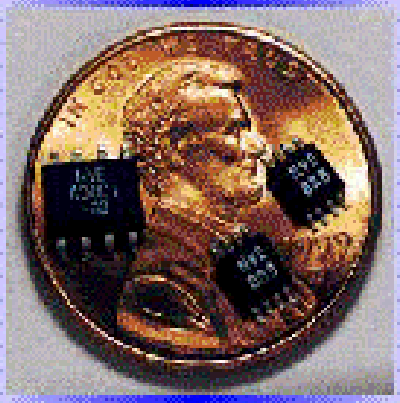
NVE
SENSOR PRODUCTS DIVISION

AD Series

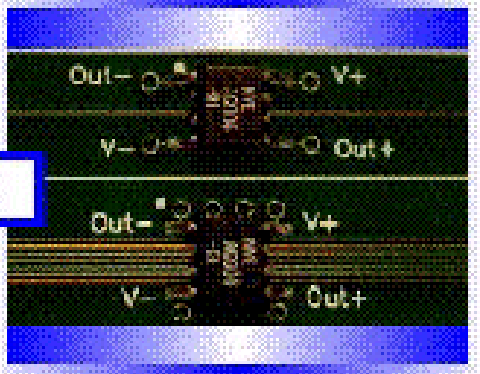
GMR Switch™

Precision Digital Magnetic Sensors



Speed

Position

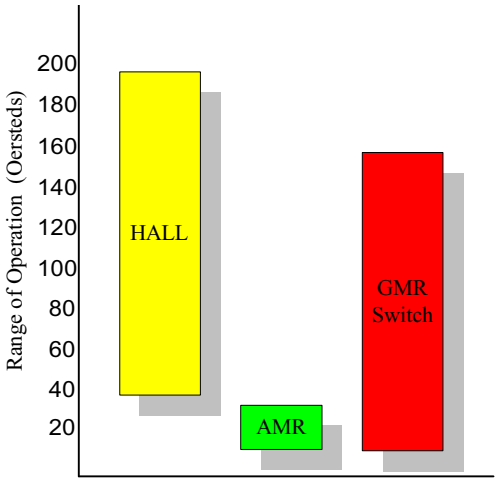


Current Sensing

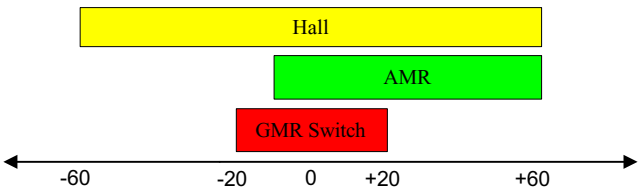
NVE
SENSOR PRODUCTS DIVISION

The GMR Switch Advantage

When GMR materials are integrated with digital on-board electronics, the result is the GMR Switch. The GMR Switch offers unmatched high performance and flexibility in magnetic field sensing.



The GMR Switch operates over a wide range of magnetic fields.



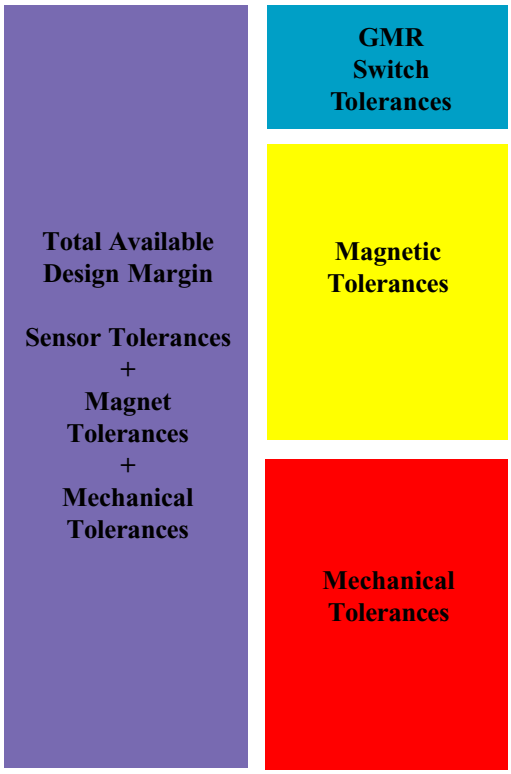
Typical Operate Point Error Band (%)
4.5 to 30 VDC -40 to +125 °C

The GMR Switch features a smaller error band than any other magnetic sensor on the market .

