NVE CORPORATION

NEW!
Ultrasensitive Sensors

Magnetic Sensors
Short-Form Catalog

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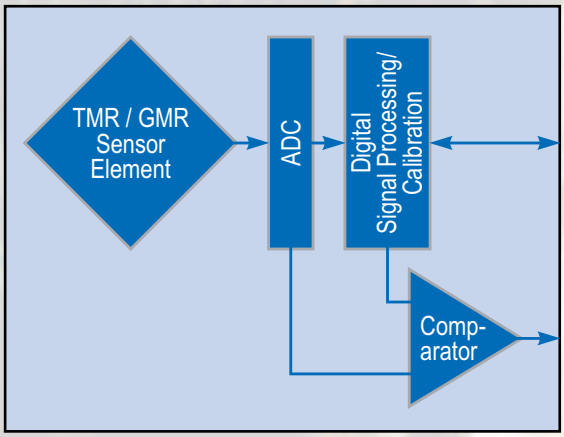
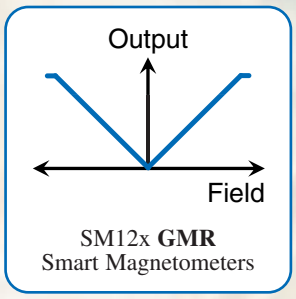
Smart Sensors

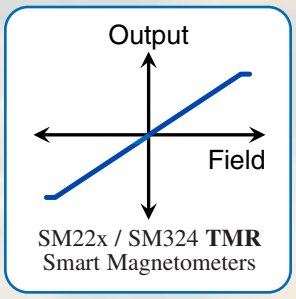
Factory Calibrated with I²C and SPI Interfaces

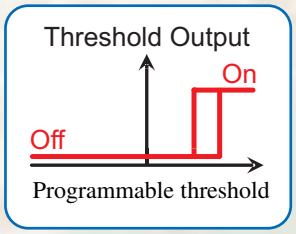
A full line of smart magnetometers and smart angle sensors combine the precision and high sensitivity of our industry-leading GMR/TMR sensors with sophisticated digital signal processing to create devices with unparalleled accuracy. This allows precision magnetic sensing with lower part counts and faster development cycles than ever before. NVE Smart Sensors come in ultraminiature, 2.5 x 2.5 mm DFN6 packages.



Smart Sensor Block Diagram.







SM-Series smart magnetometers are ideal for proximity and noncontact current sensing in robotics, mechatronics, and automotive applications. Key specifications are summarized below:

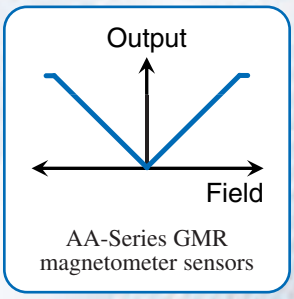
SM-SERIES SMART MAGNETOMETERS						
Part Number	**Technology**	**Accuracy**	**Update Rate**	**Range**	**Outputs**	**Features**
SM124-10	Omnipolar GMR	5%	10 kSps	0 to 1 mT	I²C; Digital Threshold	General Purpose Proximity Sensing
SM125-10				0 to 4 mT		
SM223-10	Bipolar TMR	2%	15 kSps	−1 to +1 mT	I²C; Digital Threshold	Current or Proximity Sensing
SM228-10				−15 to +15 mT		
SM225-10					SPI	
SM324-10	Bipolar TMR	0.3%	300 Sps	−2 to +2 mT	I²C; Digital Threshold	Ultraprecise Current or Proximity Sensing

ASR-Series smart angle sensors cover a range of robotics, mechatronics, and automotive applications:

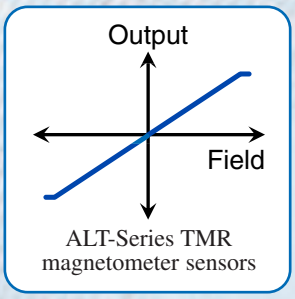
ASR-SERIES SMART TMR ANGLE SENSORS				
Part Number	**Accuracy**	**Update Rate**	**Operating Field Range**	**Outputs**
ASR002-10	2°	12.5 kSps	6 to 20 mT	High-speed SPI
ASR012-10				I²C; PWM
ASR003-10		10 kSps		SPI angle and field magnitude
ASR022-10	±3 LSB	10 kSps		ABZ; DIR (encoder emulation)

