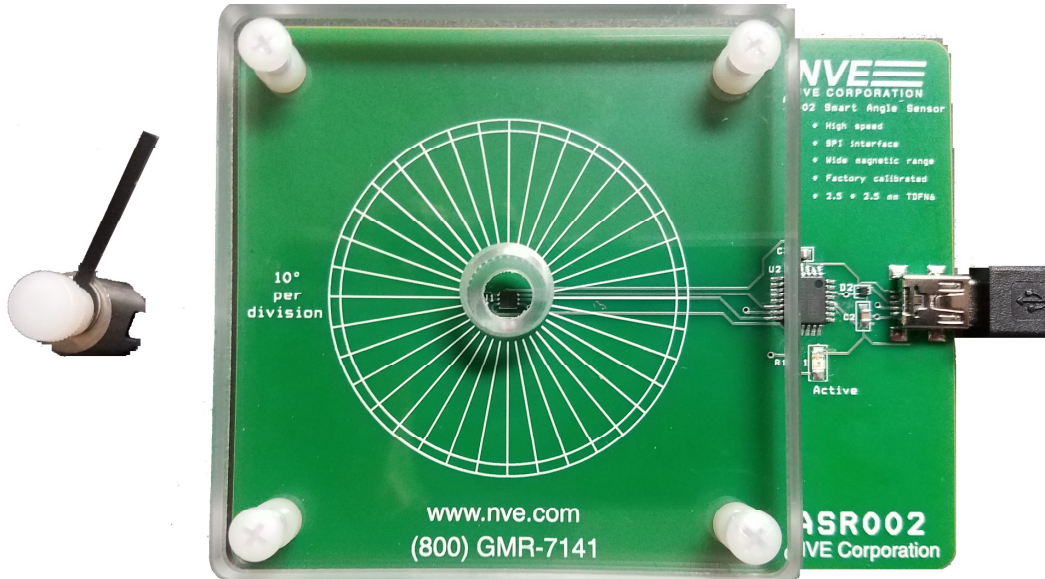


AG954-07E: ASR002 Smart Angle Sensor Evaluation Board



Summary

The AG954 Evaluation Board provides a sophisticated 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:

- 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:

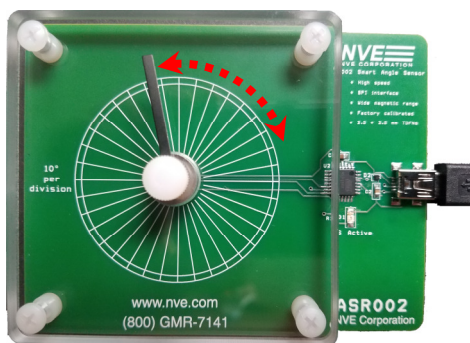


Figure 1. The ASR002 Evaluation Board.

- 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:

