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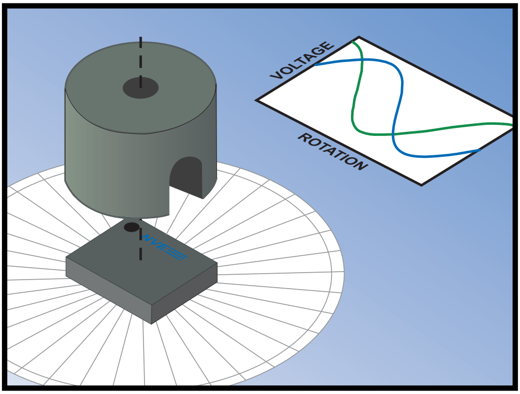
# AG933-07E
# AAT009 6MΩ Angle Sensor Evaluation Kit




SB-00-050

NVE Corporation (800) 467-7141 sensor-apps@nve.com www.nve.com

# Kit Overview

**Evaluation Kit Features**

- AAT009-10E ultralow-power angle sensor
- Part # 12426 split-pole Alnico 5 round horseshoe magnet
- Unity-gain op amp buffer
- 1.5 V to 5.5 V supply range
- Magnet locating fixture

**AAT009-10E Features**

- Tunneling Magnetoresistance (TMR) technology
- 6 MΩ typical bridge resistance for ultralow power
- 200 mV/V typical output signal
- 0.5 degree max. error (constant field)
- Wide magnet airgap tolerance
- Sine and cosine outputs for direction detection
- Ultraminiature 2.5 mm x 2.5 mm x 0.8 mm TDFN6 package

**AAT-Series Sensor Applications**

- Rotary encoders
- Motor shaft position sensors
- Internet-of-Things sensor nodes
- Battery or harvested power

| Part Number | Typ. Device Resistance | Features |
|---|---|---|
| AAT001-10E | 1.25 MΩ | Ultra-low power |
| AAT003-10E | 40 kΩ | Ideal for interface to microcontrollers |
| AAT009-10E | 6 MΩ | Ultra-ultra-low power |

**AAT009-10E Angle Sensor Description**

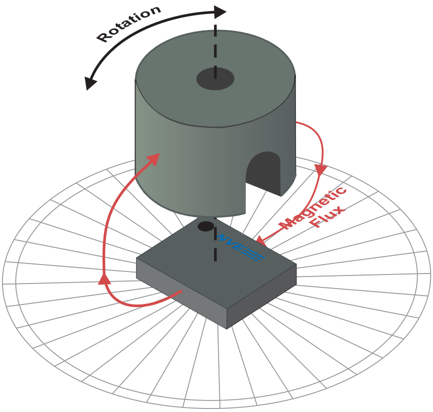
The AAT009-10E angle sensor is a ultralow power, high output magnetic sensor element for position measurements based on a rotating magnetic field.

Typical device resistance is 6 MΩ, minimizing power consumption and allowing years of operation from button cells or harvested power.

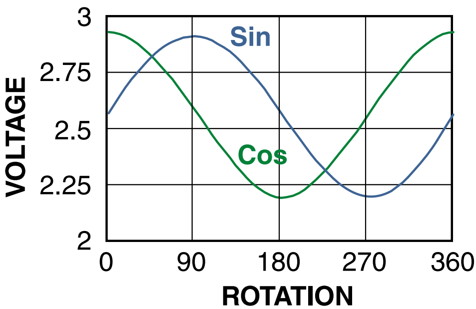
Visit **www.nve.com** for complete product specifications.

# Quick Start

⇒ Connect $V_{CC1}$ and $V_{CC2}$ to a 3.3 or 5 V supply.
⇒ Connect the "SIN" and "COS" screw terminals to an oscilloscope or to meters.
⇒ Place the split-pole magnet in the Plexiglas pocket.
⇒ Rotate the magnet.

