Self-Adjusting Hall-Effect Gear Tooth Sensor IC

1. Features

- Gear tooth detection
- Zero speed detection
- Self-adjusting magnetic range
- Short circuit protection
- 3.0V to 24V supply operating range
- -40℃~150℃ operating temperature range
- Package：TO-92S

2. Applications

- Camshaft sensor
- Gear tooth sensor
- Wheel speed sensor

3. Description

The SC9314 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.

The SC9314 uses a single Hall plate which is immune to rotary alignment problems. It is designed to be used with a bias magnet south facing the back(non-marked) side of the IC. The bias magnet can be from 100 to 300mT.

The logic recognizes an increasing or decreasing flux density. The output will trun on (Bop) after the flux has reached its peak and decreased by an amount eaqual to the hysteresis. Similarly the output will turn off (Brp) after the flux has reached its minimum value and increased by an amount equal to the hysteresis.

The device is available in a 3-pin TO-92S package and is lead (Pb) free, with matte tin lead frame plating.

Fig.1 TO-92S Package Outline

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4. Terminal Configuration

UA Package
(Top View)

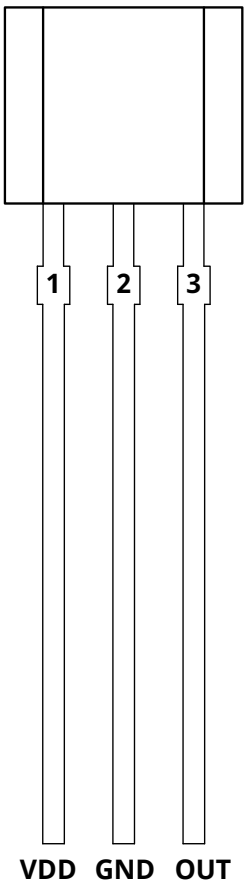


Fig.2 Pin Description

Terminal		Type	Description
Name	Number		
VDD	1	PWR	3.0V~24V power supply
GND	2	Ground	Ground
OUT	3	Output	Open-drain output required a pull-up resistor

5. Ordering Information

Ordering Information	Marking	Class	Ambient, T_A(℃)	Package	Packing	Quantity
SC9314UA-BK-Q(1)	94M	Q	-40~150	TO-92S	Bulk	1000ea/bag

Note:

(1) Q=Automotive

6. Absolute Maximum Ratings

(over operating free-air temperature range，unless otherwise noted)

Symbol	Parameter	Test conditions	Min.	Max.	Units
V_{DD}	Power supply voltage	T_J=150˚C	-0.5	30	V
V_{OUT}	Output terminal voltage	T_J=150˚C	-0.5	30	V
I_{SINK}	Output terminal current sink		-	30	mA
T_A	Operating ambient temperature		-40	150	℃
T_J	Maximum junction temperature		-55	165	℃
T_{STG}	Storage temperature		-65	175	℃
R_{thJA}	Package thermal resistance	Refer to JESD51-1 standard	-	313	℃/W

Note：
Stresses above those listed here may cause permanent damage to the device. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

7. ESD Protection

Symbol	Parameter	Test conditions	Min.	Max.	Units
V_{ESD_HBM}	HBM	Refer to AEC-Q100-002E HBM standard, R=1.5kΩ, C=100pF	-8	8	KV
V_{ESD_CDM}	CDM	Refer to AEC-Q100-011C CDM standard	-750	750	V

8. Operating Characteristics

（T_A=-40℃~150℃，V_{DD}=3.0V~24V， unless otherwise noted)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
Electrical parameters						
V_{DD}	Operating voltage	T_J<$T_{J(max)}$	3.0	5	24	V
I_{DD}	Operating supply current	V_{DD}=3.0V to 24 V	1.0	2.0	3.5	mA
V_{Qsat}	Output saturation voltage	I_O=20mA, T_A=25℃	-	150	400	mV
I_{QL}	Output leakage current	V_{DD}<24V	-	-	10	μA
t_{rp}	Response time(include power-on time)	V_{DD}>3.0V, f=1kHz	0	-	50	ms
t_r	Output rise time	R_2=1Kohm，C_2=20pF	-	-	0.5	μs
t_f	Output fall time	R_2=1Kohm，C_2=20pF	-	-	0.5	μs
f_{cu}	Upper corner frequency	-3dB, single pole	-	20	-	kHz
f_{cl}	Lower corner frequency	-3dB, single pole	-	0	-	Hz
Magnetic Characteristics						
B_{Back}	Pre-induction		-3	-	300	mT(1)
B_{OP}	Turn on hysteresis	B_{Back}=300mT	1.0	2.5	4.0	mT
B_{RP}	Turn off hysteresis	B_{Back}=300mT	1.0	2.5	4.0	mT
	Linear Region	V_{DD}=3.0V to 24V	50	-	300	mT

