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# **Magnetic Sensors Short-Form Catalog**

NEW **Smart** Sensors

### Smart Sensors Factory Calibrated with I<sup>2</sup>C 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:



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	50/	10 1-5 mg	0 to 1 mT	I <sup>2</sup> C; Digital	General Purpose		
SM125-10	GMR	570	10 KSps	0 to 4 mT	Threshold	Proximity Sensing		
SM225-10	Bipolar TMR	2%	15 kSps	-15 to +15 mT	SPI	Current or Proximity Sensing		
SM324-10	Bipolar TMR	0.3%	300 Sps	-2 to +2 mT	I <sup>2</sup> C; Digital Threshold	Ultraprecise Current or Proximity Sensing		

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

ASR-SERIES SMART TMR ANGLE SENSORS								
Part Number	Accuracy	UpdateOperatingcyRateField RangeOutputsFeatures						
ASR001-10	0.5°	2500 kSps	3 to 20 mT	I <sup>2</sup> C; PWM, Analog	High Accuracy			
ASR002-10	2°	12500 kSps	6 to 20 mT	SPI	High Speed			

## Analog Bridge Sensors Versatile, Sensitive, and Accurate



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 same output for magnetic fields of either polarity. ALT-Series TMR magnetometers are bipolar and highly linear over a wide range. H-subtype magnetometers and gradiometers offer extremely high sensitivity for low-field applications. L-subtype magnetometers use low-hysteresis GMR materials for low fields. The K-subtype is a kilooersted (fractions of a tesla) range high-field magnetometer. AB-Series sensors are differential devices, or gradiometers, with bipolar linear outputs.

	ANALOG MAGNETOMETERS							
			Linear	Range	Typical			
Part		Saturation	(lm	TI)	Sensitivity	Typical		
Number	Technology	(mT)	Min.	Max.	(mV/V/mT)	Resistance	Features	Package
AAH002-02	Omnipolar GMR	0.6	0.06	0.3	150	2 k Ω	Ultra-high sensitivity	SOIC8
AAL002-02	Low-hysteresis	1.5	0.15	1.05	35	5 k Ω	Low bysteresis	SOIC8
AAL004-10	Omnipolar	1.5	0.15	1.05	35	2.2 k Ω	Low hysteresis	TDFN6
AAL024-10	GMR	1.5	0.15	1.05	35	2.2 k Ω	Cross-axis sensitivity	TDFN6
ALT025-10	Bipolar TMR	±10	-10	+10	20	20 k Ω	for current sensing	TDFN6
AA002-02		1.5	0.15	1.05	35	5kΩ		SOIC8
AA003-02		2	0.2	1.4	26	5kΩ		SOIC8
AA004-00	Omeninalan	5	0.5	3.5	10	5kΩ	General purpose	MSOP8
AA004-02	GMR	5	0.5	3.5	10	5kΩ		SOIC8
AA005-02	OWIK	±10	1	7	5	5kΩ		SOIC8
AA006-00		5	0.5	3.5	10	30 kΩ	High resistance/	MSOP8
AA006-02		5	0.5	3.5	10	30 k Ω	low power	SOIC8
ALT005-10	Bipolar TMR	10	-10	+10	20	20 k Ω	Very low hysteresis	TDFN6
AA007-00	Omnipolar	50	5	45	1	5 k Ω	High field	MSOP8
AAK001-14	GMR	400	40	250	0.033	3.5 k Ω	Very high field; small	ULLGA6

ANALOG GRADIOMETERS							
		Linear Range Element					
Part	Saturation	(lmTl)		Spacing	Typical		
Number	(mT)	Min.	Max.	(mm)	Resistance	Package	
AB001-02	25	2	20	0.5	2.5 kΩ	SOIC8	
AB001-00	25	2	20	0.5	2.5 kΩ	MSOP8	
ABH001-00	7	0.5	4	0.5	1.2 kΩ	MSOP8	

ALT025 -10 to +10 amp current sensing

### **GMR Switch Digital 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, which are 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 TDFN and MSOP packages. The parts have a wide 4.5 to 30 volt supply range.

Standard 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. However the unique ADV001 sensor is bipolar latching (turns ON with a south field and OFF with a north field).

