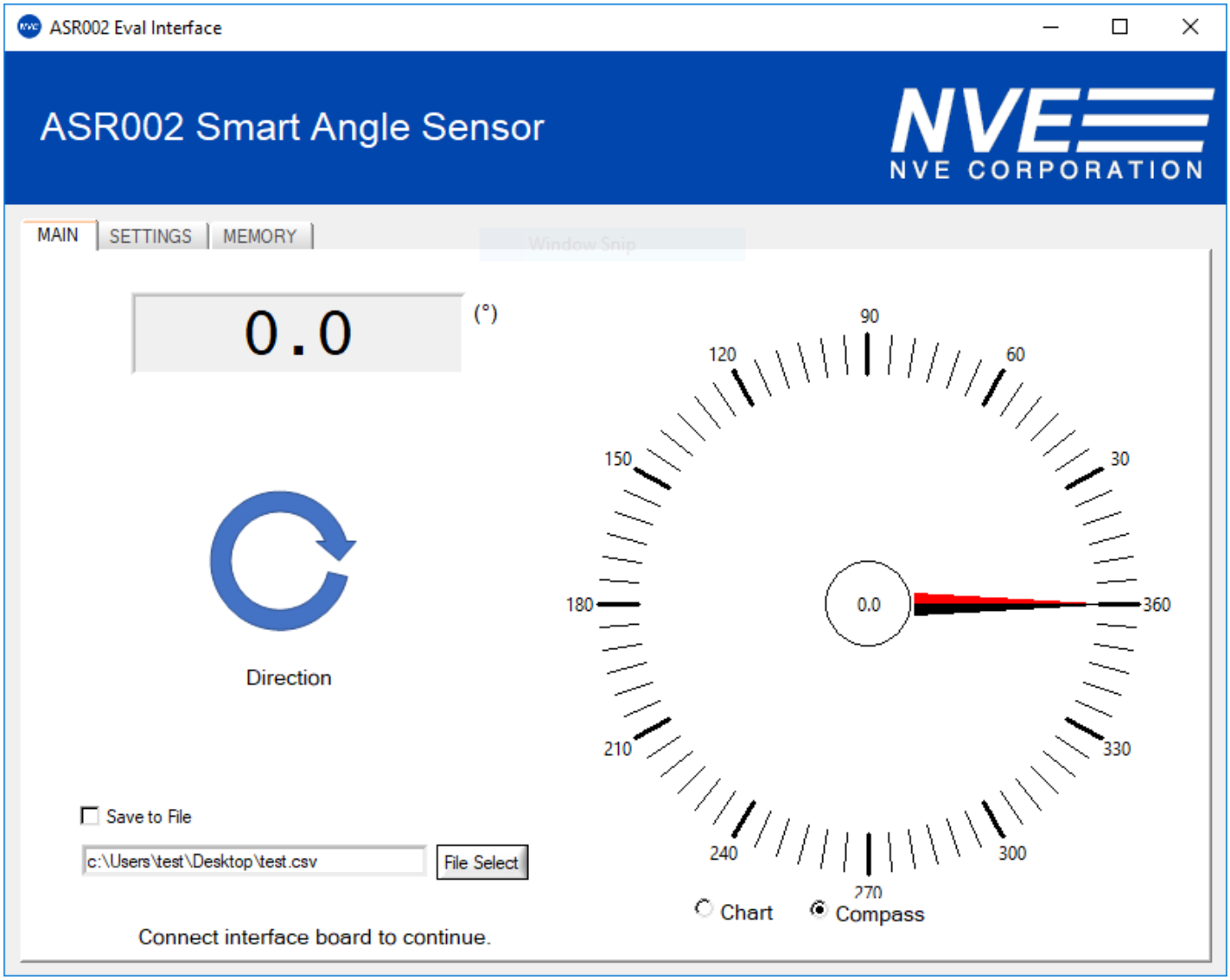
6.1. Main Tab



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.