GMR Switch™ = Larger Design Margin

The GMR Switch will accurately and reliably sense magnetic fields, with less error than any other magnetic sensor on the market today. In addition, there is minimal shift in the magnetic field operate point of the GMR Switch over both voltage and temperature extremes. This gives the manufacturer the ability to make a high precision, high tolerance magnetic sensing assembly.

The GMR Switch is the clear choice when a digital output signal is required of a magnetic field sensor.



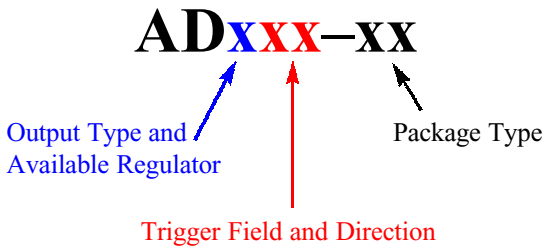
Nonvolatile Electronics, Inc. 11409 Valley View Road Eden Prairie, Mn 55344-3617 USA Telephone: 1-800-467-7141 Fax: (952) 829-9189 Internet: www.nve.com

GMR Switch Products Selection Guide

NVE's GMR Switch is available in a wide range of packaging, output type, and magnetic trigger field varieties. The purpose of this application note is to explain the different output and packaging options as well as provide information on how to specify the correct part number when ordering.

All NVE GMR Switch product part numbers follow the same general form. As shown in Figure 1 the first 'x' in the part number ADxxx–xx specifies output type, the next two x's specify trigger field and direction of sensitivity, and the last pair specify the package type. The following three sections define these numbers in detail.

Figure 1



Output Type, Available Regulator

The first numeric digit of the part number ADxxx–xx specifies the output type, and the availability of a regulated voltage supply on a separate pin. The following four output types are available:

- 20 mA Current Sink
- 20 mA Current Source
- Separate 20 mA Current Sink & 20 mA Current Source
- Two Separate 20mA Current Sinks

All of these outputs turn ON when the magnetic field is applied. (In some situations, it may be desirable to have an output that turns OFF when the magnetic field is applied. While such a sensor is not available as a standard product, it could be available as a custom product; please consult NVE.)

Some of NVE's GMR Switch products also feature a regulated supply voltage available external to the part, on a separate pin. This regulator provides a 5.8V reference capable of supplying up to 3 mA of drive current. This regulated output may be used to run an LED or any other low power device.

The following table defines the first digit in the AD part number.

ADxxx–xx

Number	Meaning
0	20 mA Current Sink
1	20 mA Current Source
2	Separate 20mA Current Sink and 20mA Current Source
3	Two Separate 20mA Current Sinks
4	20 mA Current Sink + External Regulated Voltage
5	20 mA Current Source + External Regulated Voltage
6	Separate 20mA Current Sink and 20mA Current Source + External Regulated Voltage
7	Two Separate 20mA Current Sinks + External Regulated Voltage

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Magnetic Trigger Field and Direction of Sensitivity

The second and third numeric digits of the part number (ADxxx–xx specify the magnetic trigger field and direction of sensitivity of the part. Four different magnetic trigger fields are available for the GMR Switch Products:

· 20 Gauss (20 Oersted, 2.0 mTesla, 1.6 kA/m)
· 28 Gauss (28 Oersted, 2.8 mTesla, 2.23 kA/m)
· 40 Gauss (40 Oersted, 4.0 mTesla, 3.2 kA/m)
· 80 Gauss (80 Oersted, 8.0 mTesla, 6.4 kA/m)

Other magnetic trigger field levels, from 10 Gauss to 250 Gauss, are available on a custom basis; please consult NVE.

