MLX90217

Hall-Effect Cam Sensor

Features and Benefits

- Rotary Position Gear Tooth Sensor
- Short Circuit Protection
- On-chip 10 bit A/D Converter
- Self-Adjusting Magnetic Range
- High Speed Operation
- No Chopper Delay
- Zero Speed Detection
- No Rotary Orientation Concerns

Applications

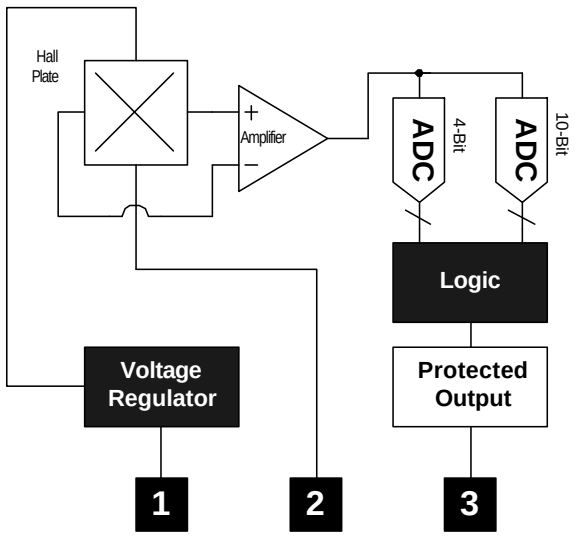
- Camshaft Sensor
- Geartooth Sensor
- Linear Encoder
- Rotary Encoder
- Direction Detection*

**See applications example*

Ordering Information

Part No.	***Temperature Suffix***	***Package***	***Temperature Range***
MLX90217	L	UA	-40°C to 150°C Automotive

Functional Diagram



Pin 1 - V_{DD} (Supply)
Pin 2 - V_{SS} (Ground)
Pin 3 - Output

Note: *Static sensitive device, please observe ESD precautions.*

Description

The MLX90217 is a self adjusting digital output rotary position gear tooth sensor designed for use in automotive camshaft sensing as well as other speed sensing applications. It is designed to be used with a bias magnet south facing the back (non-marked) side of the IC. The device has an open collector output which is short circuit protected.

The MLX90217 is a sophisticated IC featuring an on-chip 10-bit A/D Converter and logic that acts as a digital sample and hold circuit. A separate 4-bit A/D converter provides a fixed hysteresis. The 90217 does not have a chopper delay. The 90217 uses a single Hall plate which is immune to rotary alignment problems. The bias magnet can be from 50 to 400mT.

As the signal is sampled, the logic recognizes an increasing or decreasing flux density. The output will turn on (BOP) after the flux has reached its peak and decreased by an amount equal to the hysteresis. Similarly the output will turn off (BOP) after the flux has reached its minimum value and increased by an amount equal to the hysteresis.

MLX90217 Electrical Specifications

DC Operating Parameters T_A = -40°C to 150°C, V_{DD} = 3.5V to 24V (unless otherwise specified).

Parameter	*Symbol*	*Test Conditions*	*Min*	*Typ*	*Max*	*Units*
Supply Voltage	V_{DD}	Operating	3.5	-	24	V
Supply Current	I_{DD}	V_{DD} = 12V	1.5	**3.0**	4.5	mA
Supply Current	I_{DD}	V_{DD} = 3.5V to 24V	1	-	6	mA
Leakage Current	I_{LEAK}	V_{OUT} = 3.5V to 24V	-	-	10	µA
Output Current	I_{OUT}	Operating	-	-	25	mA
Output Saturation Voltage	V_{SAT}	V_{DD} = 12V, I_{OUT} = 25mA	-	-	600	mV
Output Short Circuit Current	I_{FAULT}	Fault	50	100	150	mA
Output Short Circuit Shutdown	T_{FAULT}	Fault	100	-	200	µS
Clock Frequency	f_{CLK}	Operating	300	500	800	kHz
Output Rise Time	t_r	V_{DD}=12V R_1 = 880W C_1 = 20pf		-	400	nS
Output Fall Time	t_f	V_{DD}=12V R_1 = 880W C_1 = 20pf		-	400	nS
Bandwidth	BW	Operating	-	-	15	kHz
Thermal Resistance	R_{TH}	Operating	-	-	200	°C/Watt

