MT3602 Series

Hall Effect Cam Sensor IC

MagnTek

Feature

- AEC-Q100 automotive qualified
- Self adjust magnetic range
- High speed operation frequency
- Zero speed detection
- No direction of rotation concern
- Short circuit protection
- RoHs compliant 2011/65/EU

Application:

- Cam shaft sensing
- Gear tooth sensing

Product Description

The MT3602 is a Hall-effect based gear tooth sensor IC for automotive camshaft sensing application. MT3602 is used with a bias magnet with south-pole facing the back side (unbranded side) of the IC. The chip incorporates a Hall-effect plate, an A/D converter with self-calibration technique to adjust the internal gain for air-gap variation, a digital sample-and-hold circuit, a Schmitt trigger and an open-drain output with short-circuit protection.

As the gear tooth rotates, the chip senses the increase and decrease of the flux density. When the flux density increase exceeds a pre-defined hysteresis level (B_{HYST}), the output turns on (B_{OP}). When the flux density decrease exceeds the hysteresis level (B_{HYST}), the output turns off (B_{RP}).

The MT3602 is ideal for use to detect speed, position and direction in gear-tooth based applications. It is particularly suitable for applications that require accurate duty cycle and accurate edge detection, such as automotive camshaft sensing.

Pin definition

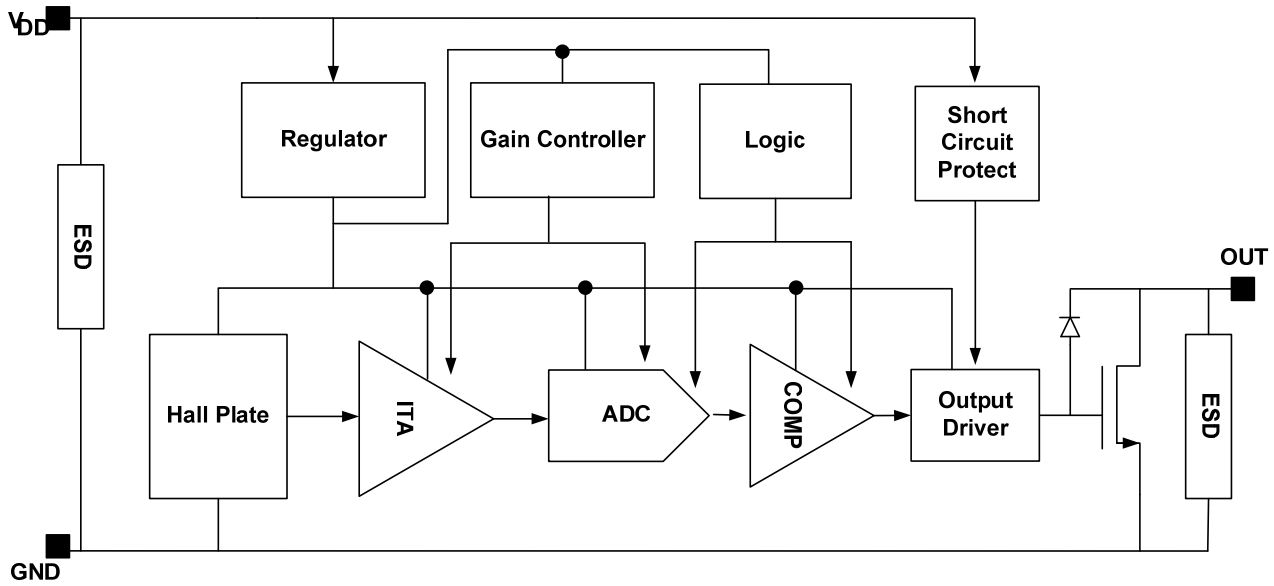
Name	Number	Description
V_{DD}	1	Power Supply
GND	2	Ground
OUT	3	Output Signal

Family members

Part Number	Description
MT3602A	Flat TO-92 package ,bulk packaging(1000pcs/bag)

The MT3602 is provided in a 3-pin Flat TO-92 that is Pb (lead) free with 100% matt tin plated leadframe

Block Diagram



Electrical and Magnetic Characteristics

Absolute Maximum Rating

Absolute maximum ratings are limiting values to be applied individually, and beyond which the serviceability of the circuit may be impaired .Functional operability is not necessarily implied. Exposure to absolute maximum rating conditions for an extended period of time may affect device reliability.

