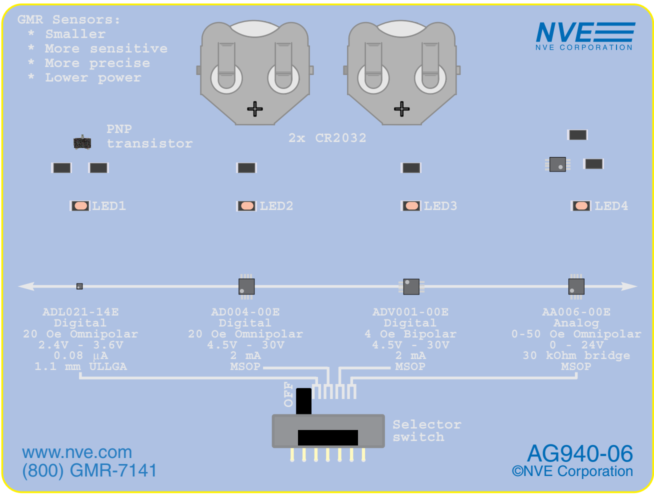
AG940-07E
Digital / Analog / Omnipolar / Bipolar GMR Magnetic Sensor Evaluation Kit



SB-00-051

Kit Overview

This kit contains:

- A battery-powered evaluation board with four of NVE's most popular GMR magnetic sensors driving indicator LEDs.

- A 0.5 x 0.25 x 0.125 inch (13 x 6 x 3 mm) Ceramic 8 bar magnet (NVE part no. 12030) to actuate the sensors.

- This manual.

	Part Number			
	ADL021-14E	**AD004-00E**	**ADV001-00E**	**AA006-00E**
Sensor Type	Digital	Digital	Digital	Analog
Sensing	20 Oe Omnipolar	20 Oe Omnipolar	4 Oe Bipolar	0 − 50 Oe Omnipolar
Supply Voltage	2.4 V − 3.6 V	4.5 V − 30 V	4.5 V − 30 V	0 − 24 V
Supply Current	0.08 μA	2 mA	2 mA	0.03 mA/V (30 kΩ)
Package	1.1 x 1.1 mm ULLGA	MSOP	MSOP	MSOP

The sensors are examples of digital, analog, omnipolar, and bipolar types:

GMR Sensor Advantages

- Smaller
- More sensitive
- More precise
- Lower power

GMR Sensor Applications

- Proximity sensors
- Medical devices
- Current sensing

Quick Start

⇒ Set the slide switch to the sensor you wish to use.
⇒ Position the magnet horizontally over the selected sensor to activate.
⇒ Turn the power OFF when not in use to preserve the batteries.

Visit ***www.nve.com*** *for product datasheets.*

Sensor Operation

Magnet Orientation

Unlike most other magnetic sensors, GMR sensors are sensitive in the plane of the IC (rather than orthogonal to the IC) as shown in Figures 3a and 3b. This is more convenient for most applications. *Omnipolar* sensors are activated by either a North or South field. *Bipolar* sensors turn on with one field polarity and off with the other. Most GMR sensors are sensitive along the length of the sensor, but some (such as the ADV001) are cross-axis sensitive. Therefore the ADV001 sensor is rotated 90 degrees relative to the other sensors on the board.

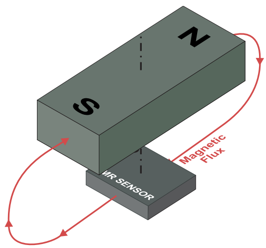


Fig. 3a. GMR sensitivity is in the IC plane.
This orientation activates bipolar sensors.
Either N-S orientation activates omnipolar sensors.

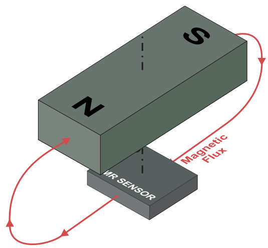


Fig. 3b. This orientation
deactivates bipolar sensors.

