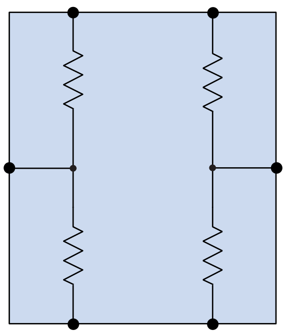
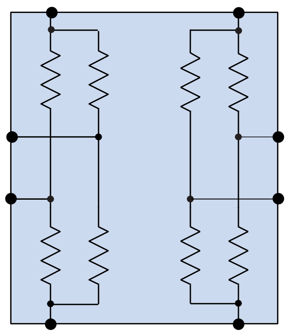
ABL/AKL-Series Gear-Tooth Sensors

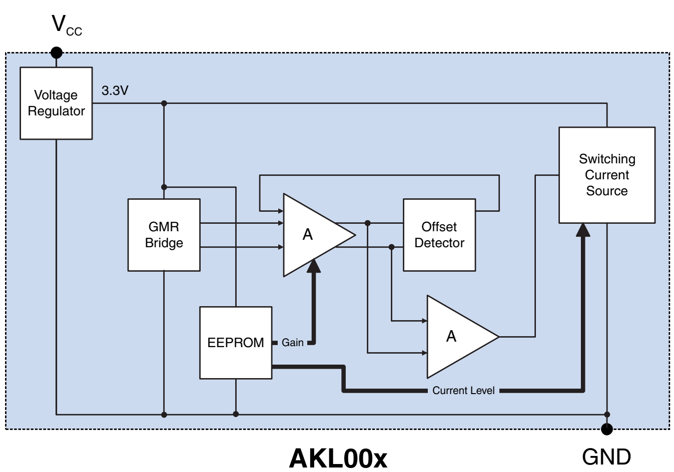
Block Diagrams



ABL00x

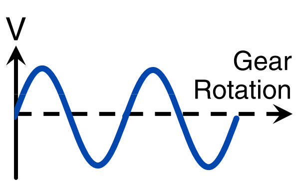


ABL01x

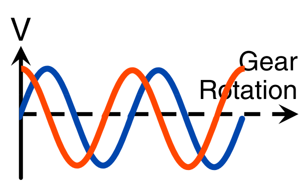


AKL00x

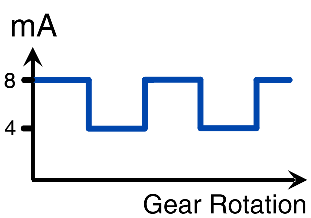
Outputs



ABL00x
Single-bridge analog sensor



ABL01x
Duak-bridge analog sensor



AKL00x digital gear-tooth sensor

Features

- Wide airgap
- Analog and digital versions
- Large analog peak-to-peak signal
- Single- and dual-bridge versions
- Operating frequency to 1 MHz
- 150°C operating temperature
- Packages as small as 2.5 mm x 2.5 mm

Applications

- Motion, speed, and position sensing
- Linear and rotational encoders
- Closed-loop servo systems
- Automotive sensors

Description

ABL and AKL-Series Gear-Tooth Sensors are versatile, wide airgap sensors typically used with ferromagnetic gears and bias magnets.

Three standard spacings are available for use with gear pitches as small as 0.6 mm, to 6 mm or more.

ABL-Series analog sensors have differential sensor elements that provide sinusoidal outputs. Single- or dual-bridge configurations are available. Dual-bridge versions provide sine and cosine outputs for direction information.

AKL-Series sensors combine a sensor bridge with integrated signal processing to provide a 50% duty cycle digital output. Integrated signal processing includes gain and offset normalization. AKL-Series sensors are configured as two-wire devices, where the supply current indicates passing teeth.

NVE Corporation 11409 Valley View Road, Eden Prairie, MN 55344-3617 Phone: (952) 829-9217 Fax: (952) 829-9189 www.nve.com

Absolute Maximum Ratings

ABL-Series Analog Gear-Tooth Sensors			
Parameter	**Min.**	**Max.**	**Units**
Supply voltage		30	Volts
Storage temperature	−65	170	°C
ESD (Human Body Model)		400	Volts
Applied magnetic field		Unlimited	Oe

AKL-Series Digital Gear-Tooth Sensors			
Parameter	**Min.**	**Max.**	**Units**
Supply voltage	−60	45	Volts
Continuous output current		16	mA
Junction temperature	−40	170	°C
Storage temperature	−65	170	°C
Junction temperature	−40	170	°C
ESD (Human Body Model)		2000	Volts
Applied magnetic field		Unlimited	Oe