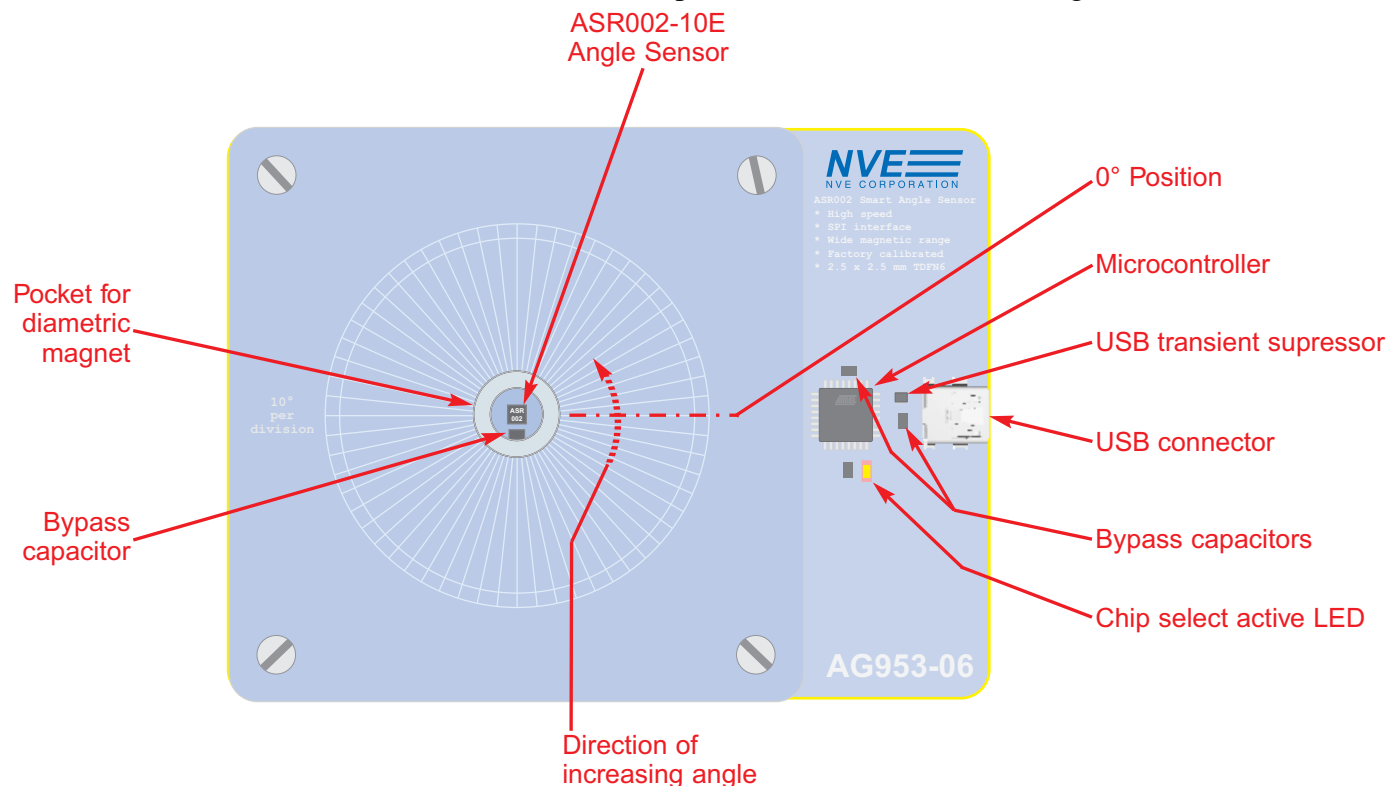


Figure 2. The Evaluation Board (actual size).

