
Two-Wire Current Square Output High Accuracy Speed Sensor IC

1. Features

- Two-wire current interface
- High sensitivity
- South and North pole pre-induction possible
- Large air gap
- Single chip solution
- -40°C to 150°C operating temperature range
- Interior integrated capacitor against electrical disturbances
- AEC-Q100 Grade0 qualified.
- Package: TS-2

2. Product Application

- ABS wheel speed sensor
- Wheel speed sensor

3. Description

The Hall Effect sensor SC9641 is designed to provide information about rotational speed to modern vehicle dynamics control systems and ABS. The output has been designed as a two-wire current interface, square wave output, high accuracy and sensitivity, with a wide operating temperature and voltage range. High ESD and EMC robustness make it ideal for harsh automotive requirements.

The regulated current output is configured for two-wire applications, can detect magnetic rings and ferromagnetic materials.

The device is packaged in a TS-2. It is lead (Pb) free, with 100% matte tin-plated lead frame.

Not to scale



Fig.1 TS-2 Package Outline

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4. Terminal Configuration

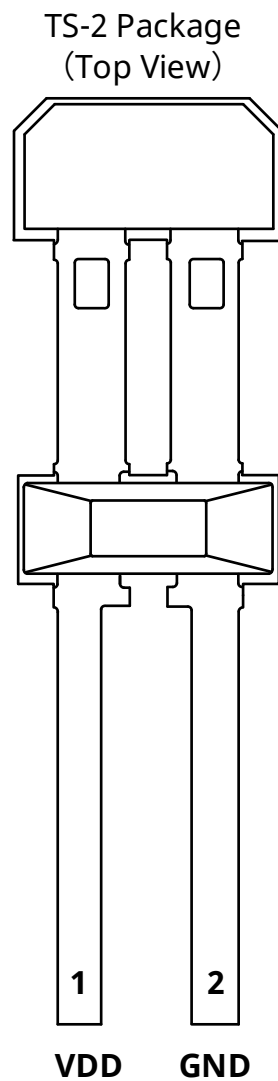


Fig.2 Pin description

Terminal		Type	Description
Name	Number		
VDD	1	PWR	4.5V ~24 V power supply
GND	2	Ground	Ground

5. Ordering Information

Ordering Information	Marking	Option	Class	Ambient, T _A (°C)	Package	Packing	Quantity
SC9641TS-P-BK	41CPA	P	-	-40 ~ 150	TS-2	Bulk	500pcs/bag
SC9641TS-P-TR	41CPA	P	-	-40 ~ 150	TS-2	Tape & reel	1500pcs/reel

6. Absolute Maximum Ratings

over operating free-air temperature range

Symbol	Parameter	Test conditons	Min.	Max.	Units
V_{DDR}	Power supply reverse Voltage	$T_j < 80^\circ\text{C}$	-0.5	-	V
V_{DD}	Power supply voltage	$t=400\text{ms}$, $R_M \geq 100\Omega$	-	30	V
I_{rev}	Reverse current	$t < 4\text{h}$, external current limitation required	-	200	mA
T_A	Operating ambient temperature		-40	150	$^\circ\text{C}$
T_j	Maximum junction temperature	5000h, $V_{DD} < 16.5\text{V}$	-55	150	$^\circ\text{C}$
T_j	Maximum junction temperature	2500h, $V_{DD} < 16.5\text{V}$	-55	160	$^\circ\text{C}$
T_j	Maximum junction temperature	500h, $V_{DD} < 16.5\text{V}$	-55	175	$^\circ\text{C}$
T_{STG}	Storage Temperature		-65	175	$^\circ\text{C}$
R_{thJA}	Thermal resistance		-	190	K/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 conditons	Min.	Max.	Units
V_{ESD_HBM}	HBM	Refer to AEC-Q100-002E HBM standard, $R=1.5\text{k}\Omega$, $C=100\text{pF}$	-8	+8	KV
V_{ESD_CDM}	CDM	Refer to AEC-Q100-011C CDM standard	-750	750	V