The following table defines the second and third digits in the AD part number:

ADxxx-xx

Number	Meaning
04	20 Gauss, Standard Direction of Sensitivity
05	40 Gauss, Standard Direction of Sensitivity
06	80 Gauss, Standard Direction of Sensitivity
20	28 Gauss, Standard Direction of Sensitivity
21	20 Gauss, Cross Axis Direction of Sensitivity
22	40 Gauss, Cross Axis Direction of Sensitivity
23	80 Gauss, Cross Axis Direction of Sensitivity
24	28 Gauss, Cross Axis Direction of Sensitivity

Package Type

NVE GMR Switch products are available in two different packages: an SOIC small outline package, and a TSSOP ultra-small outline package. GMR Switch products are not available in die form; however, NVE is able to do chip-on-board assembly in cases where GMR Switch products must be placed on extremely small PCBs, and the TSSOP package is too large; please consult NVE on these applications. In addition, custom package modifications are available; please consult NVE for details.

The following table defines the last two digits in the AD series part number:

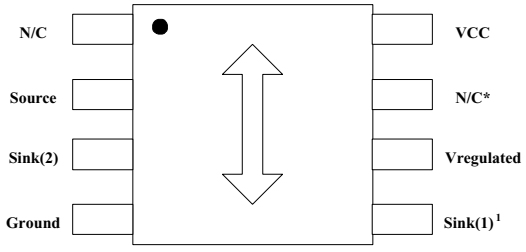
ADxxx–xx

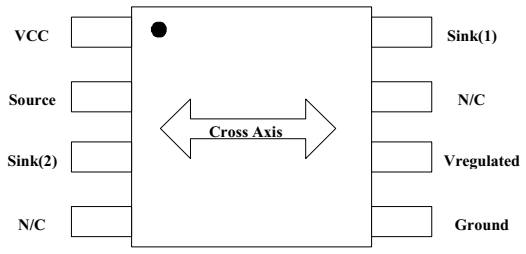
Number	Meaning
-00	TSSOP Package
-02	SOIC Package

This part numbering system allows for 128 different products based on the GMR Switch. Since it is impractical for NVE to stock all 128 different products, not all part numbers are available from inventory. In order to serve the broadest possible customer base, NVE stocks many of these part numbers. If a part is not currently in inventory, a six week lead time for delivery is required. In some cases, minimum order quantities apply.

AD Series Pin Configurations

Two directions of sensitivity are available with all parts. "Standard" direction of sensitivity is defined as the direction parallel to the edge of the package containing the pins. "Cross Axis" direction of sensitivity is defined as the direction perpendicular to the edge of the package containing the pins.





Package Marking: All SOIC packaged parts (-02 part number suffix) are marked with the correct part number on the package. Due to the limited space available on the TSSOP package (-00 part number suffix), these parts are marked with a code. See NVE for code information.

Note[1]: In the case of a standard axis part with the Vregulated pin option, Sink(1) will appear at the pin labelled N/C*.

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Magnetic Characteristics

Magnetic Specifications are listed for the minimum and maximum ranges over temperature and voltage

Nominal Operate Point (Oersteds)	Minimum Operate Point (Oersteds)	Maximum Operate Point (Oersteds)	Minimum Differential[1] (Oersteds)	Maximum Differential[1] (Oersteds)
20	15	25	5	14[2]
28	21	34	5	20[2]
40	30	50	5	25
80	60	100	5	35

Absolute Maximum Ratings

Parameters	Symbol	Min.	Max.	Units
Supply Voltage	V_{CC}		33	Volts
Reverse Battery Voltage	V_{RBP}		-33	Volts
Current Sinking Output Off Voltage			33	Volts
Current Sourcing Output Off Voltage			0	Volts
Current Sinking Reverse Output Voltage			-0.5	Volts
Current Sourcing Reverse Output Voltage			-0.5	Volts
Continuous Output Current	I_O		24	mA
Operating Temperature Range	T_A	-40	125[3]	ºC
Storage Temperature Range	T_S	-65	150	ºC
Magnetic Field	H		Unlimited[4]	Oersteds

Electrical Specifications

Electrical Specifications are T_{min} to T_{max} unless otherwise stated.

