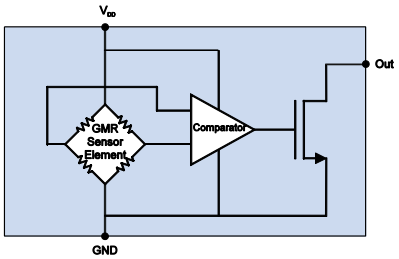
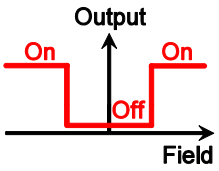
# ADMxxx Nanopower Digital Switches

## Functional Diagrams




ADMxxx

## Idealized Magnetic Response




## Features

- 2.4 V – 3.6 V operating voltage
- Operate points as low as 20 Oe
- Precise detection of low magnetic fields
- Ultraminiature 1.1 x 1.1 mm package

## Applications

- Portable instruments
- Utility meters
- Lithium cell powered applications

## Description

ADMxxx-Series sensors are Giant Magnetoresistive (GMR) Digital Switch devices designed to operate from 3.3-volt power supplies or single lithium cells with extremely supply low currents. The devices are manufactured with NVE's patented spintronic GMR technology and low-power CMOS circuitry for unmatched miniaturization, sensitivity, precision, and low power.

The output is configured as a magnetic "switch" where the output turns on when the magnetic field is applied, and turns off when the field is removed.

The applied field can be of either polarity, and the operate point is extremely stable over supply voltage and temperature. The output is current-sinking, and can sink up to 100 microamps.

## Absolute Maximum Ratings

| Parameter | Min. | Max. | Units |
|---|---|---|---|
| Supply voltage | | 5.5 | Volts |
| Output voltage | | 5.5 | Volts |
| Output current | | 200 | µA |
| Storage temperature | −65 | 135 | °C |
| Junction temperature | | 135 | °C |
| Applied magnetic field | | Unlimited | |

## Operating Specifications

| $T_{min}$ to $T_{max}$; 2.4 V < $V_{DD}$ < 3.6 V unless otherwise stated. | | | | | | |
|---|---|---|---|---|---|---|
| **Parameter** | **Symbol** | **Min.** | **Typ.** | **Max.** | **Units** | **Test Condition** |
| Supply voltage | $V_{DD}$ | 2.4 | 3 | 3.6 | Volts | |
| Operating temperature | $T_{MIN}$; $T_{MAX}$ | −40 | | 125 | °C | |
| Magnetic operate point | | | | | | |
| ADMx21 | $H_{OP}$ | 15 | 20 | 25 | Oe | |
| ADMx24 | | 21 | 28 | 34 | | |
| ADMx22 | | 30 | 40 | 50 | | |
| ADM934 | | 30 | 33.5 | 37 | | |
| Operate/release differential | $H_{OP}$−$H_{REL}$ | | | | | |
| ADMx2x | | 1 | | 14 | Oe | |
| ADM934 | | 1 | | 10 | | |
| Quiescent current | $I_{DDQ}$ | | 35 | 50 | µA | $V_{DD}$ = 2.4V |
| | | | 85 | 120 | | $V_{DD}$ = 3.6V |
| Output drive current | $I_{OL-ON}$ | 100 | | | µA | |
| Output low voltage | $V_{OL}$ | | | 0.2 | V | $V_{DD}$ = 3.6V; $I_{OL-ON}$ = 100 µA |
| Output leakage current | $I_{OL-OFF}$ | | | 0.005 | µA | |
| Frequency response | | | 100 | | kHz | |



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## Operation

**Direction of Magnetic Sensitivity**
As the field varies in intensity, the digital output will turn on and off. Unlike Hall effect or other sensors, the direction of sensitivity is in the plane of the package. The diagrams below show two permanent magnet orientations that will activate the sensor in the direction of sensitivity:

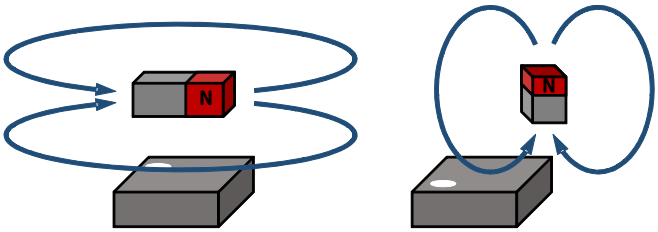


**Figure 1. Direction of magnetic sensitivity.**

ADM-Series sensors are “omnipolar,” meaning the outputs turn ON when a magnetic field of either magnetic polarity is applied.

