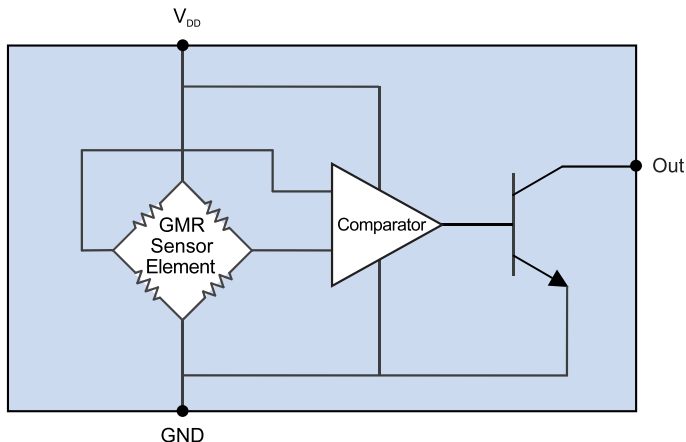
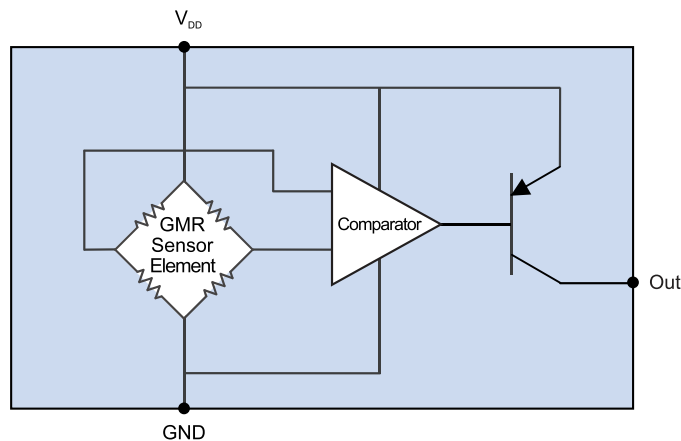


Low Voltage, Low Power Digital Magnetic Sensors

Functional Diagrams



Sinking Output Versions
(AFLx0x-xx/AFLx1x-xx)



Sourcing Output Versions
(AFLx2x-xx/AFLx3x-xx)

Features

- Digital outputs
- Low power
- Precision magnetic operate points as low as 4 Oe (0.4 mT)
- Versions for 1 V through 5 V nominal supplies
- Omnipolar response
- Temperature and voltage stability
- Frequency response to 100 kHz
- TDFN6 and MSOP8 packages

Applications

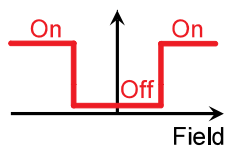
- Motion, speed, and position control
- Proximity sensing
- Portable instruments
- Utility meters
- Noncontact overcurrent protection
- Battery-powered applications

Description

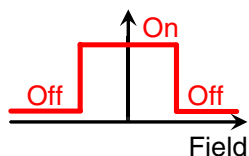
AFL-Series Sensors are GMR digital switches designed to run at low voltages and currents. Versions are available that can operate from single-cell batteries. The outputs switch at specified magnetic fields, and return when the fields are removed.

The sensors are three-terminal devices, available with either current-sinking or sourcing outputs, normally off or normally on configurations, and several supply voltage options.

Idealized Transfer Functions



Normally Off
(AFLx0x-xx/AFLx3x-xx)



Normally On
(AFLx1x-xx/AFLx2x-xx)

Absolute Maximum Ratings

Parameter	Symbol	Min.	Max.	Units
Operating temperature		-20	85	°C
Storage temperature		-65	150	°C
ESD (Human Body Model)			2000	Volts
Applied magnetic field	H _{MAX}		Unlimited	Oe