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

POPULAR AD-SERIES DIGITAL SWITCHES							
Part	Typ. Operate	Supply	Typ. Supply	Output			
Number	Point (mT)	Voltage Range	Current (mA)	Туре	Package		
AD004-00	2	4.5 to 30 V	3.5	Sink	MSOP8		
AD005-00	4	4.5 to 30 V	3.5	Sink	MSOP8		
AD006-00	8	4.5 to 30 V	3.5	Sink	MSOP8		
AD021-00	2	4.5 to 30 V	3.5	Sink	MSOP8		
AD022-00	4	4.5 to 30 V	3.5	Sink	MSOP8		
AD024-00	2.8	4.5 to 30 V	3.5	Sink	MSOP8		
AD024-10	2.8	4.5 to 30 V	3.5	Sink	TDFN6		
AD621-00	2	4.5 to 30 V	3.5	Sink+Source	MSOP8		
AD824-00	2.8	4.5 to 30 V	3.5	2 Sinks+SCP	MSOP8		
ADH025-00	1.1	4.5 to 30 V	3.5	Sink	MSOP8		
ADV001-00	±0.4	4.5 to 30 V	3.5	Bipolar Latching	MSOP8		









AFL-SERIES DIGITAL SENSORS							
	Typ. Operate	Supply					
Part Number	Point (mT)	Voltage Range	Output Type	Package			
AFL000-10E	1	0.9 to 1.3 V	Normally Off, Current Sink	TDFN6			
AFL000-01	1	0.9 to 1.3 V	Normally Off, Current Sink	Die			
AFL002-10E	2.8	0.9 to 1.3 V	Normally Off, Current Sink	TDFN6			
AFL006-10E	0.4	0.9 to 1.3 V	Normally Off, Current Sink	TDFN6			
AFL020-00E	1	0.9 to 1.3 V	Normally On, Current Source	MSOP8			
AFL030-00E	1	0.9 to 1.3 V	Normally Off, Current Source	MSOP8			
AFL100-00E	1	1.8 to 2.5 V	Normally Off, Current Sink	MSOP8			
AFL100-10E	1	1.8 to 2.5 V	Normally Off, Current Sink	TDFN6			
AFL103-01	4	1.8 to 2.5 V	Normally Off, Current Sink	Die			
AFL200-00E	1	2.7 to 3.6 V	Normally Off, Current Sink	MSOP8			
AFL300-00E	1	4.5 to 5.5 V	Normally Off, Current Sink	MSOP8			

### GMR and TMR Nanopower Digital Sensors Ultraminiature; Ultralow Power

TMR	Hall	AMR	Reed
Small	Small	Large	Very Large
Very Large	Small	Medium	Switch
Very High	Low	High	Low
High	Low	Medium	Medium
Very Low	Low	High	Switch
Low	Low	High	Low

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



Small enough to fit on the head of a pin and low enough power to run indefinitely on a button cell, NVE Nanopower Magnetic Switches provide the ultimate in miniaturization and low power. 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 mm x 1.1 mm ULLGA packages.

ADL- and ADT-Series sensors have a 2.4 to 3.6 volt supply range; AHL-, AHT, and AHK-Series operate on supplies as low as 0.9 volts.