**External Pull-Up Resistor**
Outputs are logic low when the sensor is activated. The outputs are open-drain, and should have an external pull-up resistor. For microcontroller interfaces, the microcontroller’s input pull-up resistors can be activated.



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## Illustrative Application Circuits

***Direct-Drive LED Indicator***

Although ADMxxx sensors are not capable of driving legacy LEDs, high-efficiency LEDs such as the APT3216LSECK are visible with the 100µA drive current provided by the sensors without an external driver.

This circuit illustrates a sensor powered by a single lithium button cell with a surface-mount indicator LED:

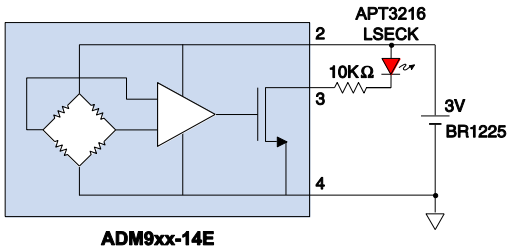


**Figure 2. Typical ADMxxx-14E application.**

***Two-Wire Sensor Interface Using a Voltage Regulator***

ADM-Series sensors are perfect for two-wire applications, because their low supply voltage and low quiescent current provide plenty of design margin. Two-wire interfaces need to operate over a wide power supply range. With the sensor off, the circuit must draw a minimal residual current, typically less than 1.5 milliamps. With the sensor on, the circuit must provide enough current to drive a significant load such as a motor or solenoid:

In this circuit, when a magnetic field is applied to the sensor, the MOSFETs turn on, turning on the LED and powering the load. This circuit uses an NVE DC001-10 regulator, which provides better regulation and operating latitude over the input voltage range than a Zener diode.

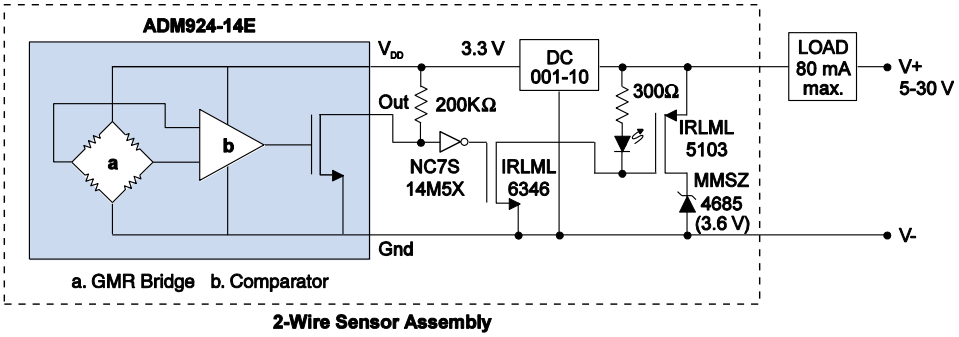


**Figure 3. Typical two-wire circuit.**

With no magnetic field and the sensor off, the residual current of the circuit is dominated by the DC001 regulator's quiescent current, which is less than one milliamp and relatively constant over input voltage. The Zener diode provides enough voltage to power the circuitry when the load is powered.