Parameter	Symbol	Min.	Max.	Units	Test Condition
Supply Voltage[3]	V_{CC}	4.5	30	V	Operating
Supply Current, Single Output GMR Switch	I_{CC}	2.5	4.5	mA	Output off V_{CC} = 12V
Current Sinking Output[2]	I_O	0	20	mA[5]	Operating
Current Sourcing Output[2]	I_O	0	20	mA[5]	Operating
Output Leakage Current	I_{LEAK}		10	µA	Output off V_{CC} = 12V
Sinking Output Saturation Voltage	V_{OL}		0.4	V	Output on I_{OL} = 20mA
Sourcing Output Saturation Voltage	V_{OH}		V_{CC}-2.5	V	Output on I_{OL} = 20mA
Regulated Output Voltage	V_{REG}	3.5	6.0	V	Operating
Regulated Output Current	I_{REG}		3.0	mA	Operating

Notes:

1. Differential = Operate Point-Release Point
2. Minimum release point = 5 Oe
3. Thermal power dissipation of the packages used by NVE is 240ºC/Watt for the SOIC package, and 320ºC/Watt for the TSSOP package. Figure 3 shows ambient temperature vs. supply voltage derating curves for both packages in free air, with a single output. Heat sinking parts by attaching to a PCB improves temperature performance.
4. There is no maximum field that will damage device.
5. Outputs must be current limited through a series resistor. Exceeding absolute maximum continuous output current ratings will result in damage to the part. Also, see Figure 2 for an output current derating curve.
6. If $V_{CC} \geq 6.6V$ than $V_{REG} \approx 5.8V$. If $V_{CC} \leq 6.6V$ than $V_{REG} \approx V_{CC}$-0.9V.