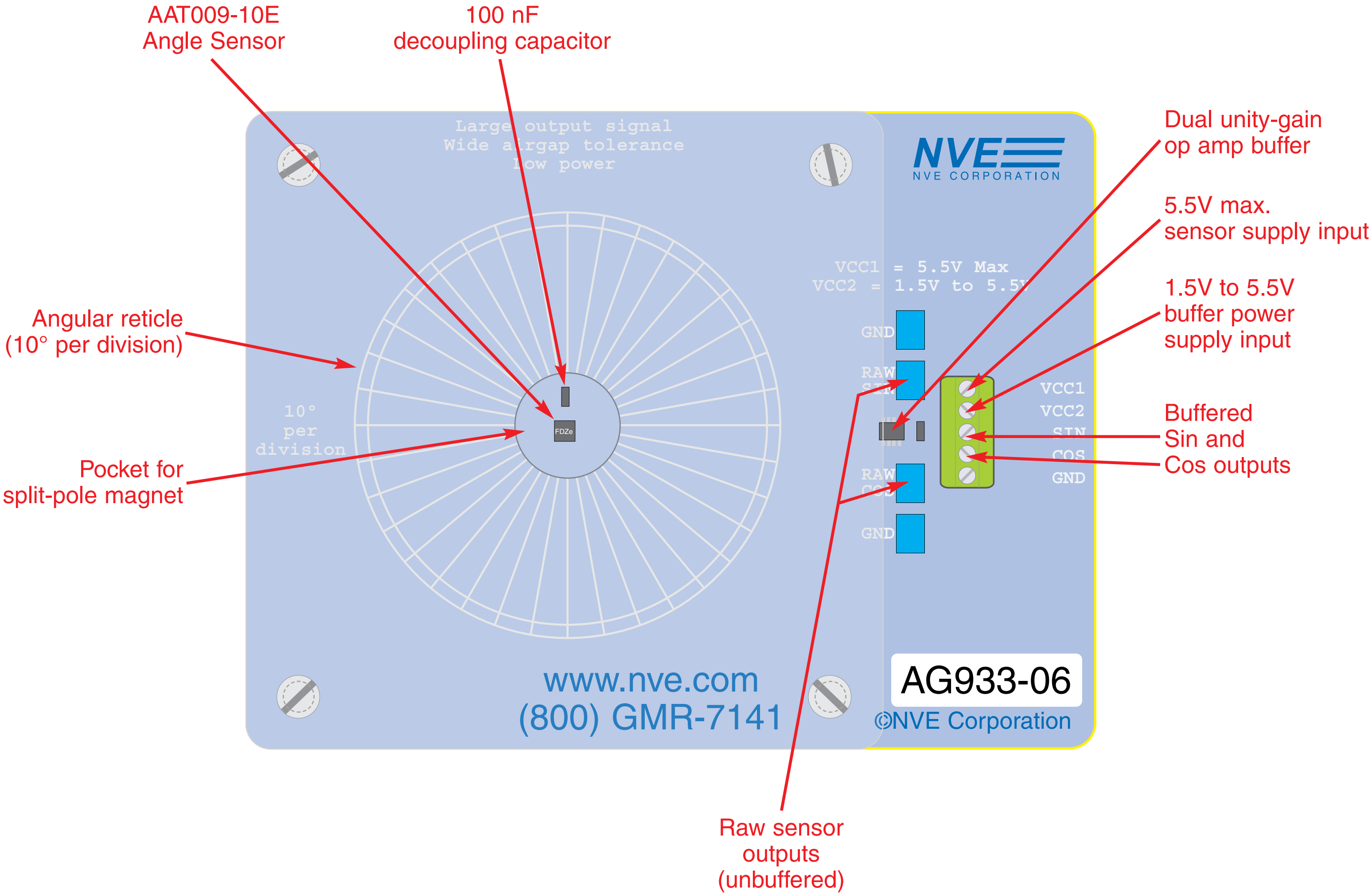



⇒ The outputs should be similar to the following graph:




The output is insensitive to magnet spacing over a wide range. Signal is lost if the magnet is too far away; if the magnet is too close the outputs will be non-sinusoidal. A relatively large magnet-sensor airgap is possible with the magnet provided with the kit, although smaller magnets will require a smaller gap.