MLX90217 Magnetic Specifications

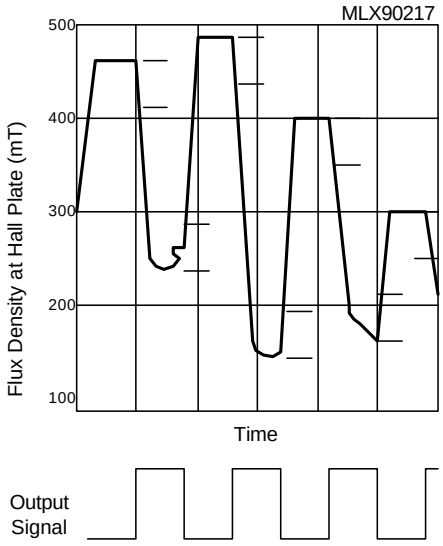
DC Operating Parameters T_A = -40°C to 150°C, V_{DD} = 3.5V to 24V (Unless otherwise specified)

Parameter	*Symbol*	*Test Conditions*	*Min*	*Typ*	*Max*	*Units*
Back Bias Range	B_{BIAS}	Operating	-30	-	400	mT
Linear Region		V_{DD} = 12V	50	-	500	mT
Hysteresis	B_{hys}	V_{DD} = 3.5V to 24V	1.8	3.5	10	mT

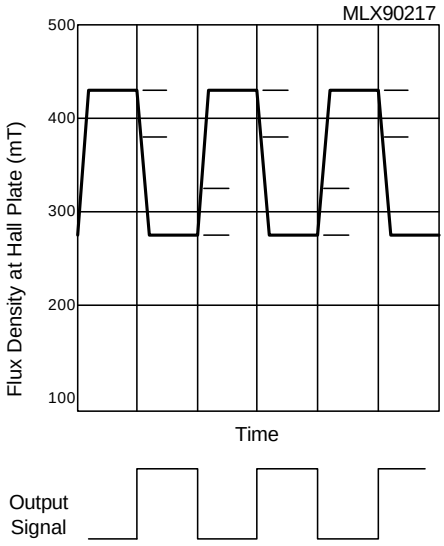
Notes: 1mT=10Gauss

Performance Graphs

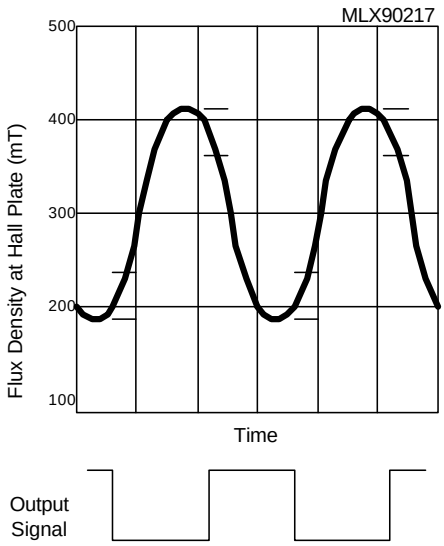
Switch Points versus Irregular Magnetic Signal (Worn Gear)



Switch Points versus Regular Magnetic Signal (New Gear)



Switch Points versus Analog Magnetic Signal (Cam Lobe)



Absolute Maximum Ratings

Supply Voltage (Operating), V_{DD}	30V
Supply Current (Fault), I_{DD}	50mA
Output Current (Fault), I_{OUT}	30mA
Output Current (Fault), I_{fault}	50mA
Output Voltage, V_{OUT}	30V
Power Dissipation, P_D	100mW
Operating Temperature Range, T_A	40°C to 150°C
Storage Temperature Range, T_S	65°C to 150°C
Maximun Junction Temp, T_J	175°C
ESD Sensitivity	+/- 7KV

Application Notes

Maximum dynamic range is 500 mT. The hysteresis is fixed at 5.0 mT. Best angular accuracy will be obtained when the magnetic circuit provides peak magnetic flux at the chip near the high end of the linear range of 500 mT. EMC protection using external components are recommended. Two possibilities are shown on the following page. Normally the South pole faces the unbranded side of the device. A North pole will enable a test sequence used in factory testing.