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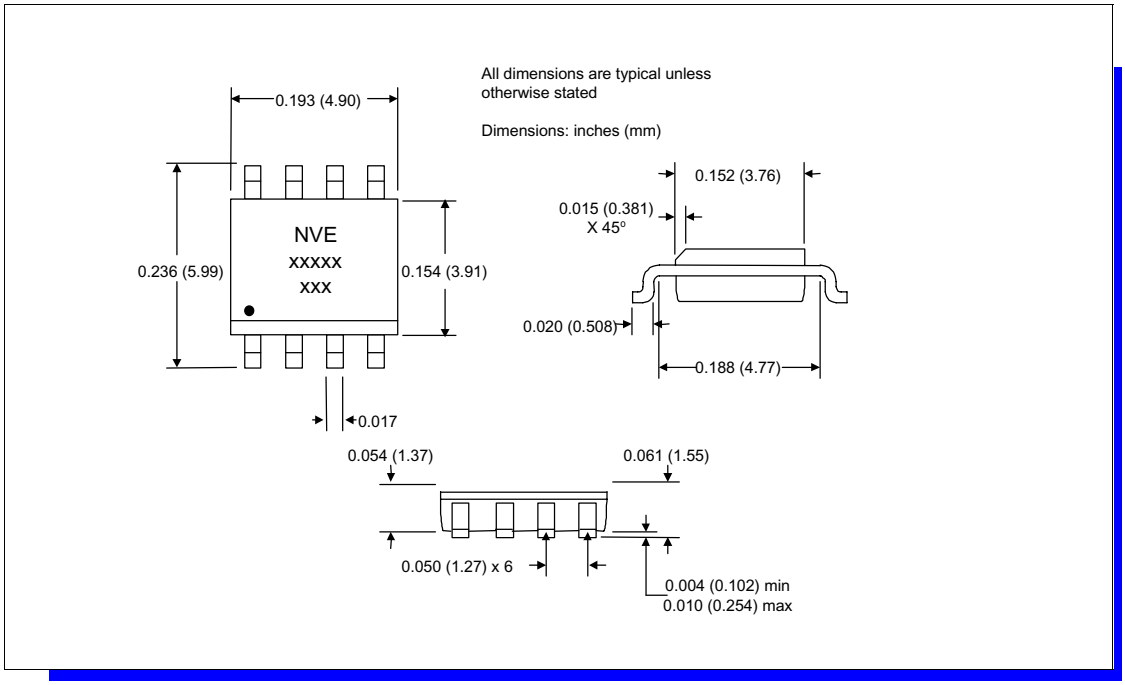
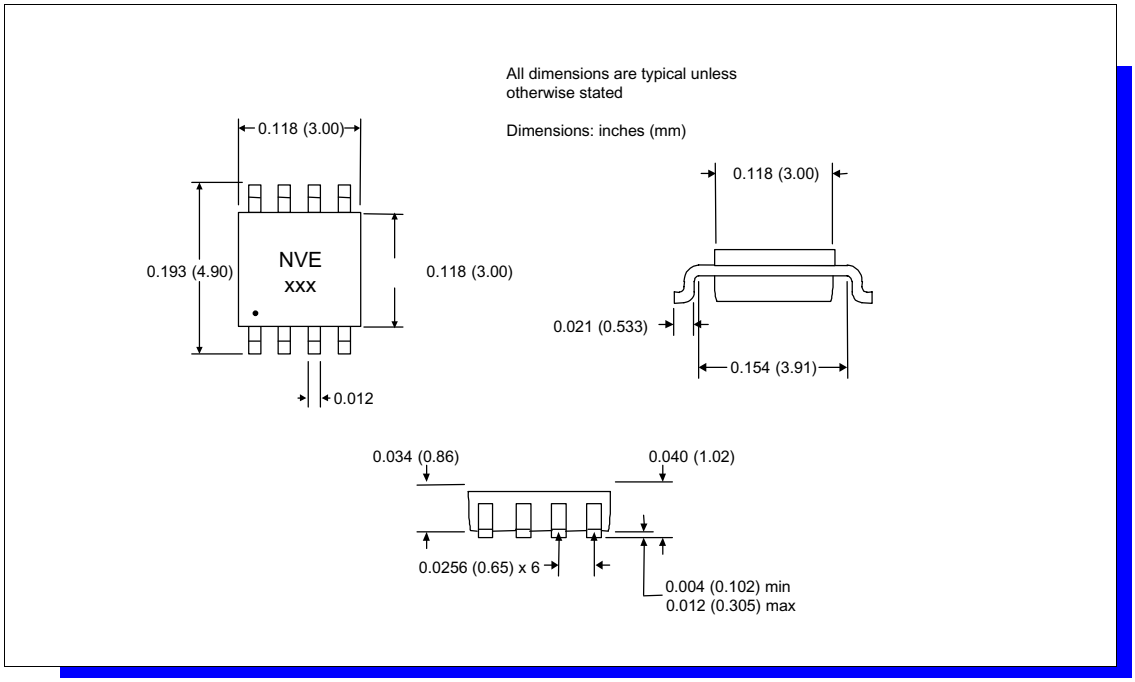
SOIC–8 package



TSSOP–8 Package



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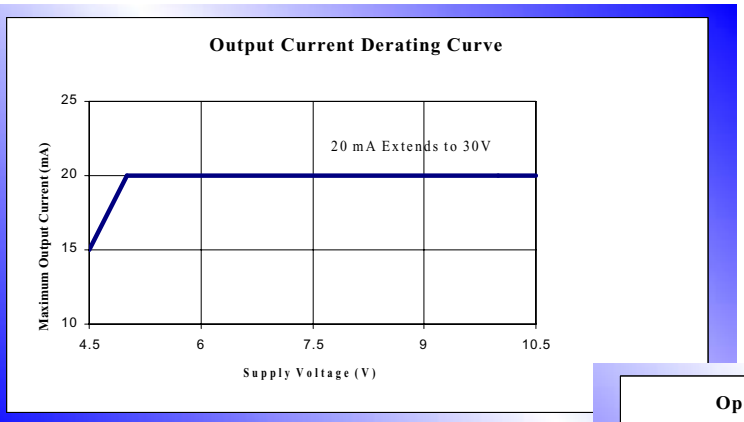