Absolute maximum ratings: all voltages listed are referenced to GND

Symbol	Parameters	Min	Max	Unit
V_{DD}	Supply Voltage	-0.5	28	V
I_{OUT}	Continuous Output Current	-	50	mA
V_{OUT}	Output voltage	-0.5	28	V
T_A	Operating Temperature Range	-40	+150	°C
T_S	Storage Temperature Range	-65	+170	°C

Magnetic Characteristics

At T_A=-40°C to 150°C, V_{DD}=3.8V to 24V (Unless other specified)

Symbol	Parameters	Test Conditions	Min	Typ	Max	Units
B_{BIAS}	Back bias range		10	-	500	mT
B_{LIN}	Linear region		50	-	400	mT
B_{HYST}	Hysteresis window		1	3	5	mT

Note: 1mT=10Guass.

Electrical Characteristics

At TA=-40°C to 150°C, V_{DD}=3.8V to 24V (Unless other specified)

Symbol	Parameters	Test Conditions	Min	Typ	Max	Units
V_{DD}	Supply voltage		3.8	-	24	V
I_{DD}	Supply current		-	2	6	mA
V_{SON}	Output saturation voltage	I_{OUT}=25mA	-	-	0.4	V
I_{OFF}	Output leakage current	V_{OUT}=24V	-	-	10	uA
T_R	Output rise time	R_L=1KOhm,C_L=20pF	-	-	1.5	us
T_F	Output rise time	R_L=1KOhm,C_L=20pF	-	-	1.5	us
F_{SW}	Maximum switching frequency		20	-	-	KHz
I_{SH}	Output short circuit current		50	100	150	mA
T_{SH}	Output short circuit shutdown		5	12	20	us
RTH	TO-92 package thermal resistance		-	230	-	°C/W

Device Evaluation Standard: EMC(Electromagnetic Compatibility)

Test name	Reference Specification
ESD-Human Body Model[1]	AEC-Q100-002
ESD-Charge Device Model[1]	AEC-Q100-011 Rev-C1
Latch Up Test[1]	AEC-Q100-004-REV-C
Radiated emissions[2]	CISPR 25
Conducted emissions,Voltage method[2]	CISPR 25
Conducted emissions,current probe method[2]	CISPR 25
Radiated Immunity,Bulk current injection[2]	ISO 11452-4
Radiated Immunity,RI,ALSE[2]	ISO 11452-2
Transient immunity,CI,Power line[2]	ISO 7637-3
ESD-E GUN Model,Handling[2]	ISO 10605
ESD-E GUN Model,Power on[2]	ISO 10605

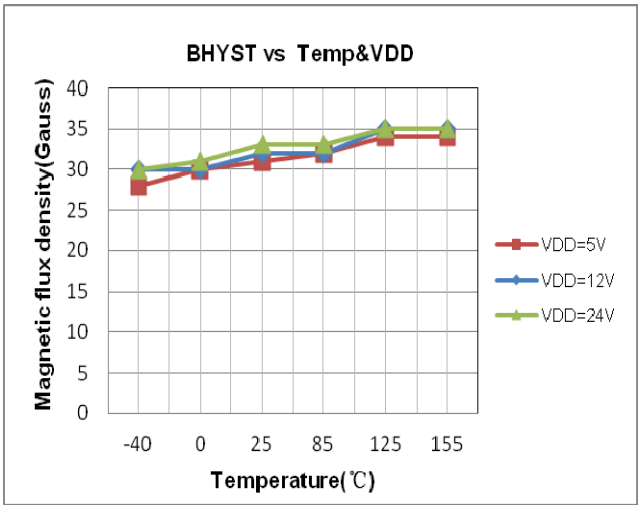
1) ESD testing is performed with no external components.

2) These tests use harsh, noisy environments and automotive application circuit.