Operating Specifications

ABL-Series Analog Gear-Tooth Sensors						
Parameter	**Symbol**	**Min.**	**Typ.**	**Max.**	**Units**	**Test Condition**
Operating temperature	T_{min}; T_{max}	−50		150	°C	
Supply voltage	V_{CC}	0		30	V	
Resistance		4	5	7	kΩ	At 25°C
Offset voltage	V_O	−4		+4	mV/V	
Non-linearity				2	%	Unipolar field sweep across near operating range
Hysteresis				2	%	
Saturation of GMR sensor elements		−180		+180	Oe	
Single resistor sensitivity	ΔR/Oe		0.04		%/Oe	
Maximum output			80		mV/V	
Resistance temperature coefficient	TCR		+0.11		%/°C	No applied field
Operating frequency	f_{MAX}	0	1		MHz	

AKL-Series Digital Gear-Tooth Sensors (T_{min} to T_{max}; 4.5 V < V_{CC} < 36 V unless otherwise stated)						
Parameter	**Symbol**	**Min.**	**Typ.**	**Max.**	**Units**	**Test Condition**
Operating temperature	T_{min}; T_{max}	−40		150	°C	
Supply voltage	V_{CC}	4.5		36	V	
Off-state supply current	I_{OFF}	3.4	4	4.8	mA	V_{CC} = 12V
On-state supply current	I_{ON}	7	8	9		
Output duty cycle		40	50	60	%	
Airgap						
AKL001-12		1		3.5	mm	
AKL002-12		1		2.5		
AKL003-12		1		2		
Operating frequency	f_{MAX}	DC		10	kHz	

NVE Corporation 11409 Valley View Road, Eden Prairie, MN 55344-3617 Phone: (952) 829-9217 Fax: (952) 829-9189 www.nve.com

Operation

Biasing
To detect gear teeth, a permanent magnet is required to generate a magnetic bias field. The sensor can then detect magnetic field variations as the gear tooth passes by.

Here are some tips for biasing:

- Because of GT Sensors' high sensitivity, small, inexpensive Ceramic 8 ferrite magnets can be used for most applications. Small sensors and magnets allow small circuit boards.
- Alnico 8 magnets can be used in high temperature applications.
- Rare-earth magnets are not recommended because they tend to saturate the sensors.
- Magnets and sensors can be placed on opposite sides of a 1.5 mm thick (0.062 inch) circuit board, which provides a convenient spacing for many applications (see Figure 1).
- The magnet can be glued to the circuit board using high-temperature epoxy adhesive.
- For more precise positioning, a pocket to hold the magnet can be machined into a thicker circuit board.
- If zero speed operation is not required, AC coupling the sensor removes the electrical offset induced by magnetic imperfections.
- If zero speed operation is required, zeroing the sensor output offset maximizes airgap (AKL-Series sensors have integrated zeroing).

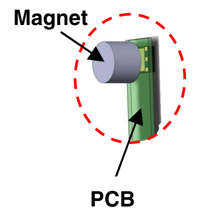


Figure 1. Biasing magnet.

Sensor orientation
To align with the axis of sensitivity, sensors should be oriented with the gear teeth perpendicular to the length of the sensor as shown in Figure 2:

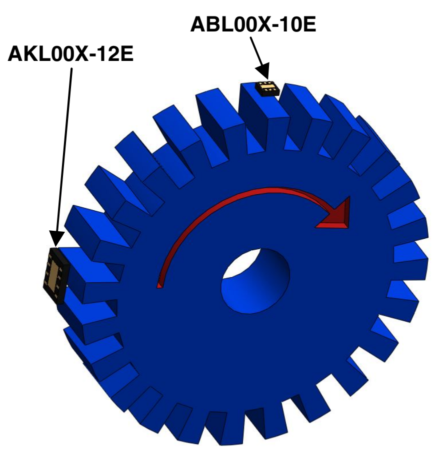


Figure 2. Sensor orientation.

Recommended sensor element spacing vs. gear pitch
Optimal sensor element spacing depends on a number of factors, including gear pitch, magnet, and sensor spacing. A rule of thumb is to select a sensor with an element spacing of approximately <u>one-fourth</u> the gear pitch. For example, for a gear pitch of 1 mm, the optimal element spacing would be 0.25 mm. Therefore a sensor with s 0.3 mm spacing, the closest available, would be selected.

NVE Corporation 11409 Valley View Road, Eden Prairie, MN 55344-3617 Phone: (952) 829-9217 Fax: (952) 829-9189 www.nve.com