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## Typical Performance

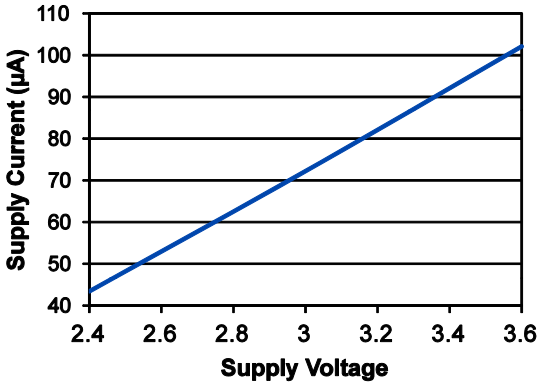


**Figure 4. Typical supply current vs. supply voltage (ADM9xx; 25°C).**

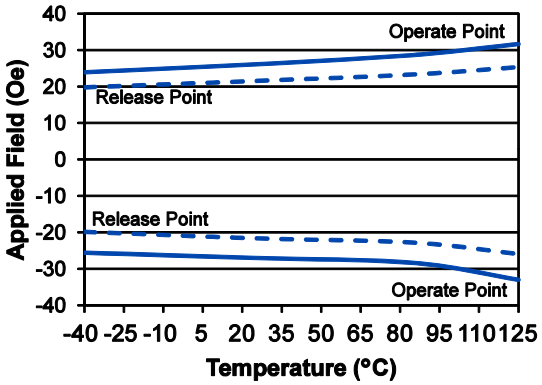


**Figure 5. Typical magnetic operate and release points vs. temperature (ADM924; Vdd=3V).**

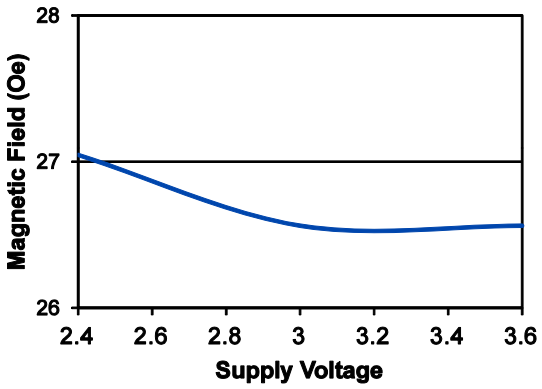


**Figure 6. Typical magnetic operate point vs. supply voltage (ADM924; 25°C).**



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## Part Numbering

**ADM 9 21 - 14E**

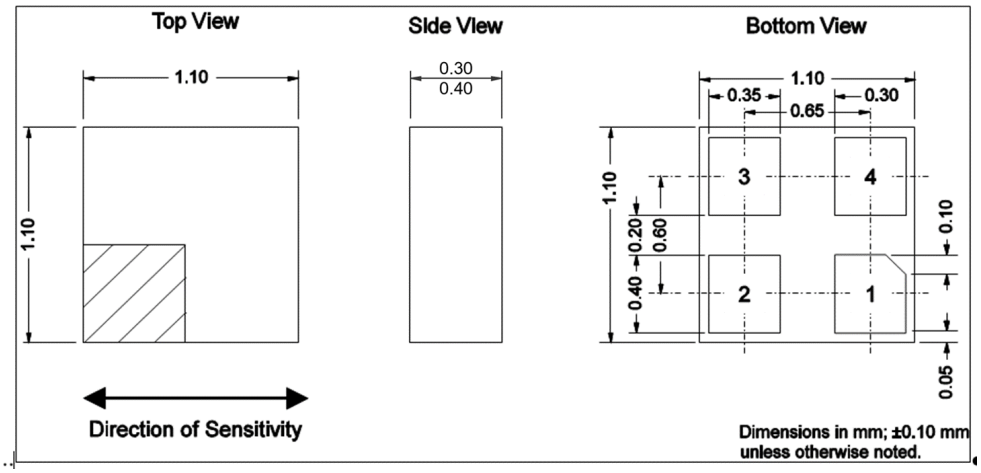
**Base Part**
ADM = 2.4V – 3.6 V
Low-Hysteresis
Nanopower digital switch

**Duty Cycling**
9 = Continuous operation

**Typ. Magnetic Operate Point**
21 = 20 Oe
22 = 40 Oe
24 = 28 Oe
34 = 33.5 Oe

**Package Type**
14E = 1.1 mm x 1.1 mm ULLGA (RoHS)

## 1.1 mm x 1.1 mm ULLGA Package (-14E suffix)




RoHS COMPLIANT

*These products have been tested for electrostatic sensitivity to the limits stated in the specifications. However, NVE recommends that all integrated circuits be handled with appropriate care to avoid damage. Damage caused by inappropriate handling or storage could range from performance degradation to complete failure.*



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## Revision History

**SB-00-062**
May 2018

**Addition**
- Added part number ADM934.

**SB-00-062**
September 2017

**Change**
- Changed package marking for ADM922 and ADM924.

**SB-00-062**
March 2017

**Change**
- Initial Release.



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SB-00-062

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