Operating Specifications

Over specified Vcc and temperature range otherwise stated.						
Parameter	Symbol	Min.	Typ.	Max.	Units	Test Condition
Supply voltage	V _{CC}	See table of available parts.				
Operating temperature	T _{MIN} ; T _{MAX}	-20		85	°C	
Magnetic operate point	H _{OP}				Oe*	
AFLxx0-xx		7	10	13		
AFLxx1-xx		15	20	25		
AFLxx2-xx		21	28	34		
AFLxx5-xx		4	7	10		
AFLxx6-xx		3	4	6		
Operate/release differential	H _{OP} -H _{REL}				Oe*	
AFLxx0-xx		1		6		
AFLxx1-xx		3		10		
AFLxx2-xx		3		10		
AFLxx5-xx		4		10		
AFLxx6-xx		1		3		
Supply current	I _{CC}				µA	Max. I _{CC} specified at V _{CC} = 1.3V Over specified V _{CC}
AFL00x-xx		20	35	55		
AFL02x-xx		30	50	75		
AFL03x-xx		15	35	55		
AFL10x-xx		25	35	45		
AFL20x-xx		30	35	45		
AFL30x-xx		30	40	50		
Output current	I _{O-ON}	100			µA	
Output voltage	Sinking (AFLx0x-xx/AFLx1x-xx)	V _{OL}		0.2	V	
	Sourcing (AFLx2x-xx/AFLx3x-xx)	V _{OH}	V _{CC} -0.15			
Output leakage current	I _{O-OFF}			0.1	µA	Output Off
Frequency response	f _{MAX}		100		kHz	
Junction-Ambient Thermal Resistance (TDFN6 or MSOP8 package)	θ _{JA}		320		°C/W	Soldered to double-sided board; free air

*1 Oe = 0.1 mT in air.

Operation

Plane and 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. Standard AFL-Series sensors are sensitive “cross-axis,” that is, across the pins from pin 1 to pin 6 or 8. The diagrams below show two magnet orientations that will activate the sensor in the direction of sensitivity:

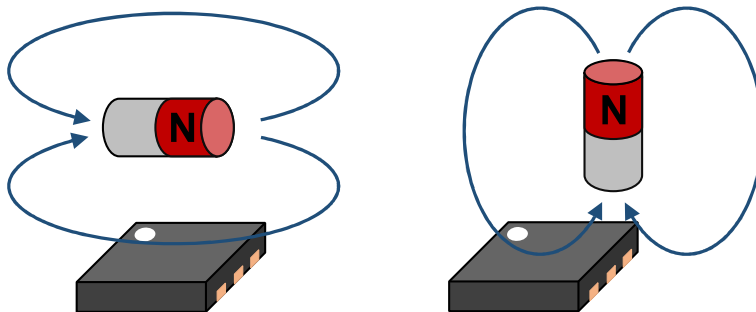


Figure 1. Plane and direction of magnetic sensitivity

Omnipolar

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

Normally OFF and Normally ON Versions

For normally OFF versions, the output turns ON when the field exceeds the magnetic operate point, and OFF when the field drops below the operate point minus the release differential. Normally ON versions turn OFF when the field exceeds the operate point and ON when it drops below the operate point minus the differential.

External Pull-Up Resistor

AFL-Series outputs are open collector, with PNP output transistors for sourcing versions and NPN transistors for sinking versions. Outputs should have external pull-up or pull-down resistors. For microcontroller interfaces, the microcontroller’s input pull-up resistors can be activated.

Typical Operation

A typical proximity sensor using an AFL006 sensor and magnet is shown below. The AFL006 is the most sensitive magnetic switch, with a 4 Oe typical operate point, and actuates with a rare-earth magnet at more than two inches (50 mm) from the sensor:

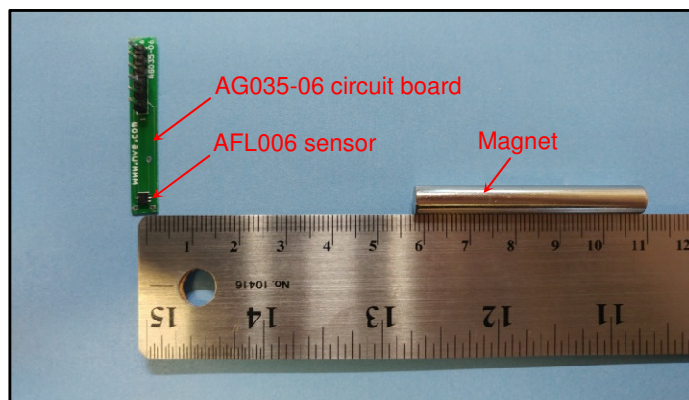


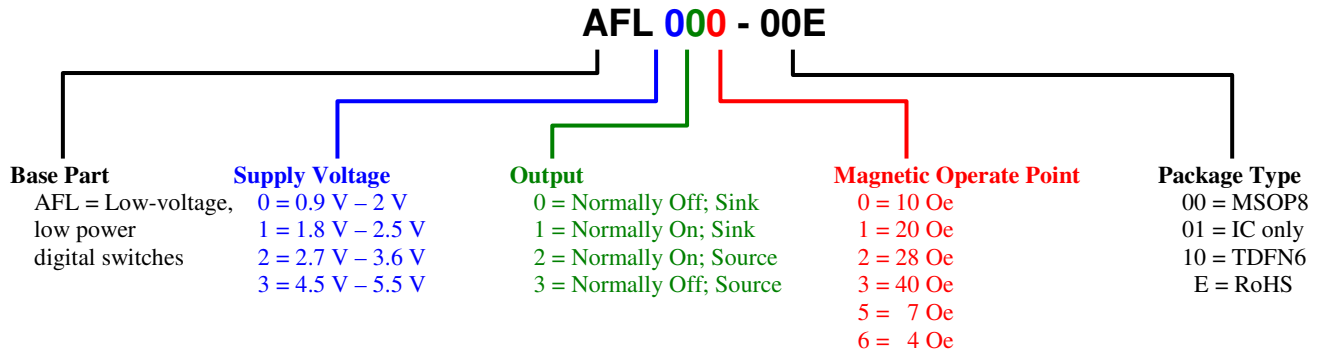
Figure 2. The AFL006 sensor activates at approximately 58 mm.

Smaller or weaker magnets can be used for closer operating distances. Because AFL-Series sensors are omnipolar, the sensor operates with either a north or south magnet pole.

Our free, Web-based application that calculates fields and operating distances for various sensor models and magnet types:
www.nve.com/spec/calculators.php

Part Numbering

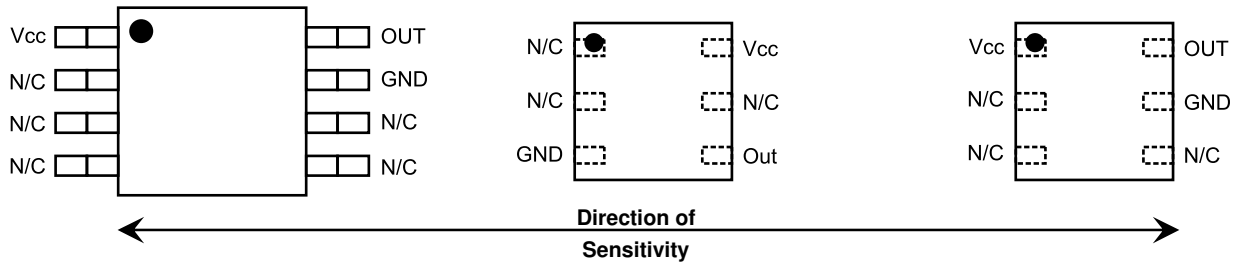
The following example shows the AFL-Series part-numbering system:



Pinouts

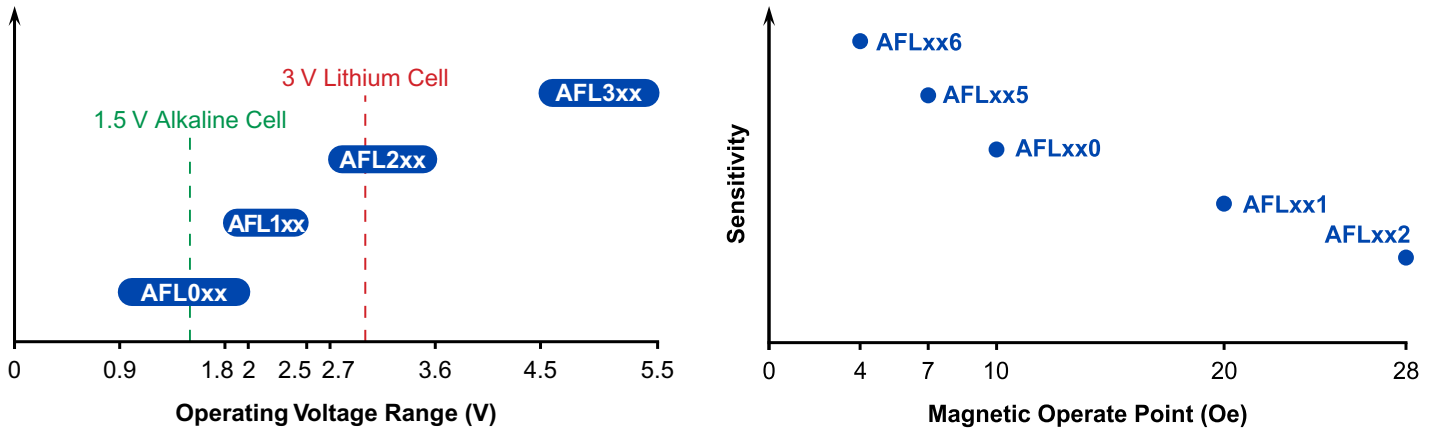
MSOP8TDFN6TDFN6

(-00 suffix)(AFLxx6-10)(Other -10 suffix)



MSOP8 (all part types)	Pin		Symbol	Description
	AFLxx6	AFLxx0 /AFLxx1/ AFLxx2/AFLxx5		
1	6	1	V _{CC}	Power supply
7	3	5	GND	Ground
8	4	6	OUT	Output (open collector)
2, 3, 4, 5, 6	1, 2, 5	2, 3, 4	N/C	No internal connection

Product Range Charts

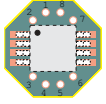


Available Parts

Available Part	Supply Voltage	Output Type	Output Source/Sink	Nominal Operate Point*	Package	Package Marking
AFL000-00E	0.9 V – 2 V	Normally Off	Sink	10Oe	MSOP8	PBBE
AFL000-10E	0.9 V – 2 V	Normally Off	Sink	10Oe	TDFN6	QBBe
AFL001-10E	0.9 V – 2 V	Normally Off	Sink	20Oe	TDFN6	QBXe
AFL002-10E	0.9 V – 2 V	Normally Off	Sink	28 Oe	TDFN6	QBLe
AFL005-10E	0.9 V – 2 V	Normally Off	Sink	7 Oe	TDFN6	QBKe
AFL006-10E	0.9 V – 2 V	Normally Off	Sink	4 Oe	TDFN6	QCHe
AFL020-00E	0.9 V – 2 V	Normally On	Source	10 Oe	MSOP8	PBCe
AFL030-00E	0.9 V – 2 V	Normally Off	Source	10 Oe	MSOP8	PBDe
AFL100-00E	1.8 V – 2.5 V	Normally Off	Sink	10 Oe	MSOP8	PBFe
AFL100-10E	1.8 V – 2.5 V	Normally Off	Sink	10 Oe	TDFN6	QBFe
AFL200-00E	2.7 V – 3.6 V	Normally Off	Sink	10 Oe	MSOP8	PBGe
AFL300-00E	4.5 V – 5.5 V	Normally Off	Sink	10 Oe	MSOP8	PBHe

Bare Circuit Boards for Sensors

NVE offers several bare circuit boards specially designed for easy connections to surface-mount sensors. Popular PCBs are shown below (images are **two times** actual size):