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

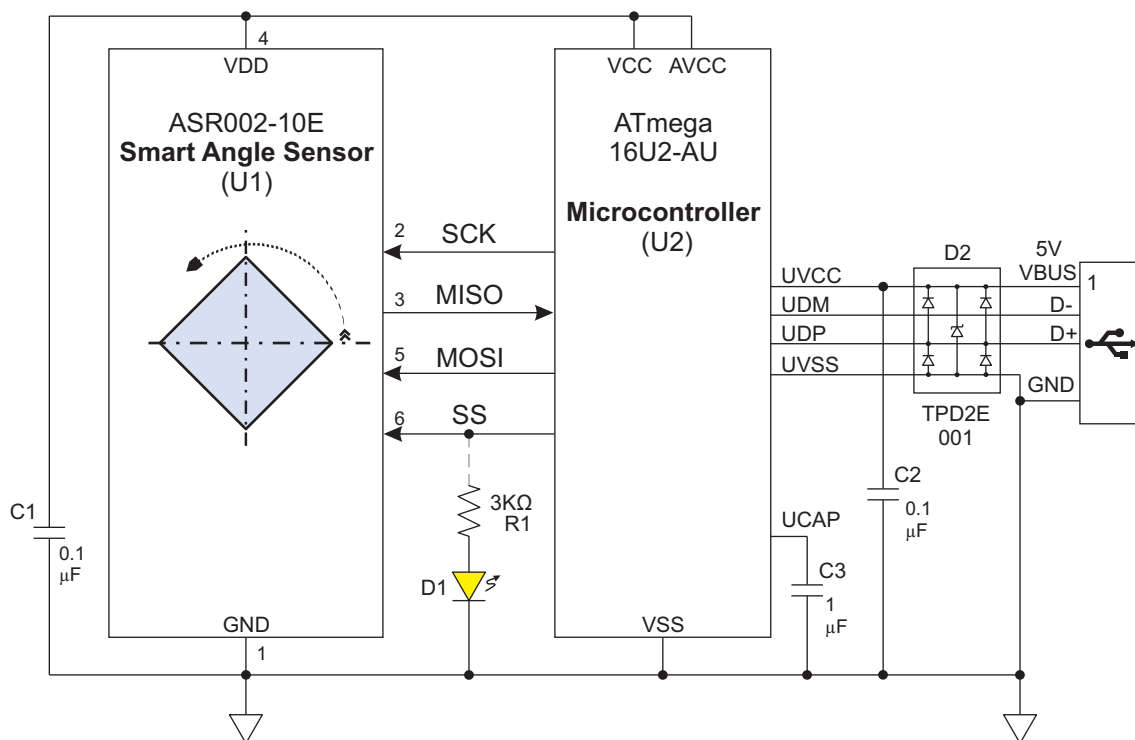


Figure 3. Evaluation Board Schematic.

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 Magnetism

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	Ferrite C5/Y25 disk magnet
12527	8	4	5	
12528	4	4	3	

*Included in this kit.

Table 1. Popular magnets for angle sensing.

We also offer machined magnet holders to hold disk magnets, which are compatible with this kit. Larger or stronger magnets require more distance to avoid oversaturating the sensor; smaller or weaker magnets may require closer spacing.

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 AG9524 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.