8. Operating Characteristics

over operating free-air temperature range (VDD=12V, unless otherwise noted)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
Electrical parameters						
V _{DD}	Operating voltage	T _J <T _{J(max)}	4.5	12	24	V
I _{DD(Low)}	Operating supply current	V _{DD} =4.5V to 24 V	5.9	7.0	8.4	mA
I _{DD(High)}	Operating supply current	V _{DD} =4.5V to 24 V	11.8	14.1	16.8	mA
Ratio	Supply current ratio	I _{DD(High)} / I _{DD(Low)}	1.9	-	-	-
t _r , t _f	Output rise/fall slew rate	RM≤750Ω, T<170°C	8	-	26	mA/us
I _X ⁽¹⁾	Current ripple	dI _X /dV _{DD}	-	-	90	uA/V
t _{po}	Power on time	V _{DD} >4.5V, for option=default	-	3.8	9	ms
		V _{DD} >4.5V, for option=P or PC	-	-	0.1	ms
Duty		V _{DD} =12V,ΔB>2mT, Sine wave	40	50	60	%
Jitter	Jitter	V _{DD} =12V,ΔB>2mT, Sine wave T _J <150°C, 1Hz<f _{mag} <2500Hz	-2	0	2	%
C	Integrated capacitance capacity	For option=PC	2.09	2.2	2.31	nF
Magnetic Characteristics						
B ₀	Pre-induction		-500	-	500	mT ⁽²⁾
ΔB _{stat} /r ⁽³⁾	Pre-induction offset	B _{left} -B _{right} when the gear is stationary	-20	0	20	mT
ΔB ⁽⁴⁾	Differential induction	B _{left} -B _{right} when the gear is rotating	-120	-	120	mT
B _{HYS}	Hysteresis		0.3	0.7	1.5	mT
f _{mag}	Frequency	-3dB, single pole, for option= default	5	-	20	kHz
		-3dB, single pole, for option= P or PC	1	-	10	kHz

Note:

(1) The ratio of the change in current to the increase in power supply as the operating voltage increases

(2) 1mT=10GS

(3) The magnetic field difference between the left and right Hall induction points in the chip is measured only by the back magnetic field, no gear or the gear is stationary

(4) After eliminating the back magnetic deviation, the magnetic field difference between the left and right Hall induction points inside the chip is passed when the gear or magnetic ring rotates