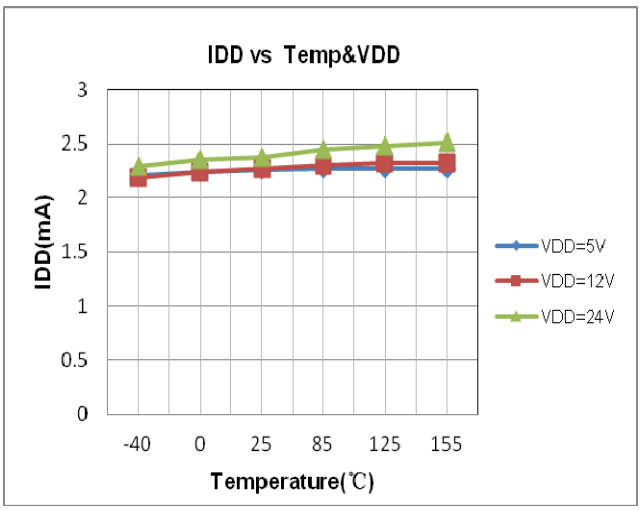
For more EMC performance information, please contact MagnTek.

Characteristic Performance

Magnetic Characteristics versus Temperature& Supply Voltage

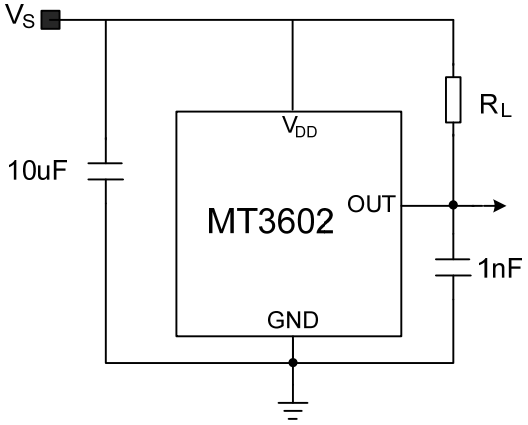


Average Supply Current versus Temperature& Supply Voltage

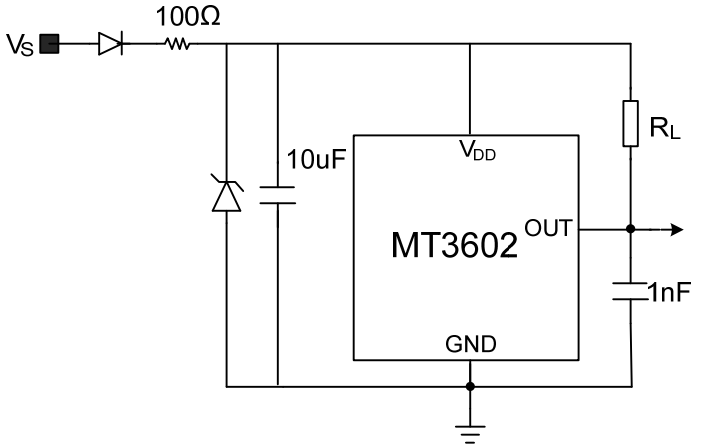


Application Information

Application Circuit Note: R_L recommend 1KOhm to 10KOhm

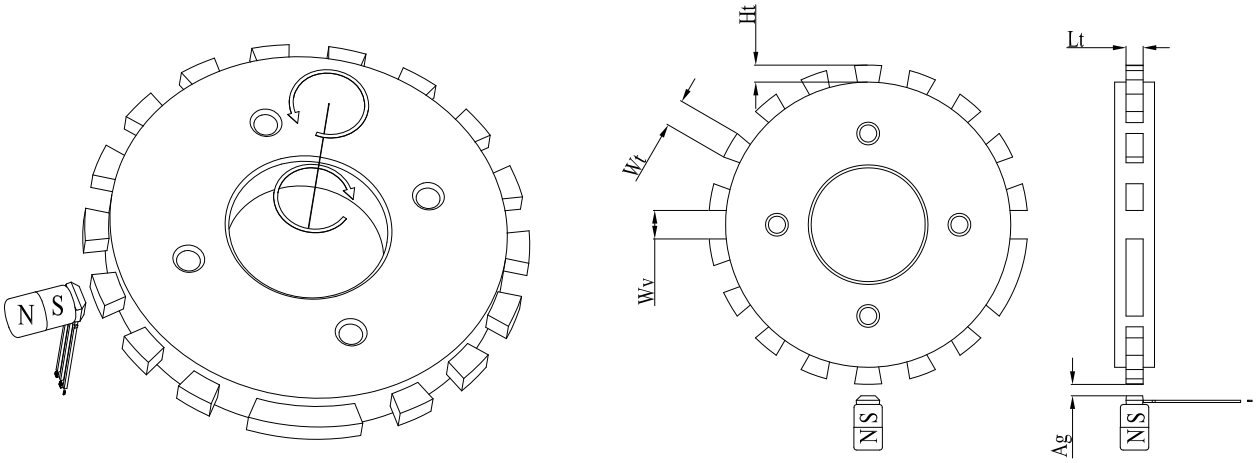


Typical application



Harsh, noisy environments and automotive application

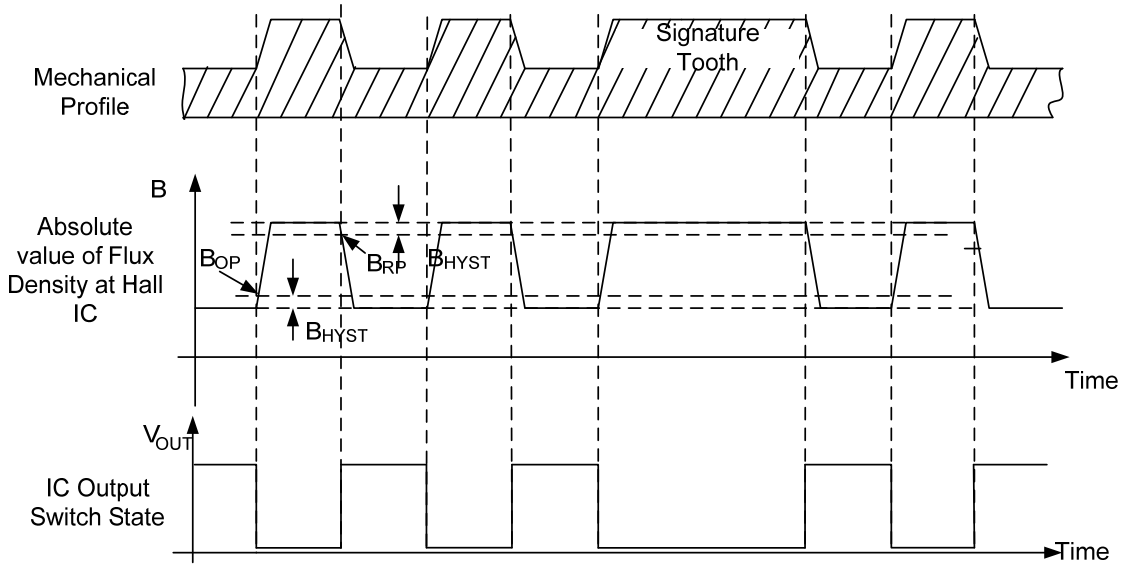
Configuration with Radial-Tooth



To generate adequate magnetic field, the following recommendations should be followed in the design and specification of magnet targets:

Symbol	Parameters	Min	Typ	Max	Units
AG	Distance of air gap	0.5	-	2.5	mm
H_T	Height of tooth	3.0	-	-	mm
L_T	Length of tooth	3.0	-	-	mm
W_T	Width of tooth	2.0	-	-	mm
W_V	Width of valley	2.0	-	-	mm
Material		Low carbon steel			

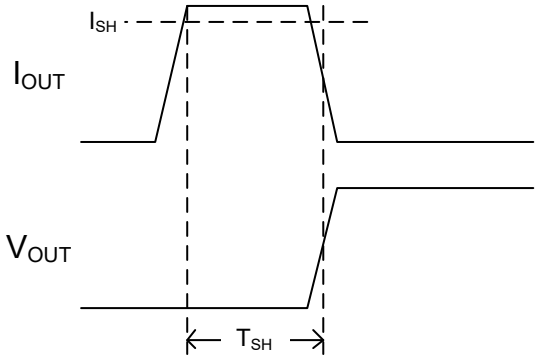
Operating Waveform



B_{OP}: Operate point, switches the output ON (V_{OUT}=Low)
B_{RP}: Release point, switches the output OFF (V_{OUT}=High)

Short circuit Protection

The MT3602 features output short-circuit protection, which turns off the output driver if the output current exceeds a pre-defined short-circuit current level I_{SH} for more than a time period of T_{SH}, as depicted in the diagram below.