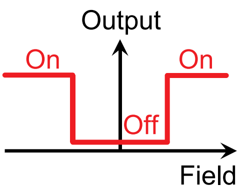


Fig. 4a. Digital omnipolar.

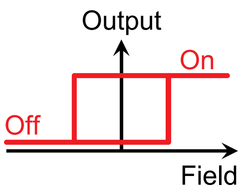


Fig. 4b. Digital bipolar.

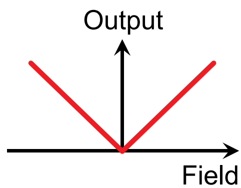


Fig. 4c. Analog omnipolar.

Magnetic Field and Distances

GMR sensors are quite sensitive, allowing large distances from the magnet. The 0.5 x 0.25 inch (13 x 6 mm) low-cost ceramic magnet supplied with this demo provides 20 Oe to operate the ADL021, AD004, and AA006 from approximately 0.5 inches (13 mm). The 4 Oe ADV001 operates at more than an inch (25 mm). Larger or stronger magnets (such as Alnico or rare earth) operate even farther away, while smaller or weaker magnets need closer spacings.

With its extreme sensitivity, the ADV001 can be spuriously acivated by a very close magnet due to remnant package magnetism. This is reversible—unlike some sensors, GMR sensors are not permanently affected by large fields.