Figure 2

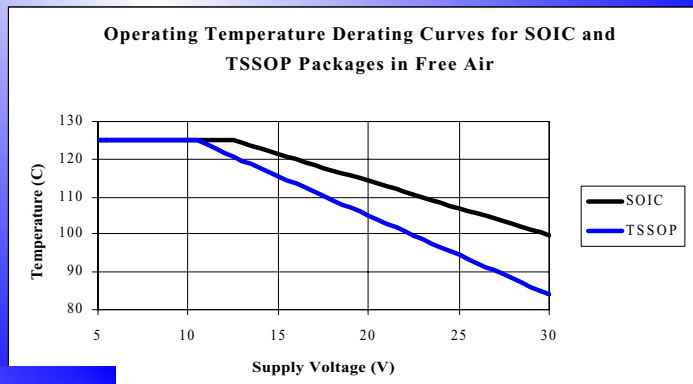
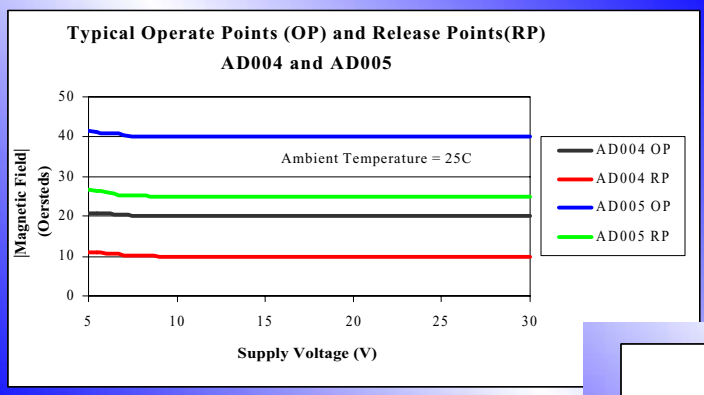
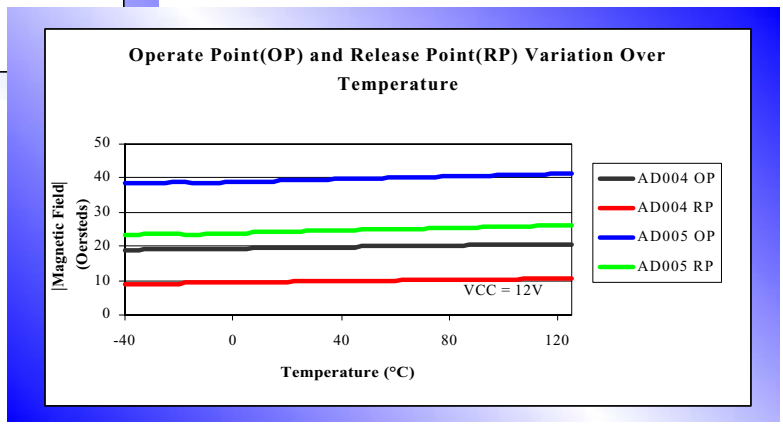


Figure 3





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About NVE

An ISO 9001 Certified Company

Nonvolatile Electronics, Inc., (NVE) is a high technology components manufacturer having the unique capability to combine leading edge Giant Magnetoresistive (GMR) materials with integrated circuits to make novel electronic components. Products include Digital Magnetic Field Sensors, Linear Magnetic Field Sensors, Differential Magnetic Field Sensors (Gradiometer), Digital Signal Isolators and Isolated Bus Transceivers.

NVE is a leader in GMR research and in 1994 introduced the world's first products using GMR material, a line of GMR magnetic field sensors that can be used for position, magnetic media, wheel speed and current sensing.

NVE is located in Eden Prairie, Minnesota, a suburb of Minneapolis. Please visit our Web site at www.nve.com or call 1-800-467-7141 for information on products, sales or distribution.

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