Analog Bridge Sensors

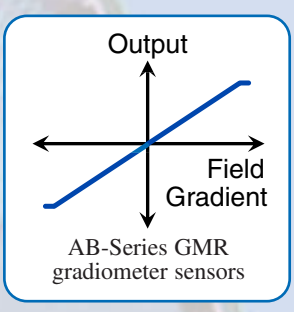
Versatile, Sensitive, and Accurate



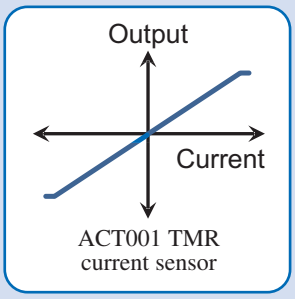
AA-Series GMR magnetometer sensors



ALT-Series TMR magnetometer sensors



AB-Series GMR gradiometer sensors



ACT001 TMR current sensor

GMR and TMR analog bridge sensors are ideal for a wide range of magnetic sensing, including position and current. ***AA-Series*** GMR magnetometers are omnipolar, providing the a positive output for either field polarity. ***AB-Series*** sensors are differential devices (gradiometers), with bipolar outputs. ***H-subtype*** magnetometers and gradiometers have higher sensitivity. ***L-subtype*** magnetometers use low-hysteresis GMR materials for precise low-field measurements. The ***K-subtype*** is a kilooersted range high-field magnetometer. ***ALT-Series*** TMR magnetometers are high sensitivity, low hysteresis, and bipolar. The ***ACT001*** current sensor has a TMR sensor element and an integrated current strap.

ANALOG MAGNETOMETERS

Part Number	Technology	Saturation (mT)	Linear Range (mT)		Typical Sensitivity (mV/V/mT)	Typical Bridge Resistance	Feature	Package
			Min.	Max.				
AAH002-02	Omnipolar GMR	0.6	0.06	0.3	150	2 kΩ	Ultra-high sensitivity	SOIC8
AAL002-02	Low-hysteresis Omnipolar GMR	1.5	0.15	1.05	35	5 kΩ	Low hysteresis	SOIC8
AAL004-10						2.2 kΩ		DFN6
AAL024-10							Cross-axis sensitivity for current sensing or proximity sensing	
ALT021-10	Bipolar TMR	±0.3	−0.2	+0.2	2500	20 kΩ		
ALT023-10		±1.5	−1	+1	500			
ALT025-10		±10	−10	+10	20			
AA002-02	Omnipolar GMR	1.5	0.15	1.05	35	5 kΩ	General purpose	SOIC8
AA003-02		2	0.2	1.4	26			
AA004-00		5	0.5	3.5	10			MSOP8
AA004-02								SOIC8
AA005-02		10	1	7	5			
AA006-00		5	0.5	3.5	10	30 kΩ	Low power	MSOP8
AA007-00		50	5	45	1	5 kΩ	High field	
AAK001-14		400	40	250	0.033	3.5 kΩ	Very high field; small	1.1 mm x 1.1 mm DFN4
ALT025-14	Bipolar TMR	±10	−10	+10	0.033	20 kΩ	Ultrahigh sensitivity; small	
AKT001-14	Omnidirectional TMR	1500	50	800	0.025	1 MΩ	Ultrahigh field; ultralow power	

ANALOG GRADIOMETERS

Part Number	Saturation (mT)	Linear Range (|mT|)		Typical Bridge Resistance	Package
		Min.	Max.		
AB001-02	25	1	17.5	2.5 kΩ	SOIC8
AB001-00	25	1	17.5	2.5 kΩ	MSOP8
ABH001-00	7	0.5	4	1.2 kΩ	MSOP8

NEW!

ANALOG CURRENT SENSOR

Part Number	Linear Range	Output Sensitivity	Package
ACT001-10	±0.5 A	40 mV/V-A	DFN6

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GMR Switch Sensors

Sensitive and Precise

GMR Switch Precision Digital Sensors provide more precise operate points than Hall-effect or other conventional sensors. Magnetic operate points range from 0.4 mT (the world's most sensitive magnetic switches) to 8 mT.