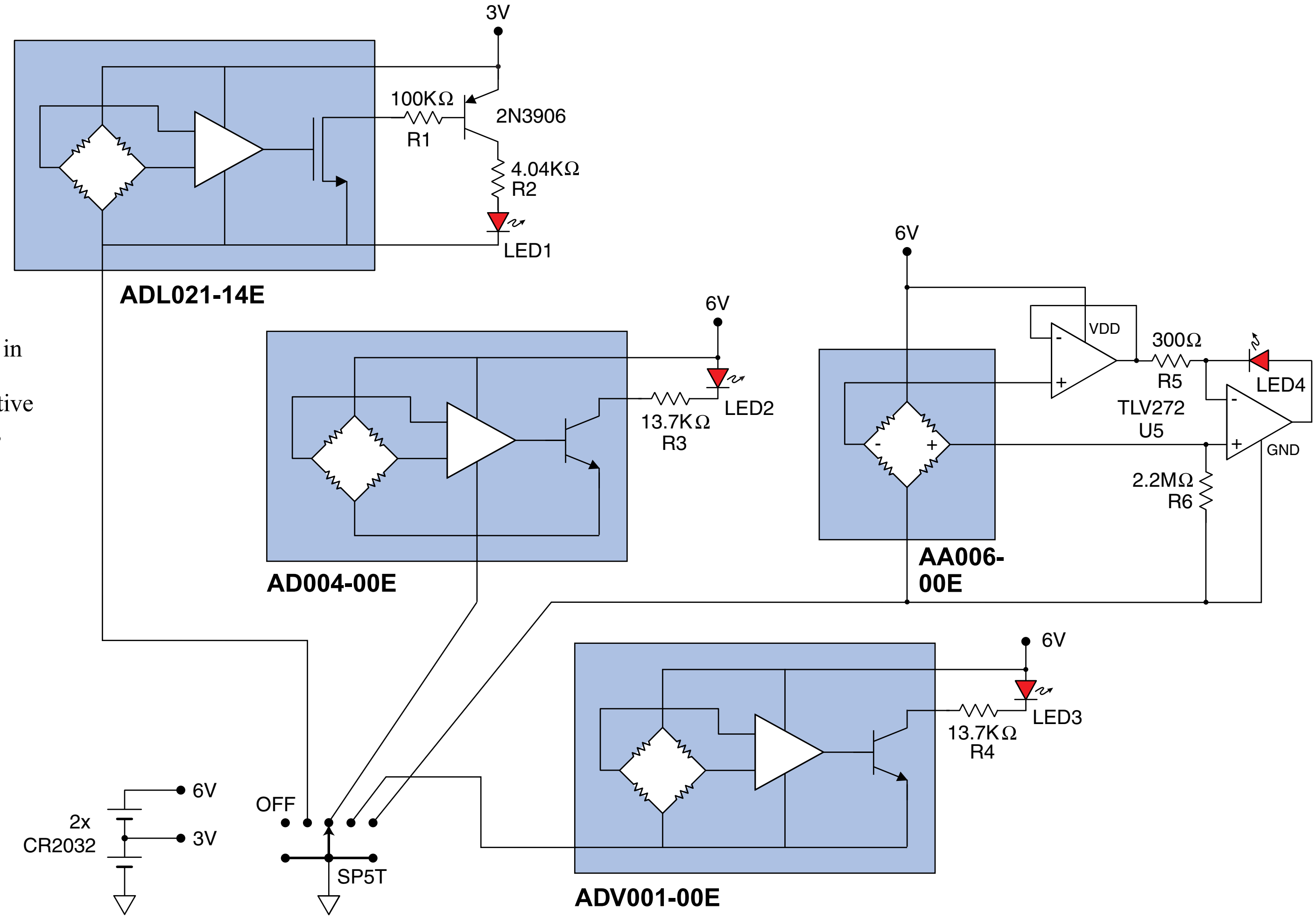
Evaluation Board Schematic

Two 3-volt lithium coin cells power the evaluation board. The ADL021, which has a 2.4V to 3.6V supply range, is powered by one cell (3V nominal); the other sensors are powered by both cells in series (6V nominal).

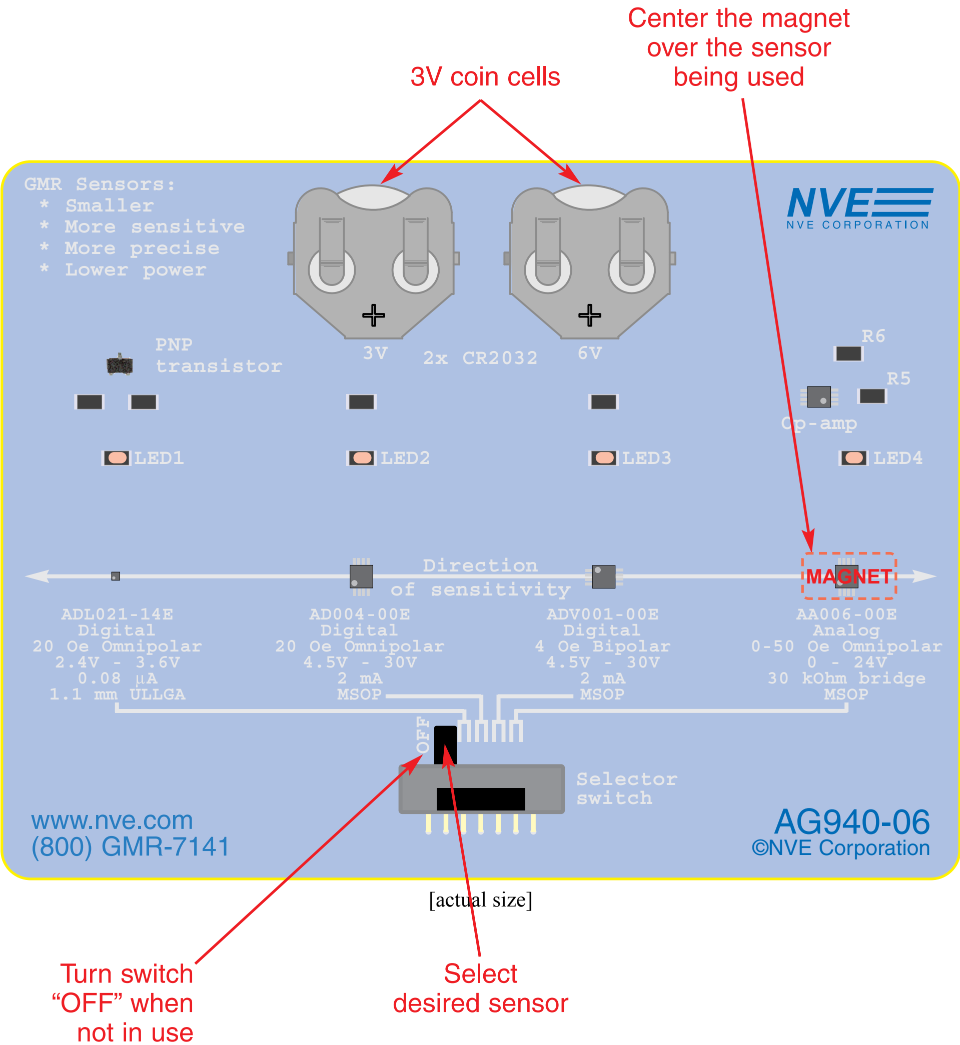
The switch selects the sensor to be powered by connecting the selected sensor and associated circuitry to the power supply ground return.