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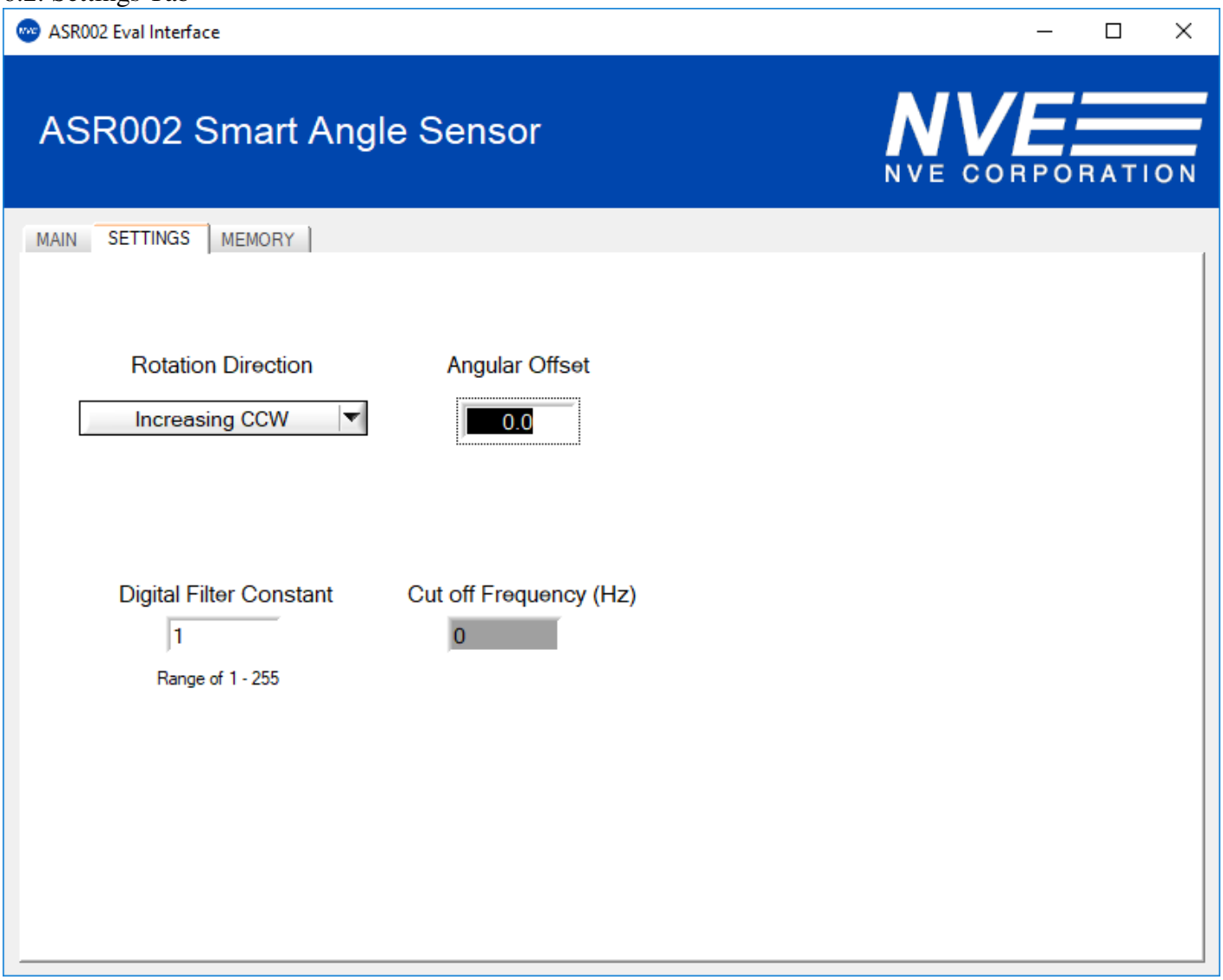
6.2. Settings Tab



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 ($f_{CUTOFF} = f_{SAMPLE}/(2\pi\ m)$, where f_{SAMPLE} = approx. 12.5 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.