Note:
(1) 1mT=10GS

9. Block Diagram

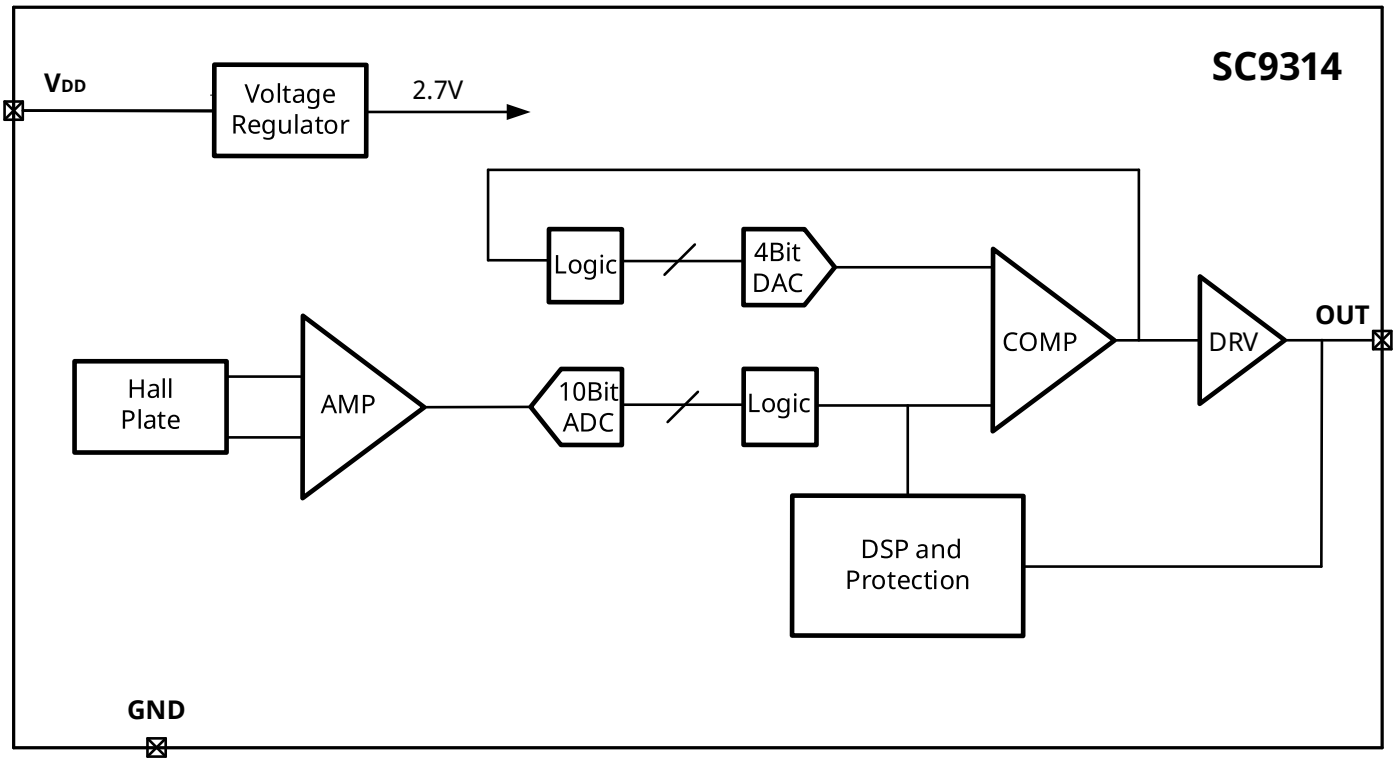


Fig.3 Block Diagram

10. Function Description

In the case of ferromagnetic toothed wheel application, the IC has to be biased by the South pole of a permanent magnet (Typical 300mT). When assembling the sensor system, a magnet as back bias flux from 100mT to 300mT is suggested. Normally the South pole of magnet faces the unbranded side of the IC and the magnet is glued to the back surface (non branded side) of the IC using an adhesive or suitable epoxy. Due to the SC9314's "Self-adjusting" over a wide range of back bias flux, the need for any trimming in the application is eliminated.

At the chip power on state, if the power is raised quickly and the output is reset to the high state whatever the field is. The output will change to low after the flux has reached its minimum value and then increased by an amount equal to the hysteresis. The output will change to high after the flux has reached its peak and then decreased by an amount equal to the hysteresis similarly. However, if the supply is raised slowly, then the reset state is not determined; the output can be either high or low.

It is strongly recommended that an external ceramic bypass capacitor in the range 10nF to 1uF be connected between the supply and ground of the device to reduce external noise. The series resistor in combination with the bypass capacitor creates a filter for EMC pulse.

The pull-up resistor should be chosen to limit the current through the output transistor, without exceeding the maximum continuous output current of the device.

11. Gear Tooth Sensing

In the case of ferromagnetic toothed wheel application, the IC has to be biased and only biased by the South pole of a permanent magnet which should cover both Hall probes

The maximum air gap depends on

- the magnetic field strength (magnet used; pre-induction), and
- the toothed wheel that is used (dimensions, material, etc.)

