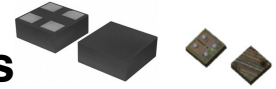
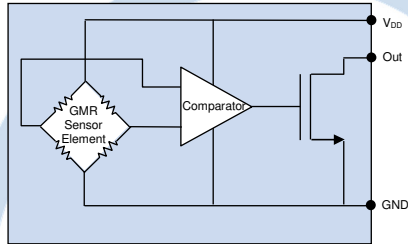


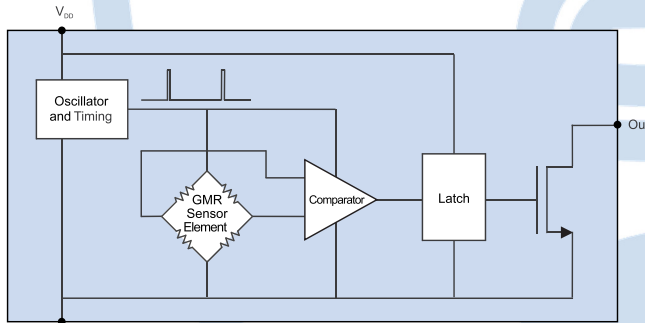
Medical-Grade Magnetic Switch Sensors



Functional Diagrams



BD9xx
(continuous duty)



BD0xx / BD1xx / BDL122NC
(duty-cycled)

Features

- Operate points as low as 0.5 mT and as high as 350 mT
- Low hysteresis to prevent magnetic latching
- 0.9 V to 2.4 V and 2.4 V to 3.6 V operating voltages
- Power as low as 29 nW
- 1.1 x 1.1 mm DFN4 and 0.65 x 0.65 mm wafer-level, chip-scale packages

Applications

- Implantable medical devices
- Continuous glucose monitoring
- Endoscopy power switch
- Medical instruments
- Hearing aids

Description

BD-Series sensors are medical-grade xMR magnetic switches manufactured with NVE's patented spintronic technology for unmatched miniaturization, sensitivity, precision, and low power.

Most versions are normally open, so the output connects to ground when the magnetic field is applied. A normally-closed version is also available. An integrated latch ensures the output is available continuously in duty-cycled versions.

A variety of operating points as well as custom operate points are available. The applied field can be of either polarity, and the operate points are extremely stable over supply voltage and temperature. The outputs current-sinking, and can sink up to 100 microamps.

MRI-correct versions are available that are guaranteed to provide correct outputs in fields up to 3 tesla. All NVE medical sensors can withstand magnetic fields up to 9 tesla without damage.

The products consist of a GMR or TMR sensor element, CMOS signal processing circuitry to convert the analog sensor element output to a digital output, and an oscillator and timing circuit for duty cycling. Continuous-duty, high-speed versions without the oscillator are also available.

Rigorous Testing

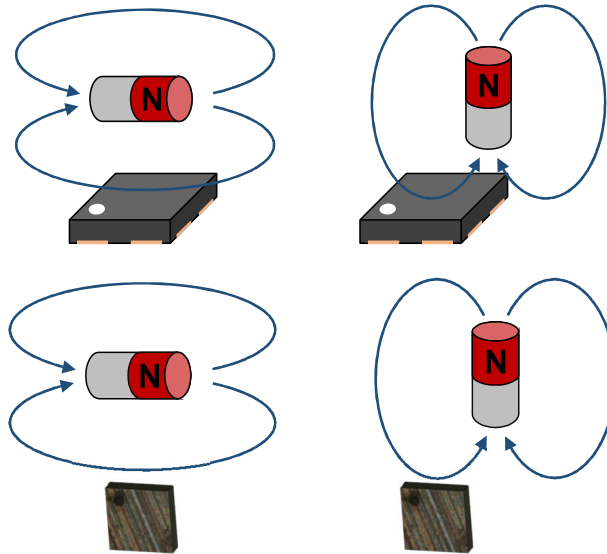
All parts are 100% tested for electrical and magnetic parameters. To ensure quality and reliability in medical applications, BDxxx parts are preconditioned and tested as follows:

- 100% of the parts receive a 24-hour bake at 150°C prior to final test.
- 100% visual inspection of the parts in the tape after final test.
- Lot qualification test where 200 parts that have passed final test from each production lot are exposed to two thermal cycles using a standard solder reflow profile, then re-tested for correct operation. All parts must pass for the parts to be accepted into inventory.