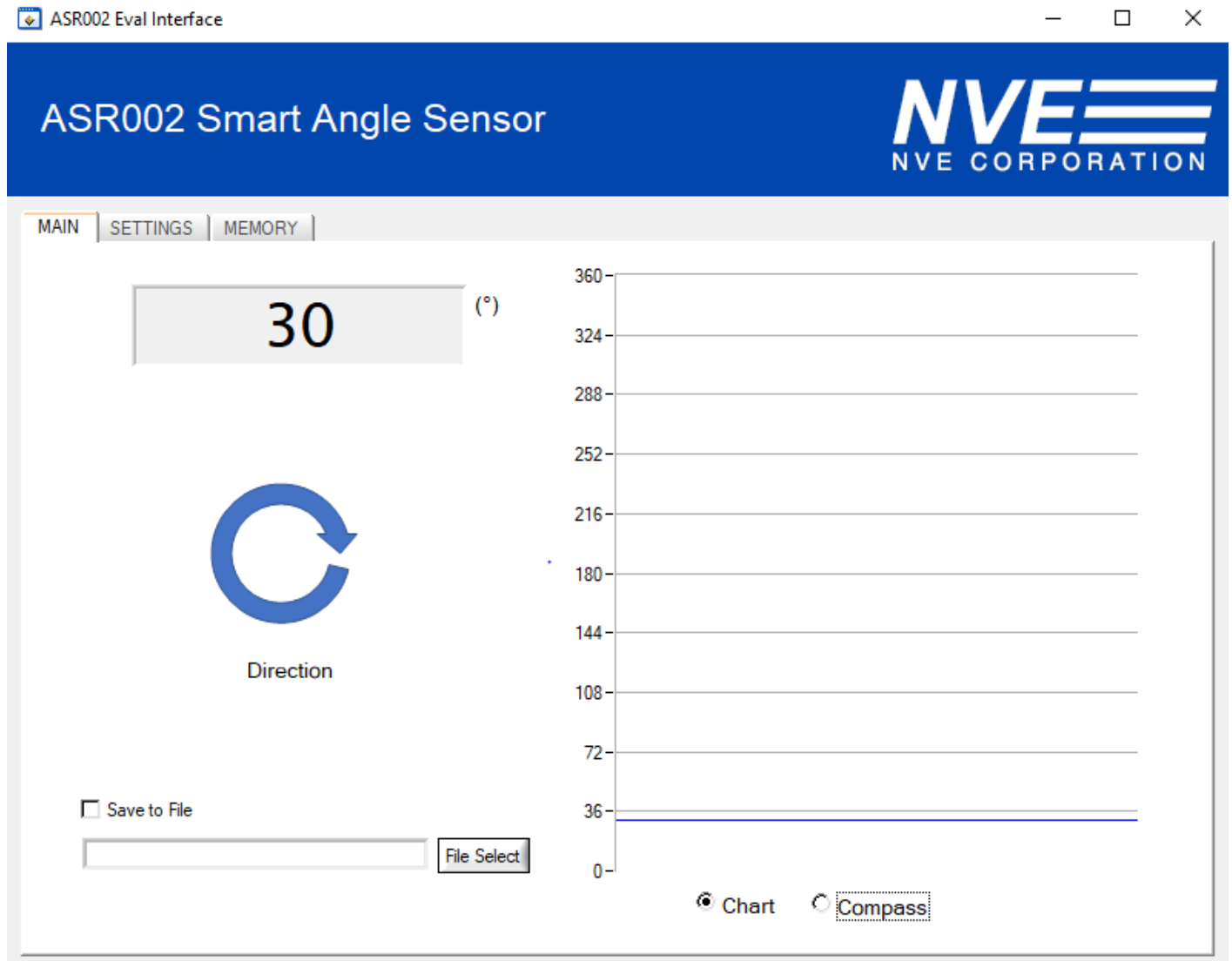
6. User Interface Operation

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 – A graphical interface to change the digital output threshold and its hysteresis.
3. Memory – A table shows the sensor's data and calibration constants. Parameters can be changed by double-clicking on the appropriate cell, typing in a new number, and hitting "Enter."

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 display changes the display precision.

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

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

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

Save to File – Saves a measurement session measured angle history to a file.