Each of the sensors drive an LED to indicate the output. The AD004 and ADV001 sensors have high current drivers, so no external circuitry is required for the LED. The ADL021 low-power sensor has an external transistor to drive its LED.

The AA006 analog sensor drives an op-amp current-follower to vary the LED brightness proportionally to the sensor output. The current in LED4 is equal to the differential analog sensor output divided by R5. R6 provides a small negative sensor bias so the LED is fully off with no field, even if the sensor or op-amp have slight offset voltages.



Board Layout



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*Visit **YouTube.com/NveCorporation** for a demonstration of this evaluation kit.*

How GMR Works

Revolutionary Technology

The key to NVE's sensors is Giant Magnetoresistance (GMR), which produces a large change in resistance in response to a magnetic field. "Giant" refers to the very large output signals. GMR resistance depends on the relative magnetic alignment of the ferromagnetic pinned and free layers separated by a conducting, non-magnetic spacer (see Figure 1a):

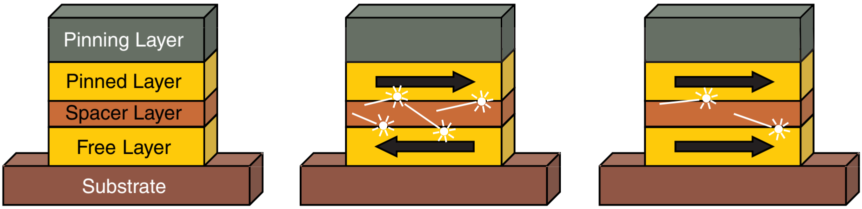

Fig. 1a. GMR Structure.

Fig. 1b. Anti-aligned magnetic moments (high resistance).

Fig. 1c. Aligned magnetic moments (low resistance).

The conducting spacer layer is typically less than two nanometers, or five atomic layers, thick.

Electrons scatter more frequently when their quantum spin differs from the magnetic orientation of the layer through which they are traveling, as in Figure 1b. If the magnetic moments of the ferromagnetic layers are aligned, as in Figure 1c, electron scattering is minimized and resistance is lowest. If the magnetic moments of the ferromagnetic layers are in opposing directions (anti-aligned), electron scattering is a maximum and resistance is highest.

Integrated Circuitry

NVE sensors are configured as Wheatstone bridges of GMR to increase sensitivity and cancel temperature variation. Digital sensors integrate GMR bridges with comparators. Ultralow power digital sensors (such as the ADL021 in this kit) add duty cycling and latching to minimize average power consumption.

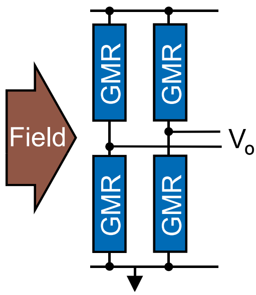

Fig. 2. Wheatstone bridge configuration.

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Manual No.: SB-00-051