Application Note:

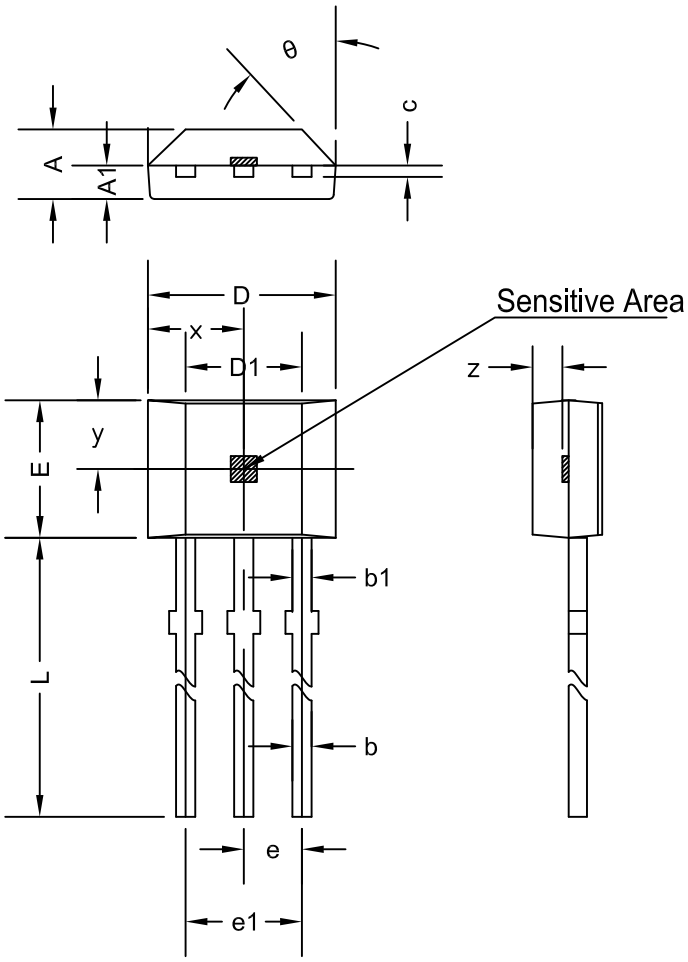
The MT3602 has a maximum dynamic range of 500 mT. The linear dynamic range is 400mT. The hysteresis is fixed at 4mT. It is recommended to use a bias magnet that provides a flux density close to the high end of the linear range to achieve the best angular accuracy.

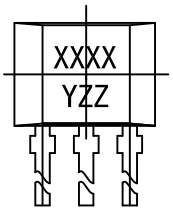
The output is reset to high level (output driver is off) at chip power-on whatever the magnetic filed is. The output only changes after the first minimum (bottom of the flux density waveform) is detected. However, if the power supply of the chip rises very slowly from zero, the reset state cannot be guaranteed.

The bias magnet must be glued to the back surface (unbranded side) of the IC with the south-pole facing the unbranded side of the device.

PACKAGE DESIGNATOR

(MT3602A) Flat TO-92





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DateCode: Y (year, 0~9) ZZ (week, 01~55)

Symbol	Dimensions in Millimeters		Dimensions in Inches	
	Min	Max	Min	Max
A	1.420	1.670	0.056	0.066
A1	0.660	0.860	0.026	0.034
b	0.350	0.560	0.014	0.022
b1	0.400	0.550	0.016	0.022
C	0.360	0.510	0.014	0.020
D	3.900	4.200	0.154	0.165
D1	2.970	3.270	0.117	0.129
E	2.900	3.280	0.114	0.129
e	1.270 TYP		0.050 TYP	
e1	2.440	2.640	0.096	0.104
L	13.500	15.500	0.531	0.610
x	2.025TYP		0.080TYP	
y	1.545TYP		0.061TYP	
z	0.500TYP		0.020TYP	
θ	45°TYP		45°TYP	