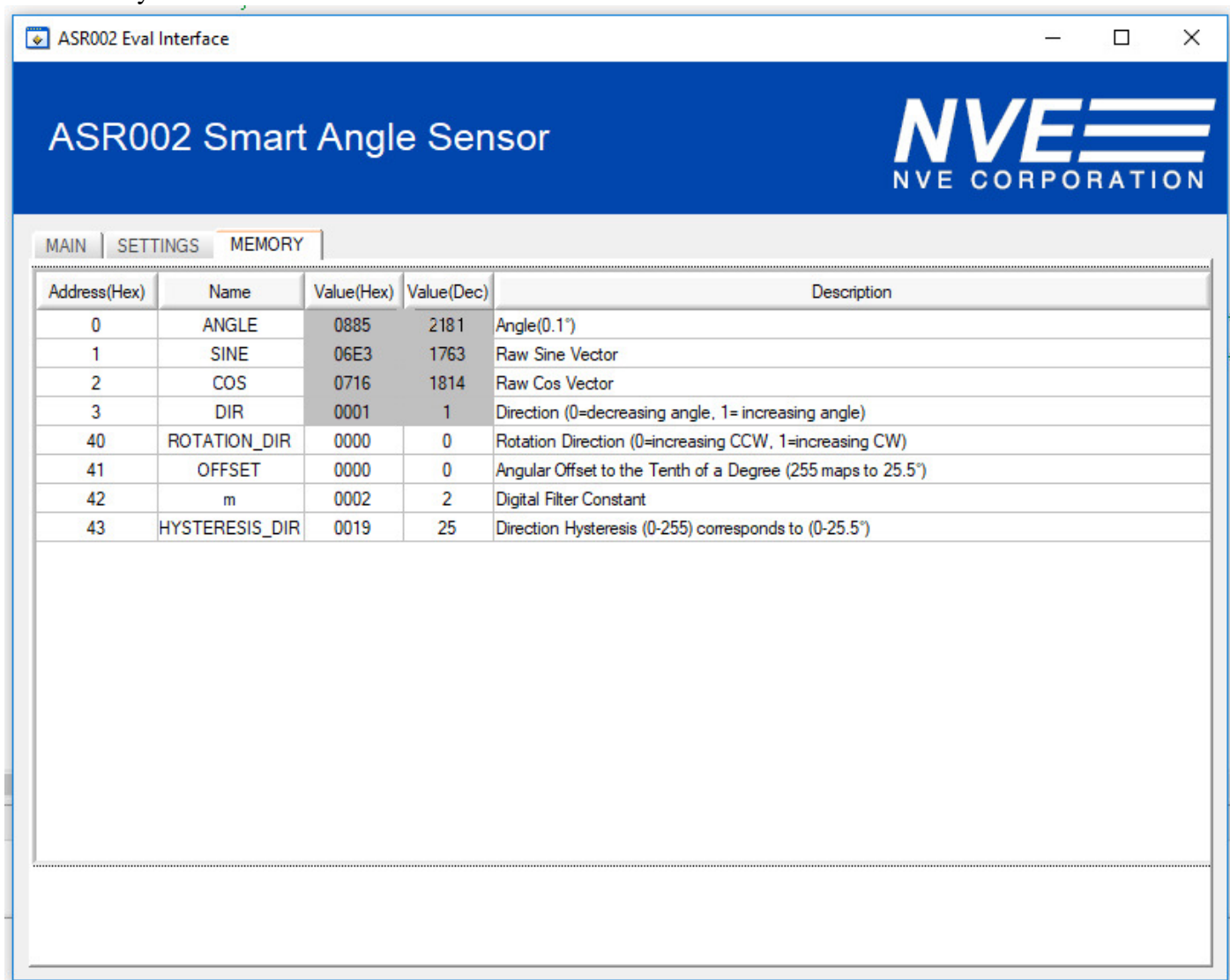
6.2. Settings Tab

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

Set Zero Angle (°) – Sets the Sensor’s angular offset. An angle value can be entered, or clicking on the button zeros the Sensor at its current position.

Set 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 in Hz 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 since the evaluation board is designed for lower speeds.

6.3. Memory Tab



Address(Hex)	Name	Value(Hex)	Value(Dec)	Description
0	ANGLE	0885	2181	Angle(0.1°)
1	SINE	06E3	1763	Raw Sine Vector
2	COS	0716	1814	Raw Cos Vector
3	DIR	0001	1	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	0002	2	Digital Filter Constant
43	HYSTERESIS_DIR	0019	25	Direction Hysteresis (0-255) corresponds to (0-25.5°)

This tab provides direct access to the Sensor's internal memory for reading and writing. Addresses 0 to 3 are Sensor outputs, and can only be read, not written. These outputs are two-byte (16 bit) unsigned integers. 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.

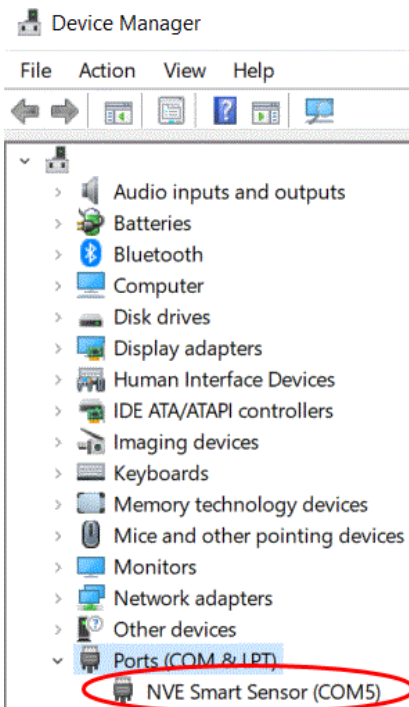
The user-settable parameters are in addresses 0x40 to 0x43, and can be read or written. All parameters are single byte with a range of 0 to 255. The sensor's parameter memory is nonvolatile, so the settings remain after power is removed.