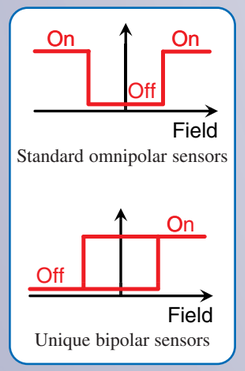
AD-Series digital sensors are available with a variety of switch points and output configurations, and come in DFN6 and MSOP 8 packages. The parts have a wide 4.5 to 30 volt supply range.

AD-Series sensors are omnipolar, so a field of either polarity switches the sensor ON, and the sensor turns OFF when the field is removed.

AFL-Series sensors have supply voltages ranging from 0.9 to 5.5 volts for low-voltage and battery-powered applications.

POPULAR AD-SERIES DIGITAL SWITCHES

Part Number	Typ. Operate Point (mT)	Supply Voltage Range	Typ. Supply Current (mA)	Output Type	Package
AD004-00	2	4.5 to 30 V	4	Sink	MSOP8
AD005-00	4				
AD006-00	8				
AD021-00	2				
AD022-00	4				
AD024-00	2.8				
AD024-10	2.8				TDFN6
AD621-00	2			Sink+Source	MSOP8
AD824-00	2.8		3	2 Sinks+SCP	
ADH025-00	1		4	Sink	

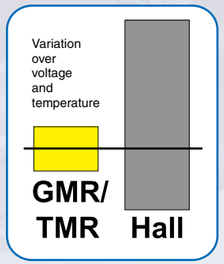


Standard omnipolar sensors

Unique bipolar sensors

AFL-SERIES DIGITAL SENSORS

Part Number	Typ. Operate Point (mT)	Supply Voltage Range	Output Type	Package
AFL000-10	1	0.9 to 2V	Normally Off, Current Sink	DFN6
AFL000-01				Die
AFL002-10	2.8		Normally Off, Current Sink	DFN6
AFL006-10	0.4			
AFL020-00	1		Normally On, Current Source	MSOP8
AFL030-00			Normally Off, Current Source	
AFL100-00		1.8 to 2.5 V	Normally Off, Current Sink	
AFL100-10				DFN6
AFL103-01	4			Die
AFL200-00	1	2.7 to 3.6 V		MSOP8
AFL300-00		4.5 to 5.5 V		



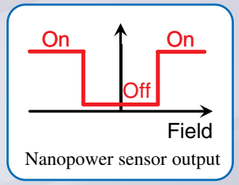
GMR and TMR Nanopower Digital Switches

Ultraminiature; Ultralow Power

Benefits:	GMR	TMR	Hall	AMR	Reed
Size	**Small**	**Small**	Small	Large	Very Large
Signal Level	**Large**	**Very Large**	Small	Medium	Switch
Sensitivity	**High**	**Very High**	Low	High	Low
Temperature	**High**	**High**	Low	Medium	Medium
Power	**Low**	**Very Low**	Low	High	Switch
Cost	**Low**	**Low**	Low	High	Low

Popular **digital switch applications**:
- Cylinder position sensors
- Proximity sensors
- End-of-travel sensors


1.1 mm DFN4 packages fit on the head of a pin.



Nanopower sensor output

NVE Nanopower Magnetic Switches are small enough to fit on the head of a pin and low enough power to run forever on a button cell. TMR and internally duty-cycled GMR versions reduce power consumption to nanowatts. The sensors are available with a variety of operate points and come in tiny 1.1 by 1.1 mm DFN packages.

The ***ADL-*** and ***ADT-Series*** sensors have a 2.4 to 4.2 volt supply range for lithium batteries or 3.3 volt supplies. ***AHL-***, ***AHT-***, and ***AHK-Series*** sensors operate as low as 0.9 volts for use with 1.5 volt batteries.