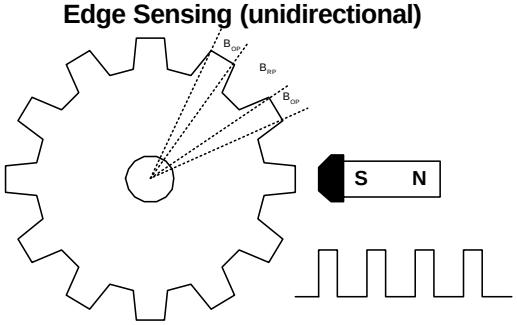
Unique Features

The output is reset to the high state at power on (output driver is off) whatever the field is. The output only changes after the first min is detected. The reset state holds no information about the field. If the supply of the chip is raised slowly, the reset state is not stable. This has been observed at 0 field but it should be the same with small and large fields.

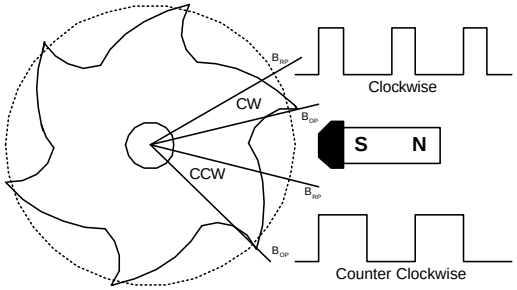
Gear tooth sensors often need to be adjusted after the module is assembled to align the magnet with differential Hall plates or orient with teeth. However the MLX90217 is “self adjusting” over a wide range of back bias flux eliminating the need for any trimming in the application. The magnet may be glued to the back surface (non branded side) of the IC using a cyanoacrylate adhesive or suitable epoxy.

Applications Examples

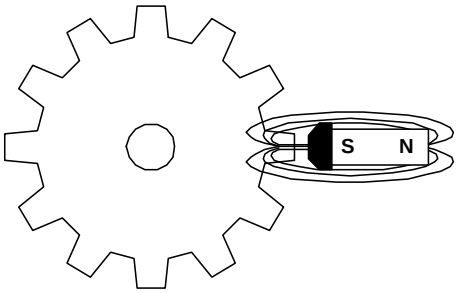
Edge Sensing (unidirectional)



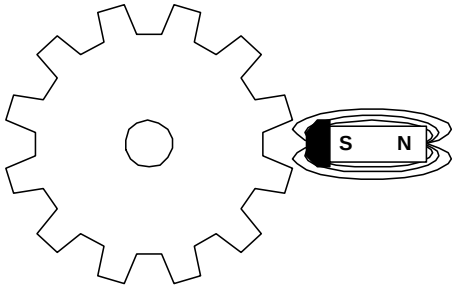
Lobe Sensing (bidirectional)