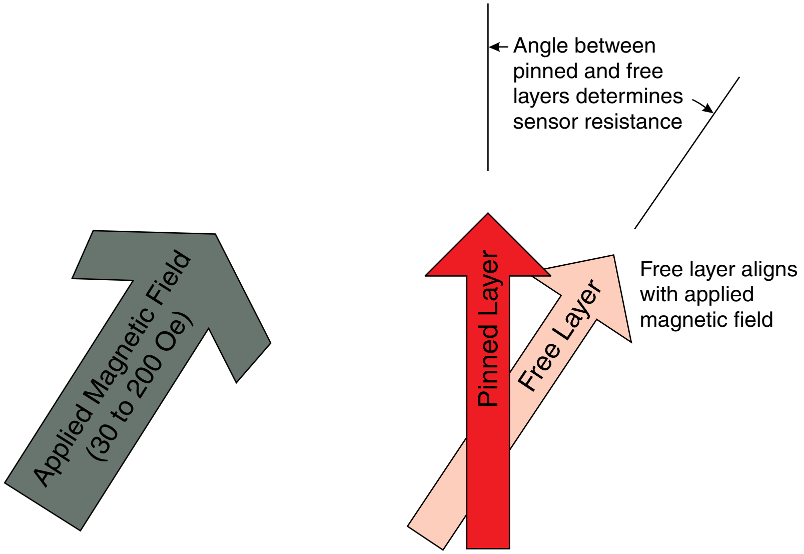
# Evaluation Board Layout



# Principles of Operation

Each of the four sensor elements contains two magnetic layers: a “pinned,” or fixed direction layer; and a movable-direction, or “free” layer. Internal sensor pairs are 90° out of phase to provide quadrature outputs.

The diagram below illustrates the configuration, using arrows to represent the magnetic orientation of the layers:

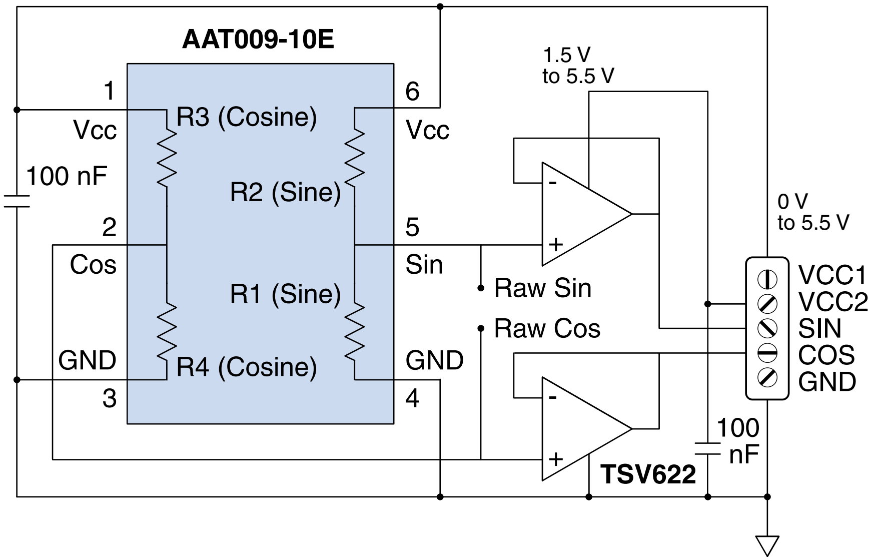



The sensor element free layers will align with the external field. As the applied field changes direction, the angle between the free layer and the pinned layer changes, changing the resistance of spintronic Tunneling Magnetoresistance (TMR) elements, which changes the device output voltages.

In the typical configuration, an external magnet provides a saturating magnetic field (30 to 200 Oe) in the plane of the sensor, as demonstrated in this kit.

Depending on the application, a bar magnet can also be used instead of a split-pole magnet.

# PCB Assembly




**AG933-07E Evaluation Kit schematic.**

The PCB assembly includes a unity-gain buffer for low-impedance outputs that prevent downstream electronics from loading the sensor bridge. Buffering may not be necessary in the end application depending on the impedance of downstream electronics.

Raw output signals from the AAT009 are also available as test points, however an unpowered buffer will load the sensor, so the buffer should be either powered or removed to use the raw outputs.

Separate supply connections for the sensor and op amp ($V_{CC1}$ and $V_{CC2}$) allow monitoring the sensor supply current only, or $V_{CC1}$ and $V_{CC2}$ can be connected together.

The op amp has a 1.5 V minimum supply voltage, while the sensor has no minimum. Sensitivity increases proportionately to the sensor supply voltage, as does current consumption.

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NVE Corporation
11409 Valley View Road
Eden Prairie, MN 55344-3617



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