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NANOPOWER SENSORS							
	Tech-	Typ. Operate	Supply	Typ. Supply	Typ. Update		
Part Number	nology	<b>Point</b> (mT)	Voltage Range	Current (µA)	Frequency	Packag	
ADL021-14E	GMR	2	2.4 to 3.6 V	0.05	55 Hz	ULLGA	
ADL022-14E	GMR	4	2.4 to 3.6 V	0.05	55 Hz	ULLGA	
ADL024-14E	GMR	2.8	2.4 to 3.6 V	0.05	55 Hz	ULLGA	
ADL121-14E	GMR	2	2.4 to 3.6 V	0.035	30 Hz	ULLGA	
ADL122-14E	GMR	4	2.4 to 3.6 V	0.035	30 Hz	ULLGA	
ADL124-14E	GMR	2.8	2.4 to 3.6 V	0.035	30 Hz	ULLGA	
ADL921-14E	GMR	2	2.4 to 3.6 V	35	Continuous	ULLGA	
ADL922-14E	GMR	4	2.4 to 3.6 V	35	Continuous	ULLGA	
ADL924-14E	GMR	2.8	2.4 to 3.6 V	35	Continuous	ULLGA	
ADT922-14E	TMR	4.5	2.4 to 3.6 V	0.6	Continuous	ULLGA	
ADT923-14E	TMR	3.2	2.4 to 3.6 V	0.6	Continuous	ULLGA	
ADT924-14E	TMR	2.2	2.4 to 3.6 V	0.6	Continuous	ULLGA	
ADT925-14E	TMR	1.5	2.4 to 3.6 V	0.6	Continuous	ULLGA	
AHL021-14E	GMR	2	0.9 to 2.4 V	0.095	110 Hz	ULLGA	
AHL024-14E	GMR	2.8	0.9 to 2.4 V	0.095	110 Hz	ULLGA	
AHL025-14E	GMR	1	0.9 to 2.4 V	0.095	110 Hz	ULLGA	
AHL921-14E	GMR	2	0.9 to 2.4 V	35	Continuous	ULLGA	
AHL924-14E	GMR	2.8	0.9 to 2.4 V	35	Continuous	ULLG	
AHL925-14E	GMR	1	0.9 to 2.4 V	35	Continuous	ULLGA	
AHT921-14E	TMR	2	0.9 to 1.8 V	0.3	Continuous	ULLG	
AHT924-14E	TMR	2.8	0.9 to 1.8 V	0.3	Continuous	ULLG	
AHT925-14E	TMR	1	0.9 to 1.8 V	0.3	Continuous	ULLG	
AHK991-14E	TMR	350	0.9 to 1.8 V	2	Continuous	ULLG	

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### Popular digital sensor applications:

- Cylinder position sensors
- Proximity sensors
- End-of-travel sensors

### Angular Bridge Sensors Small, Accurate, and Ultralow Power

AAT and ADT-Series noncontact angle and rotation sensors are based on spintronic Tunneling Magnetoresistance (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 are packaged in NVE's 2.5 x 2.5 x 0.8 mm TDFN6 package.

AAT-Series angle sensors provide sine and cosine signals defining the 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 (20 kilohm output impedances) for direct interface to simple microcontrollers, to 6 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 TDFN6 package

Popular applications include:

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

	0100						
AAT-SERIES ANGLE SENSORS							
Part		Typ. Output	Operating	Typ. Device			
Number	Configuration	(ea. output; p-p)	<b>Field Range</b>	Resistance	Package		
AAT001-10E	Half-bridge	200 mV/V	3 to 20 mT	1.25 MΩ	TDFN6		
AAT003-10E	Half-bridge	200 mV/V	3 to 20 mT	40 K Ω	TDFN6		
AAT006-10E	Half-bridge	200 mV/V	1.5 to 10 mT	1.5 M Ω	TDFN6		
AAT009-10E	Half-bridge	200 mV/V	3 to 20 mT	6 MΩ	TDFN6		
AAT101-10E	Full-bridge	400 mV/V	3 to 20 mT	625 K.Q.	TDFN6		

ADT-SERIES ROTATION SENSORS							
Part	Part Max. Error Typ. Typ. Supply						
Number	(const. field)	Hysteresis	Current	Package			
ADT001-10E	0.5°	20°	2.5 A	TDFN6			
ADT002-10E	0.5°	4°	2.5 A	TDFN6			



ADT-Series rotation sensor truth table

Typical configuration





### **Gear-Tooth Sensors** Small and Robust



4	DIGITAL GEAR-TOOTH SENSORS						
2			Element				
1	Part	Single or	Spacing				
	Number	<b>Dual Bridge</b>	(mm)	Package			
	AKL001-12	Single	1	TDFN8			
	AKL002-12	Single	0.5	TDFN8			
	AKL003-12	Single	0.3	TDFN8			

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0.5

0.3

1

0.5

0.3

1

0.5

0.3

MSOP8

MSOP8

TDFN6

TDFN6

TDFN6

TDFN6

TDFN6

TDFN6

Dual

Dual

Single

Single

Single

Dual

Dual

Dual

ABL015-00

ABL016-00

ABL004-10

ABL005-10

ABL006-10

ABL014-10

ABL015-10

ABL016-10

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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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