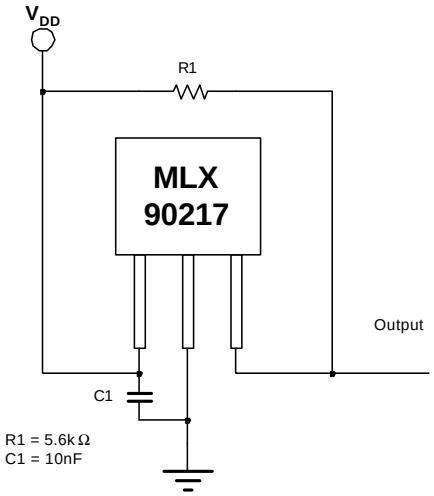
Flux Concentration - Tooth Position



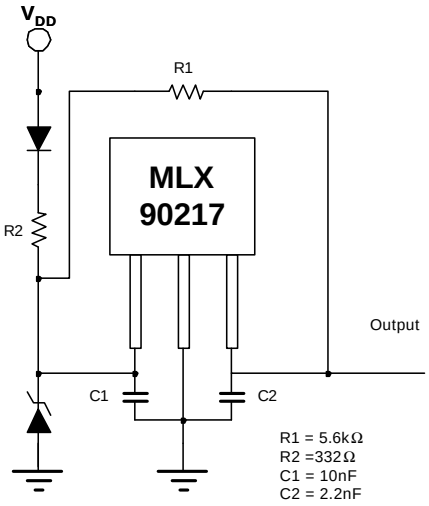
Flux Concentration - Valley Position



Recommended Wiring and Minimum Protection Circuit

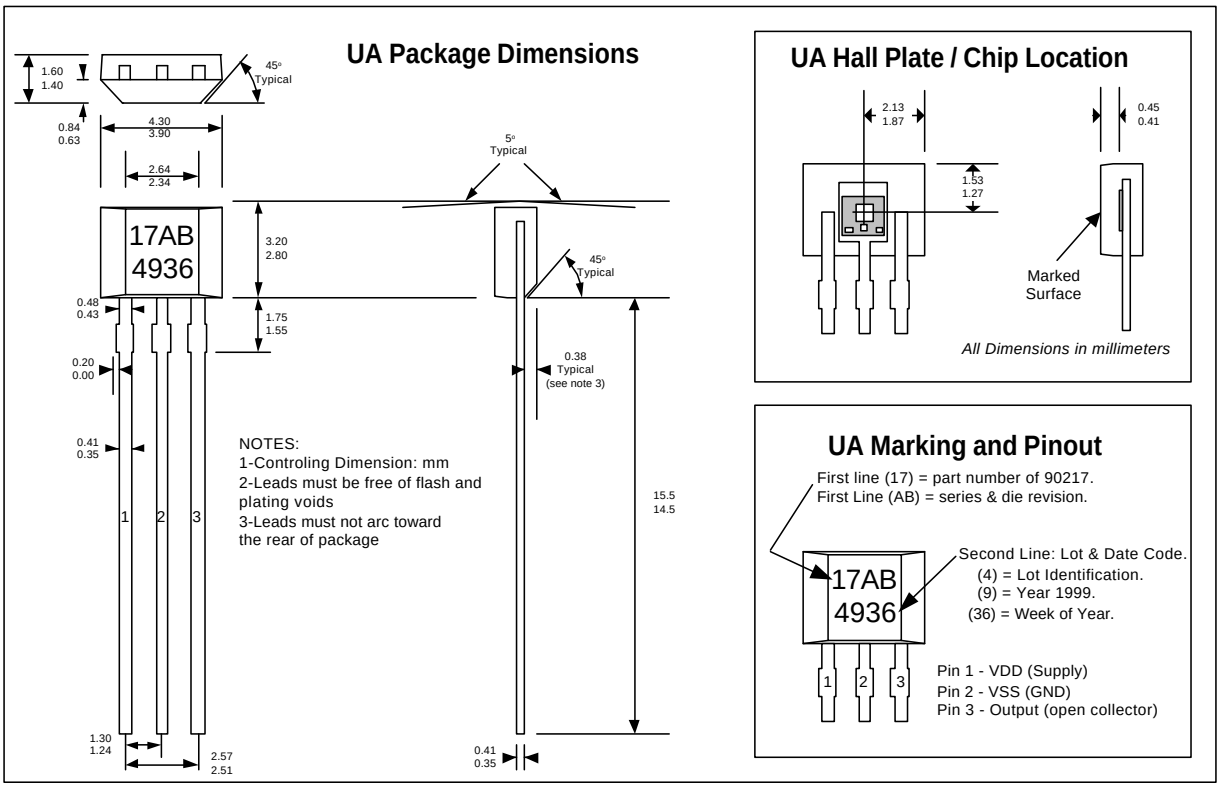


Severe Environment and Automotive Protection Circuit



In severe cases it may be necessary to include a Zener diode to clamp positive interference and Schottky diodes to clamp negative excursions.

Physical Characteristics



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