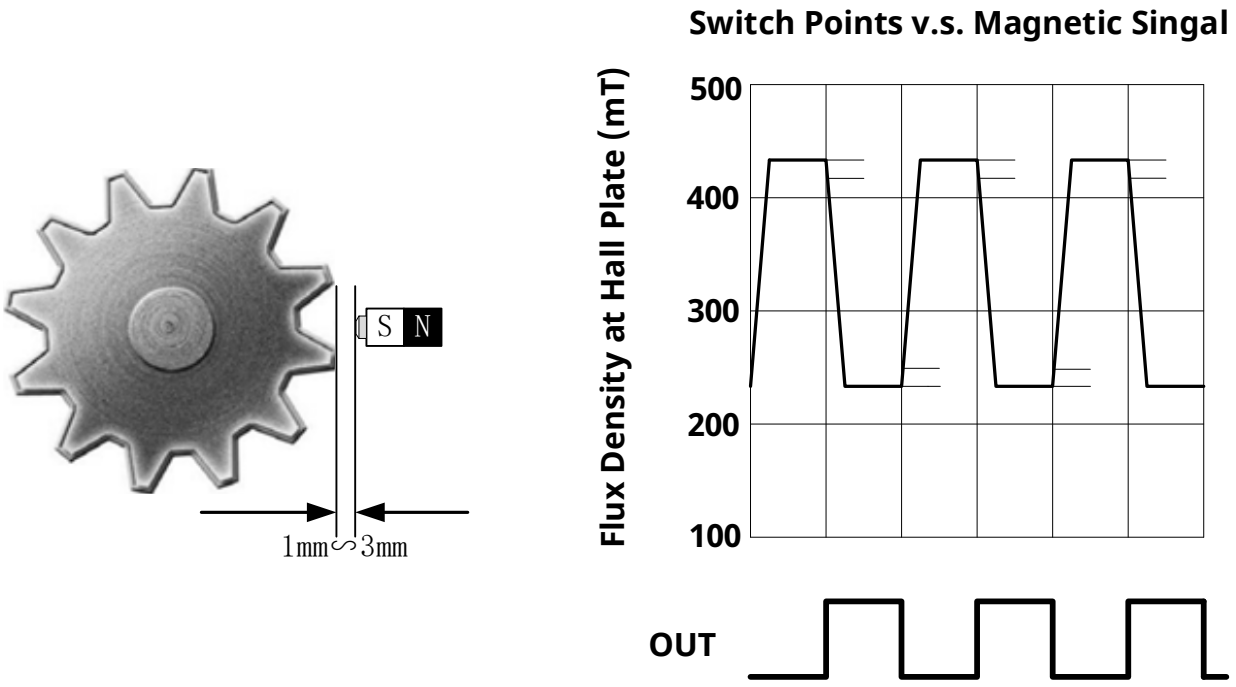


Fig.4 Switch Points versus Magnetic Signal

12. Typical Application

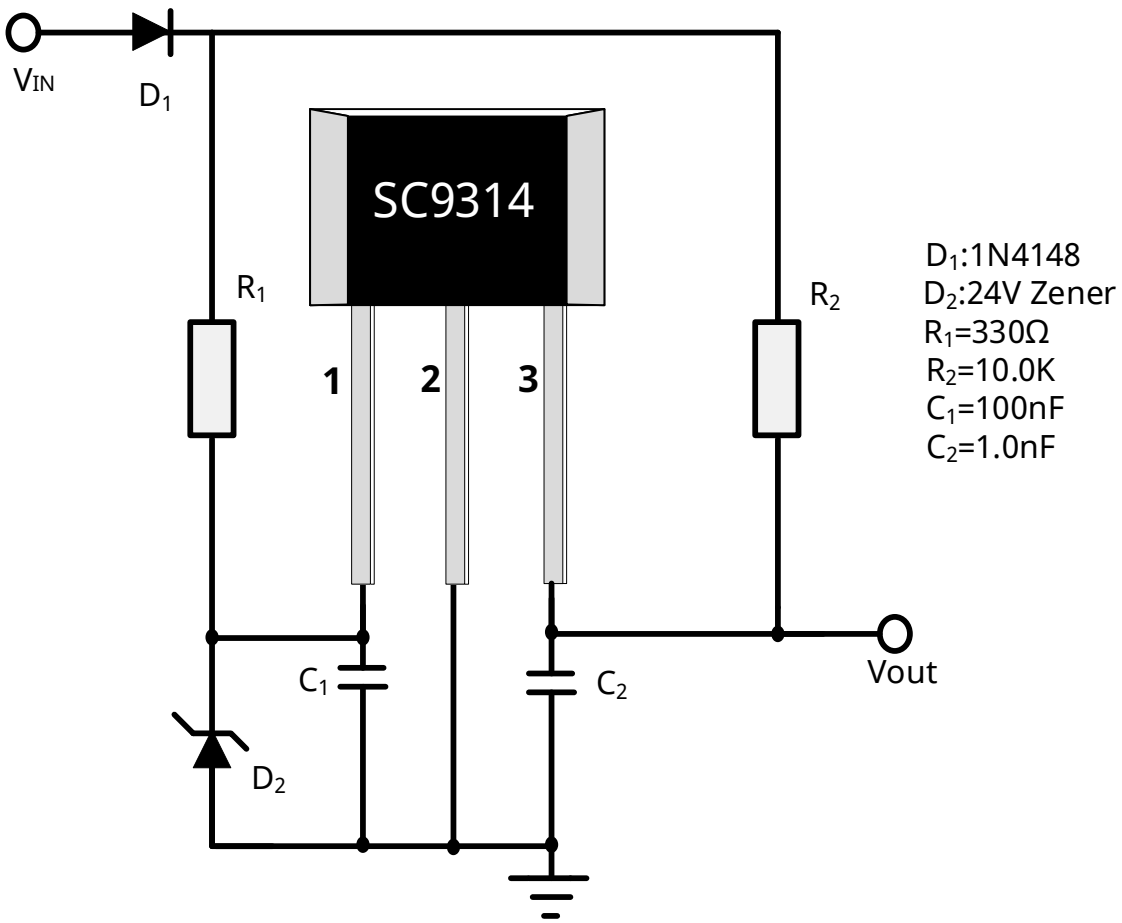
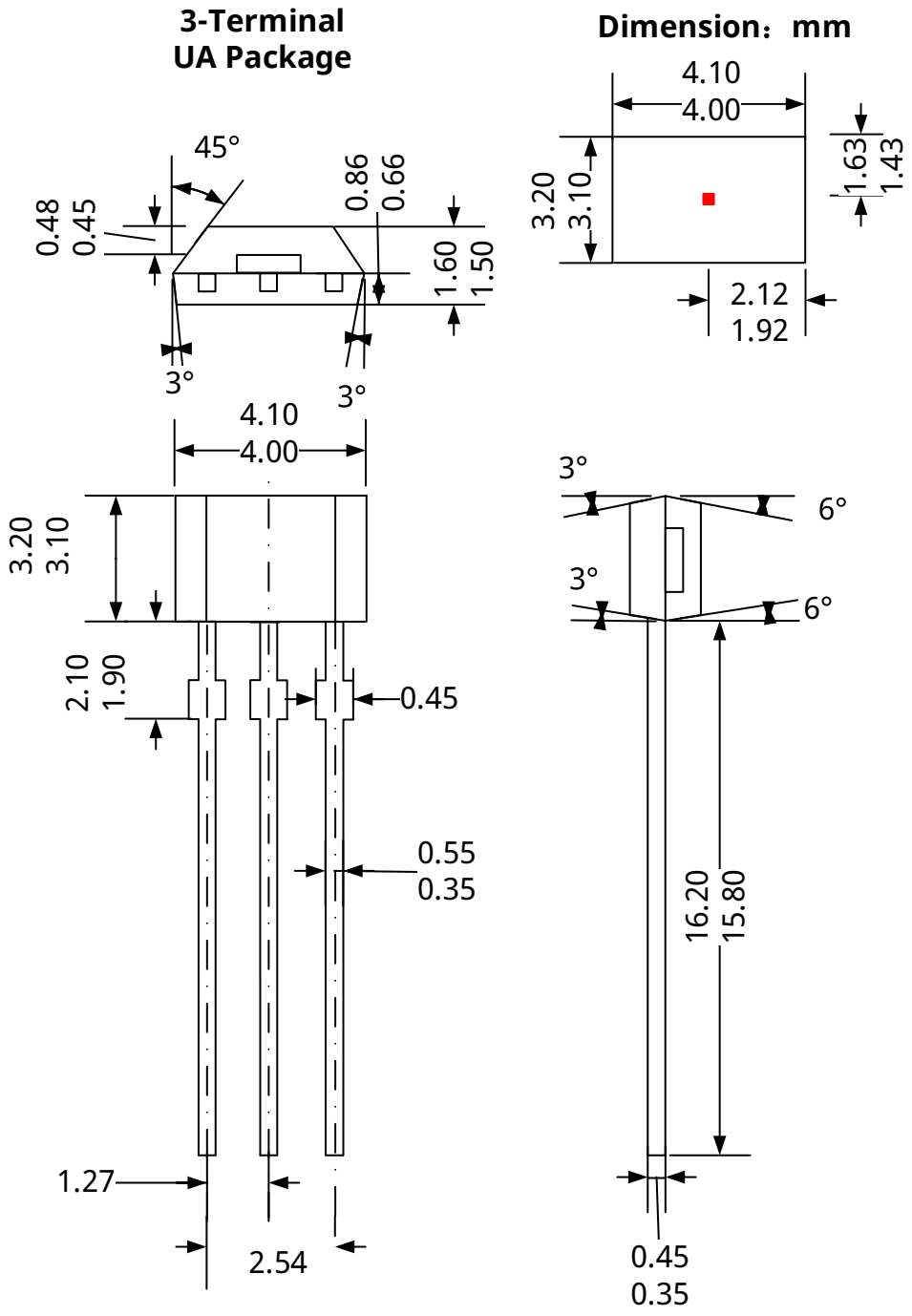


Fig.5 Typical Application Circuit

13. Package Information “TO-92S”



Notes:

1. Exact body and lead configuration at vendor’s option within limits shown.

2. Height does not include mold gate flash.

3. The plating thinckness is 7-17um.

Where no tolerance is specified, dimension is nominal.

Fig.6 Package Dimension

14. Revision History

Revision	Date	Description
Rev.0.1	2016-05-07	Preliminary datasheet
Rev.2.3	2019-12-18	The final revision of old datasheet
Rev.A1.0	2020-11-19	Unified datasheet format
Rev.A1.1	2024-11-27	Update order information；Update POD dimension

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