NANOPOWER SENSORS

Part Number	Tech-nology	Typ. Operate Point (mT)	Supply Voltage Range	Typ. Supply Current (µA)	Typ. Update Frequency	Package
ADL021-14	GMR	2	2.4 to 4.2 V	0.05	55 Hz	1.1 mm x 1.1 mm DFN4
ADL022-14		4				
ADL024-14		2.8				
ADL121-14		2		0.035	30 Hz	
ADL122-14		4				
ADL124-14		2.8				
ADL921-14		2		35	Continuous	
ADL922-14		4				
ADL922NC		4 (normally closed)				
ADL924-14		2.8				
ADT922-14	TMR	4.5		0.6		
ADT923-14		3.2				
ADT924-14		2.2				
ADT925-14		1.5				
ADK991-14		350		1		
AHL021-14	GMR	2	0.9 to 2.4 V	0.095	110 Hz	
AHL024-14		2.8				
AHL025-14		1				
AHL921-14		2		35	Continuous	
AHL924-14		2.8				
AHL925-14		1				
AHT922-14	TMR	4.5	0.9 to 1.8 V	0.3		
AHT923-14		3.2				
AHT924-14		2.2				
AHT925-14		1.5				
AHK991-14		350		2		

Angle and Rotation Sensors

Small, Precise, and Ultralow Power

AAT- and ADT-Series noncontact angle and rotation sensors are based on spintronic TMR elements for small size, large signals, and low power. An external magnet provides a saturating magnetic field in the plane of the sensor. The sensors work with magnetic fields from 1.5 to 20 mT. Parts come in ultraminiature 2.5 by 2.5 mm DFN6 packages.

AAT-Series angle sensors provide sine and cosine signals defining the absolute angle of rotation. Outputs are proportional to the supply voltage and peak-to-peak output voltages are much larger than conventional sensors. ***AAT00x*** sensors consist of two half-bridges, while ***AAT10x*** sensors have two full bridges with differential outputs. The ***AAT006*** works with extremely low fields. Available bridge resistances range from 40 kilohm typical device resistance for direct interface to simple microcontrollers, to six megohms for ultralow power.

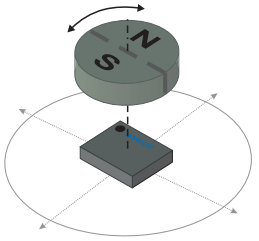
ADT-Series rotation sensors have two digital, binary outputs. The outputs are 90 degrees out of phase to provide directional information. The ***ADT001*** is high hysteresis for noise immunity in applications such as speed sensing; the ***ADT002*** is low hysteresis to provide accurate, absolute rotational information.

Key features of ***AAT-*** and ***ADT-Series*** sensors are:

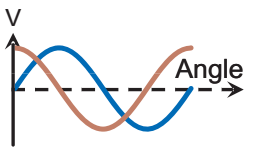
- Extremely low power
- Wide airgap tolerance
- 0.5° repeatability
- Wide supply range
- −40 °C to 125 °C operating range
- Ultraminiature DFN6 package

Popular applications include:

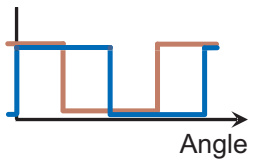
- Rotational position sensors
- Rotational speed sensors
- Encoders
- Water meters



Typical configuration



AAT-Series
angle sensors



ADT-Series
rotation sensors

ADT-SERIES ROTATION SENSORS				
Part Number	**Max. Error**	**Typ. Hysteresis**	**Typ. Supply Current**	**Package**
ADT001-10	1.5°	20°	2.2 µA	DFN6
ADT002-10		4°		

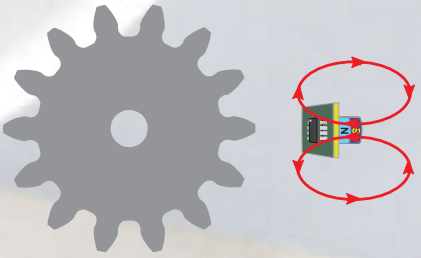
	Output	
Angle	**Sin**	**Cos**
0° to 90°	H	H
90° to 180°	H	L
180° to 270°	L	L
270° to 360°	L	H

ADT-Series rotation sensor truth table.