7. Troubleshooting

➤ No communications

• Basic Steps

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



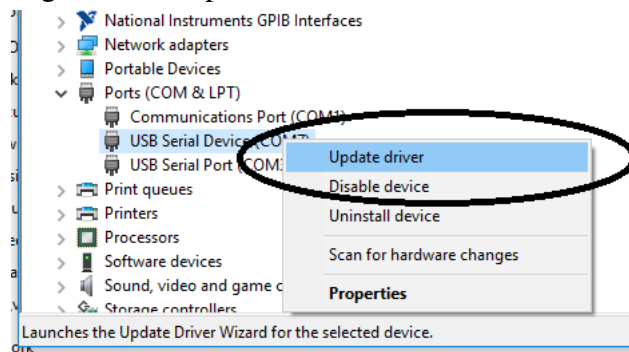
- Reinstall the USB driver.

• Manually set the driver

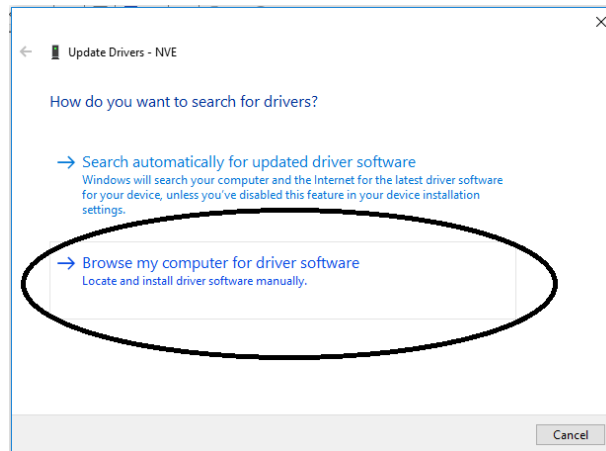
- Use Windows Device Manager to determine how the evaluation board USB is configured.

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

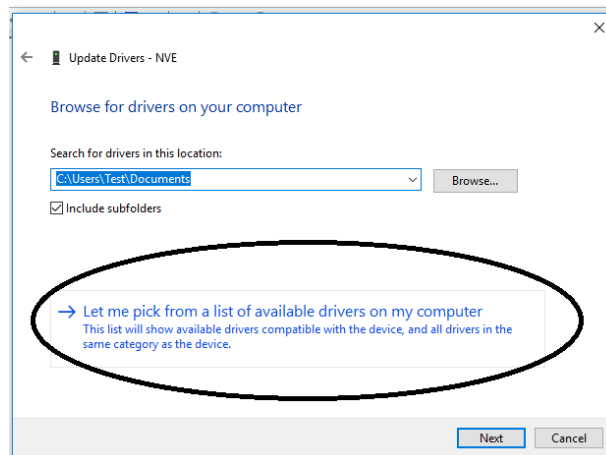
▪ Right click, “Update Driver”



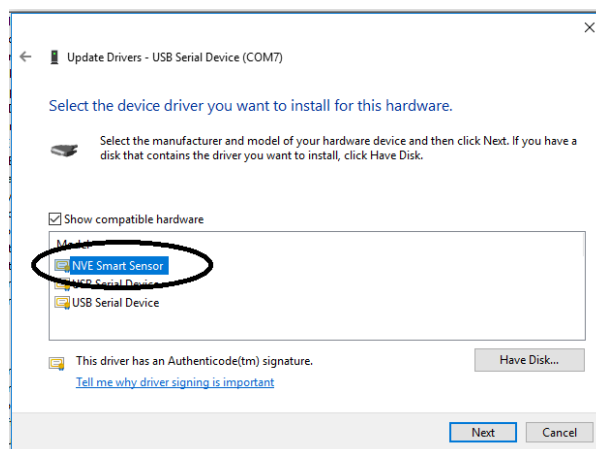
- Choose “Browse my computer for driver software”:



- 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

December 2018

Change

- Initial Release

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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

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