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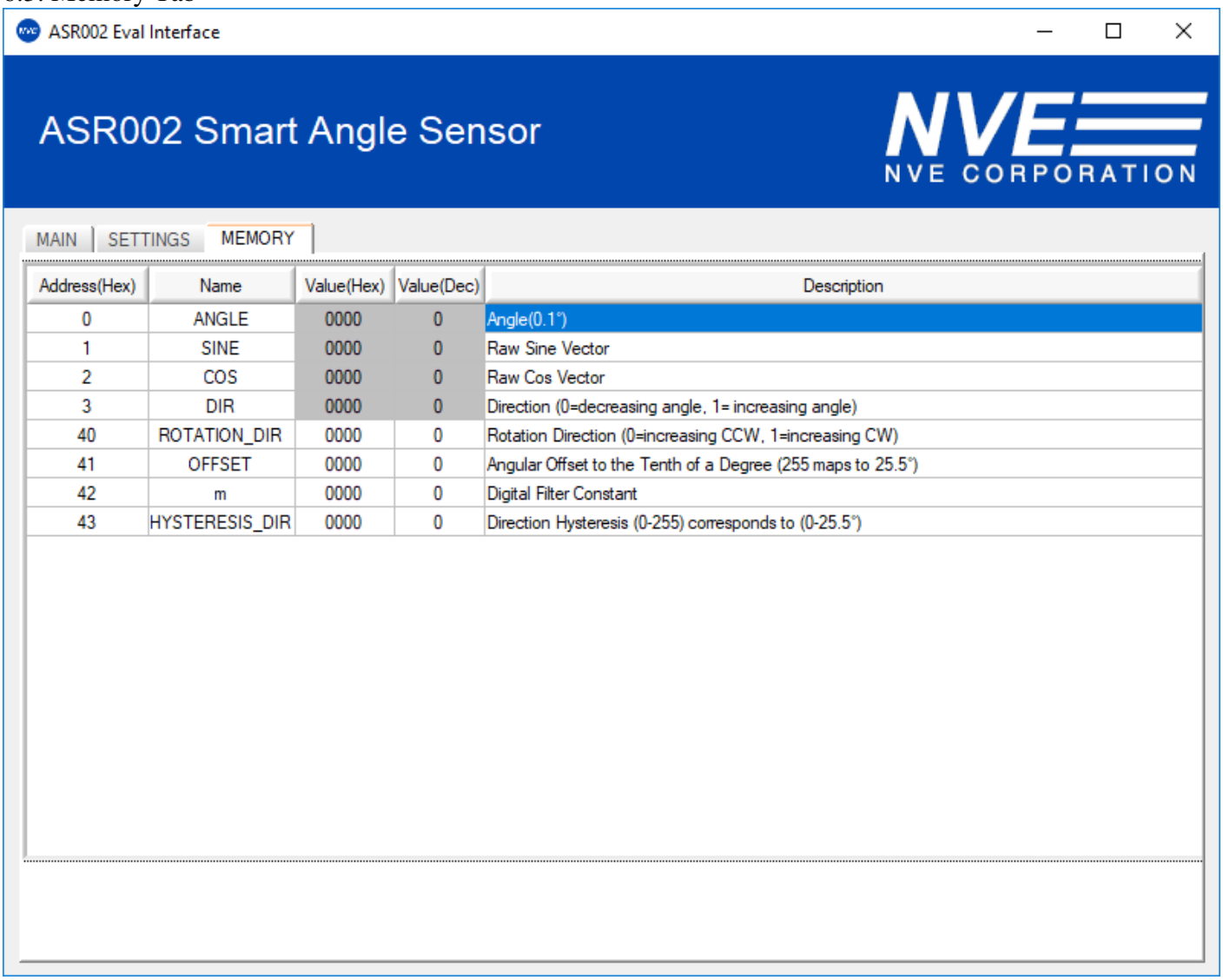
6.3. Memory Tab



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.

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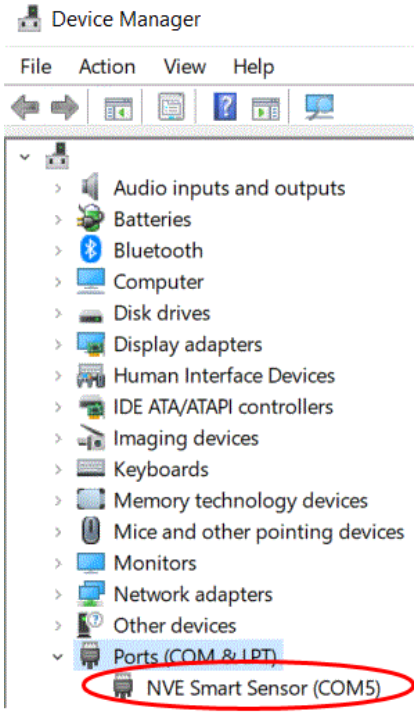
7. Troubleshooting

No communications

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



3. Reinstall the USB driver.

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8. Revision History

SB-00-082-B
February 2019

Change
- Simplified “Troubleshooting” section.
- Minor text changes.

SB-00-082-A
December 2018

Change
- Initial Release.

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