In-Plane or Omnidirectional Sensitivity

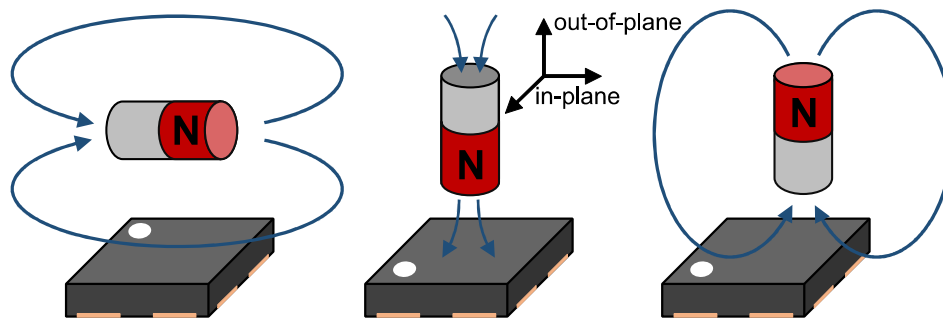
As the field varies in intensity, the digital output will turn on and off. The sensors are “omnipolar,” meaning the outputs respond equally to magnetic field of either north or south polarity.

BD0xx, BD1xx, and BD9xx sensors are sensitivity in the plane of the package, unlike Hall-effect sensors. The diagrams below show two permanent magnet orientations that will activate the sensor in the direction of sensitivity:



BD0xx/BD1xx/BD9xx in-plane sensitivity.

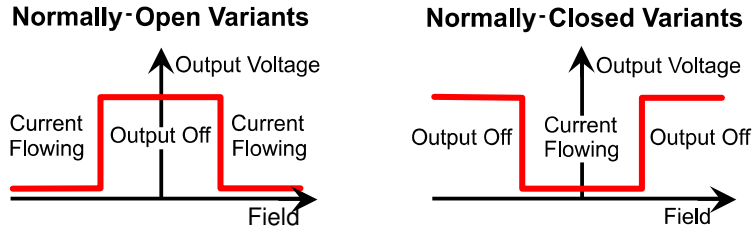
The BDK991-14E and BHK991-14E are omnidirectional, meaning they are sensitive to magnetic fields in any direction, so multiple sensors are not needed for orthogonal or unknown directions of applied fields:



BDK991/ BHK991 omnidirectional sensitivity.

Normally Open and Normally Closed Variants

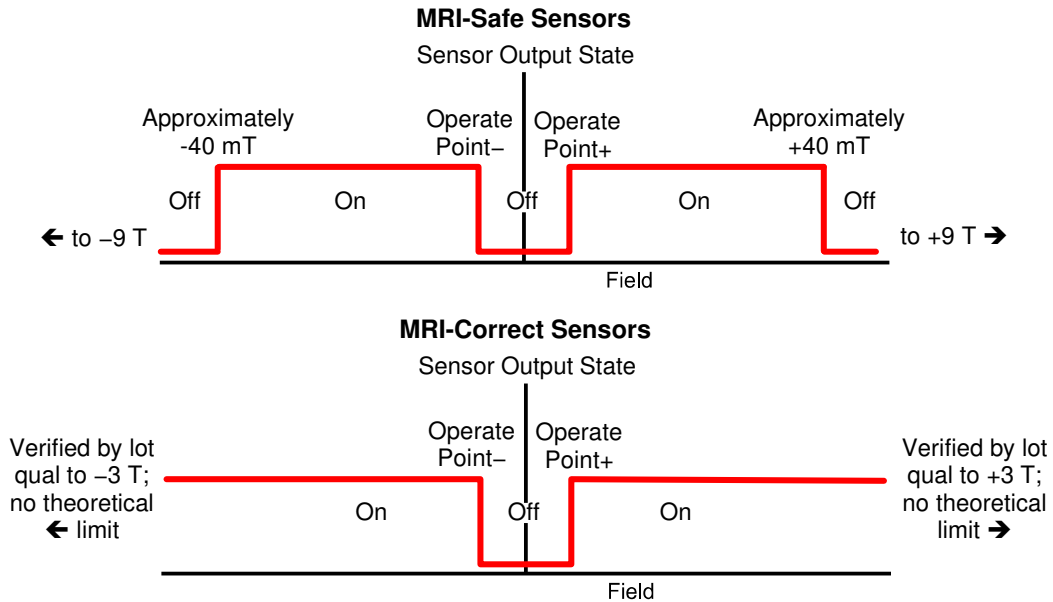
Most sensor outputs are normally open, but parts with the “NC” suffix are normally closed. The normally-closed configuration is useful in applications such as activating electronics when they are removed from a case, or activating sealed electronics in single-use medical devices:



Definition of output state for medical-grade sensors.

MRI Safety

NVE’s medical-grade sensors have been rigorously tested to ensure they cannot be damaged by magnetic fields of any strength up to 9 tesla. Not all sensors will maintain the correct output state when the magnetic field exceeds a certain threshold, typically beginning around ± 40 mT, however. NVE medical sensors can be characterized as either MRI Safe or MRI Correct. All NVE medical sensors are MRI Safe, but only select medical sensors are designed to also be MRI Correct. If the output state needs to be sampled while inside an MRI machine, the sensor should be MRI Correct.



Popular Parts

Part Number	Operate Point	Power Consumption	Duty Cycled or Continuous Duty	Package	Features
BD020-14E	1.3 mT	2.4 to 3.6 V 30 nA	Duty-cycled	1.1 x 1.1 x 0.45 mm DFN4	Precise operate point
BD024-14E	1.4 mT	2.4 to 3.6 V 30 nA	Duty-cycled	1.1 x 1.1 x 0.45 mm DFN4	Precise operate point
BD027-14E	1.5 mT	0.9 to 2.4 V 32 nA	Duty-cycled	1.1 x 1.1 x 0.35 mm DFN4	Industry standard
BD028-14E	1.6 mT	0.9 to 2.4 V 32 nA	Duty-cycled	1.1 x 1.1 x 0.35 mm DFN4	Precise operation point
BD032-14E	1.6 mT	0.9 to 2.4 V 32 nA	Duty-cycled	1.1 x 1.1 x 0.45 mm DFN4	MRI-Correct output to 3 Tesla
BD036-14E	2.8 mT	0.9 to 2.4 V 32 nA	Duty-cycled	1.1 x 1.1 x 0.35 mm DFN4	Robust high operate point
BD121-14E	2 mT	2.4 to 3.6 V 50 nA	Duty-cycled	1.1 x 1.1 x 0.45 mm DFN4	MRI-Correct output to 3 Tesla
BD129-14E	2 mT	2.2 to 3.6 V 25 nA	Duty-cycled	1.1 x 1.1 x 0.35 mm DFN4	MRI-Correct output to 3 Tesla 100% tested at 2.1 V
BD927-14E	1.5 mT	0.9 to 2.4 V 15 μ A	Continuous duty	1.1 x 1.1 x 0.35 mm DFN4	High speed 100 kHz bandwidth
BD940-14E	1.5 mT	0.9 to 1.8 V 0.2 μ A	Continuous duty	1.1 x 1.1 x 0.35 mm DFN4	TMR for low power; high speed 3 kHz bandwidth
BDL122NC-14E	4 mT	2.4 to 3.6 V 30 nA	Duty-cycled	1.1 x 1.1 x 0.35 mm DFN4	Normally Closed High Temperature
BDK991-14E	320 mT	2.4 to 3.6 V 1.5 μ A	Continuous duty	1.1 x 1.1 x 0.35 mm DFN4	TMR for low power; high speed 20 kHz bandwidth; omnidirectional sensitivity
BHK991-14E	350 mT	0.9 to 1.8 V 1 μ A	Continuous duty	1.1 x 1.1 x 0.35 mm DFN4	TMR for low power; high speed 3 kHz bandwidth; omnidirectional sensitivity

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