AAT-SERIES ANGLE SENSORS					
Part Number	**Bridge Configuration**	**Typ. Output** (ea. output; p-p)	**Operating Field Range**	**Typ. Device Resistance**	**Package**
AAT001-10	Half-bridge	200 mV/V	3 to 20 mT	1.25 MΩ	DFN6
AAT003-10				40 KΩ	
AAT006-10			1.5 to 10 mT	1.5 MΩ	
AAT009-10			3 to 20 mT	6 MΩ	
AAT101-10	Full-bridge	400 mV/V		625 KΩ	

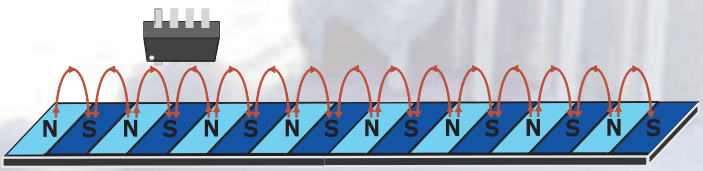
Gear-Tooth and Encoder Sensors

Robust and Precise



ABT-, ABL-, and AKL-Series gear-tooth sensors used with bias magnets and ferromagnetic gears.

A typical AET-Series encoder sensor with a multipole magnet.

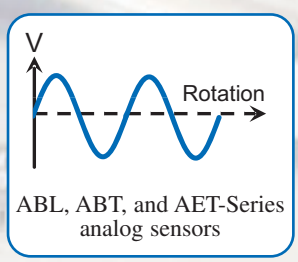


AET-Series encoder sensors used with magnetic linear scale tape.

NVE has a full line of gear-tooth and encoder sensors. Gear-tooth sensors are used with ferromagnetic gears and bias magnets; encoder sensors are used with multipole magnets. These unique parts feature large signals, wide airgap tolerance, and high operating temperature.

AET-Series encoder sensors have differential TMR sensor elements that provide sinusoidal outputs from cyclic magnet poles on multipole magnets or linear scale tape. Various spacings are available for various pole pitches. Interpolation allows extremely precise rotational or linear position sensing. Double bridges provide direction information.

ABL-Series and ***ABT-Series*** analog gear-tooth sensors have differential sensor elements that provide sinusoidal outputs. Various sensor spacings are available to match a variety of gear pitches. Double bridges generate sine and cosine outputs to provide direction information. **ABL-Series** sensors use venerable GMR.



ABL, ABT, and AET-Series analog sensors

AKL-Series digital gear-tooth sensors are two-wire devices where the supply current indicates a passing tooth.

TMR Encoder Sensors				
Part Number	**Half/ Full Bridges**	**Pole Pitch** (normal mode)	**Pole Pitch** (double-pitch mode)	**Package**
AET500-02	Half	5 mm	N/A	SOIC8
AET050F-00	Full	0.5 mm	1 mm	MSOP8
AET075F-00		0.75 mm	1.5 mm	
AET100F-00		1 mm	2 mm	
AET120F-00		1.2 mm	2.4 mm	

GMR ANALOG GEAR-TOOTH SENSORS			
Part Number	**Single or Dual Bridge**	**Gear Pitch** (mm)	**Package**
ABL004-00	Single	1.7 to 6	MSOP8
ABL005-00		0.8 to 1.7	
ABL006-00		0.5 to 0.8	
ABL014-00	Dual	1.7 to 6	
ABL015-00		0.8 to 1.7	
ABL016-00		0.5 to 0.8	
ABL004-10	Single	1.7 to 6	DFN6
ABL005-10		0.8 to 1.7	
ABL006-10		0.5 to 0.8	
ABL014-10	Dual	1.7 to 6	
ABL015-10		0.8 to 1.7	
ABL016-10		0.5 to 0.8	

DIGITAL GEAR-TOOTH SENSORS		
Part Number	**Element Spacing** (mm)	**Package**
AKL001-12	1	DFN8
AKL002-12	0.5	
AKL003-12	0.3	

TMR ANALOG GEAR-TOOTH SENSORS			
Part Number	**Single or Dual Bridge**	**Gear Pitch** (mm)	**Package**
ABT250-00	Dual	0.6 to 2	MSOP8
ABT375-00		1 to 3	
ABT500-00		1.3 to 4	
ABT600-00		1.6 to 4.8	

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ISO 9001

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On the Cover

NVE sensors facilitate the Internet of Things with miniaturization, high sensitivity, low power, and simple, smart interfaces.

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