AG915-06:
0.25" (6 mm) octagonal
MSOP8



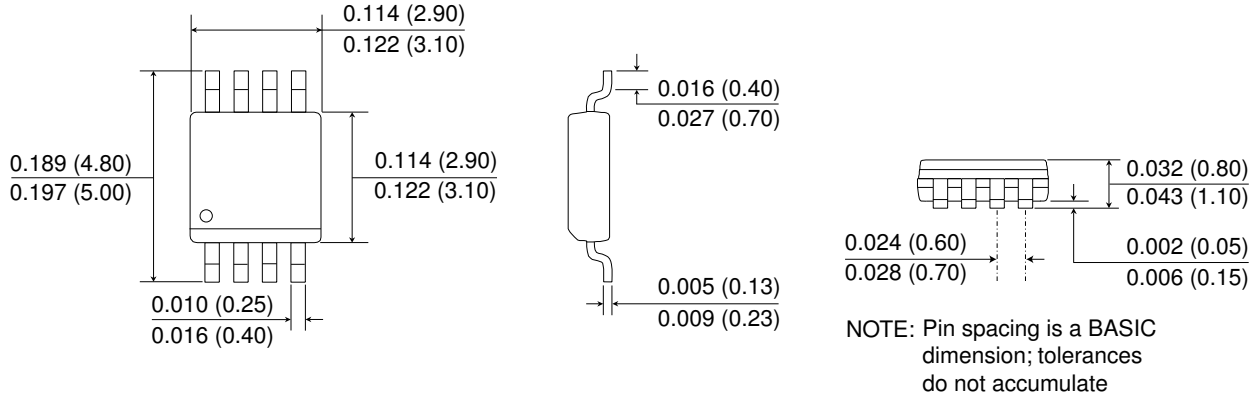
AG918-06 (standard) / **AG919-06** (cross-axis):
2" x 0.25" (50mm x 6 mm) MSOP8



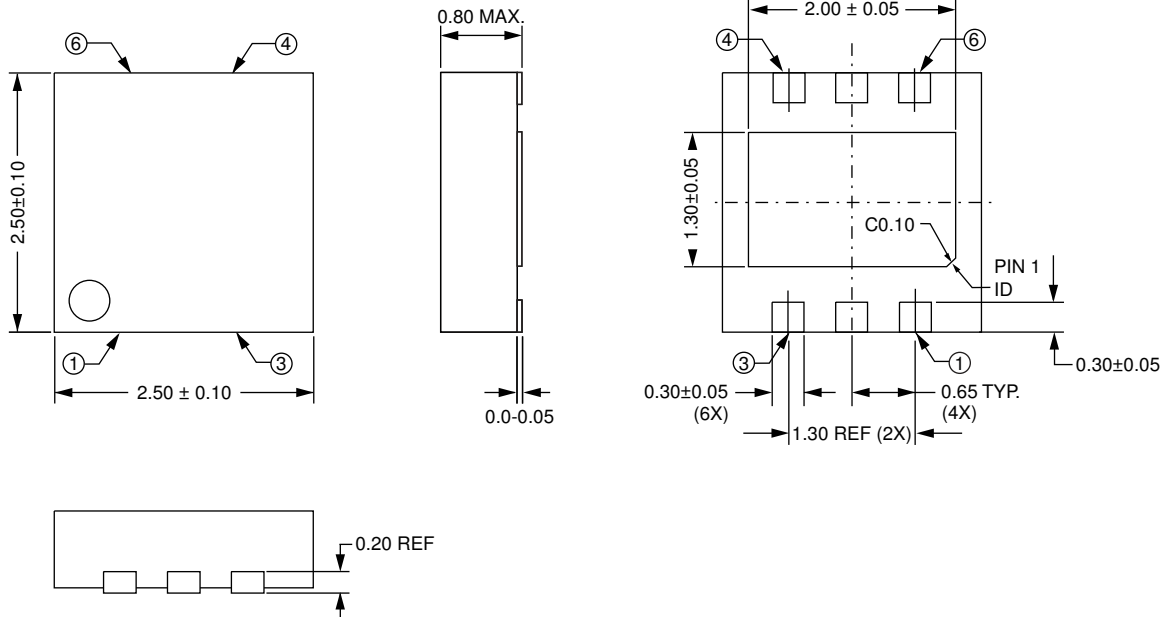
AG035-06:
1.57" x 0.25" (40mm x 6 mm) TDFN6

Package Drawings

MSOP8 (-00 suffix)



TDFN6 (-10 suffix)



Soldering profile per JEDEC J-STD-020C, MSL 1.



Revision History

SB-00-015-D

October 2017

Change

- Added “typical operation” description and illustration (p. 3).
- Added product range charts (p. 5).
- Added page with bare circuit boards (p. 6).

SB-00-015-C

June 2017

Change

- Added AFL006 high-sensitivity version.
- Increase maximum supply voltage for AFL0xx to 2 V.

SB-00-015-B

March 2017

Change

- Cosmetic datasheet changes.

SB-00-015-A

June 2007

Change

- Initial release.

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October 2017