9. Block Diagram

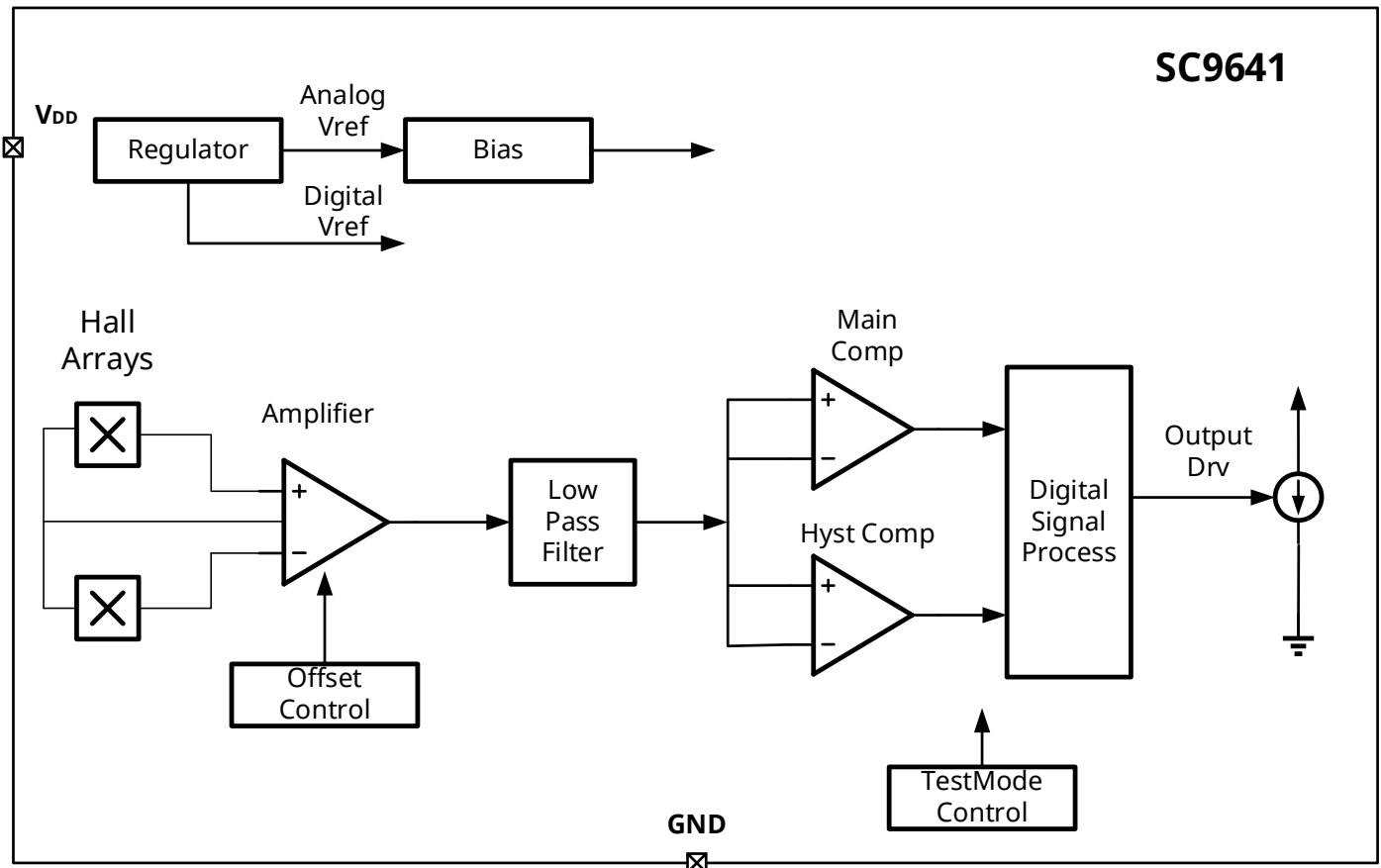


Fig.3 Block Diagram

10. Function Description

The SC9641 is an optimized Hall-effect sensing integrated circuit that contains two Hall sensing points inside the chip to detect the motion of a permanent magnet or ferromagnetic object by measuring its differential magnetic flux density.

In order to detect the motion of a ferromagnetic object, a permanent magnet must be affixed to the back of the chip (no mark surface), and the magnetic flux offset of up to $\pm 20\text{mT}$ must be eliminated through the internal self-calibration algorithm of the chip.

There is a certain hysteresis in the chip. When the differential magnetic field is higher than the positive hysteresis, the output current changes from low to high at the next moment when the differential magnetic field equals zero. When the hysteresis of the differential magnetic field is less than negative, the output current changes from high to low at the next moment when the differential magnetic field equals zero. If the spacing of permanent magnets or ferromagnetic objects is regularly distributed, the output current waveform duty cycle is 50%.

Because the circuit is a two-wire current type output and has high EMC robustness, it is very suitable for ABS wheel speed sensor.

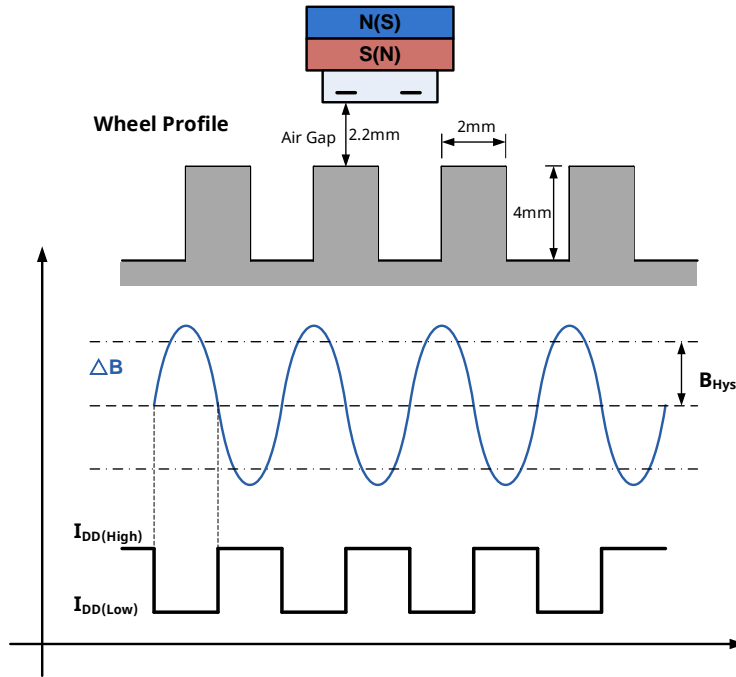


Fig.4 Gear position-differential magnetic field-output response diagram

11. Typical Application

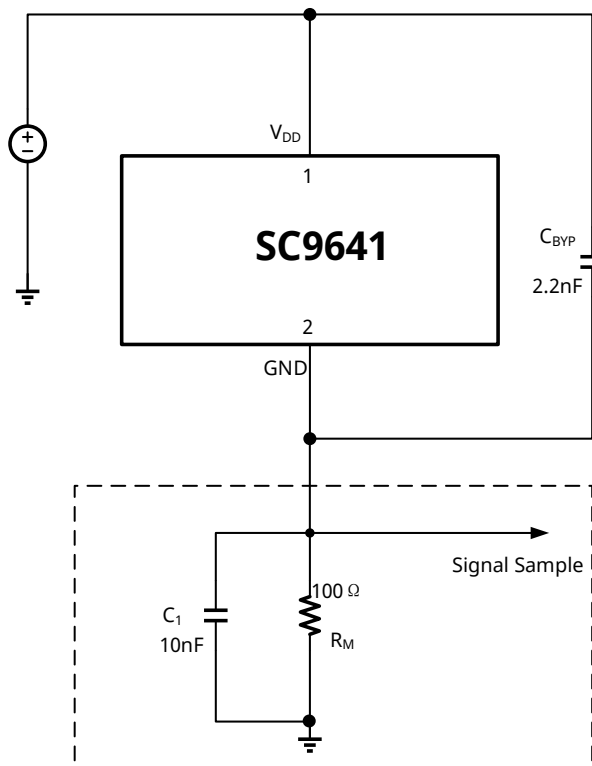
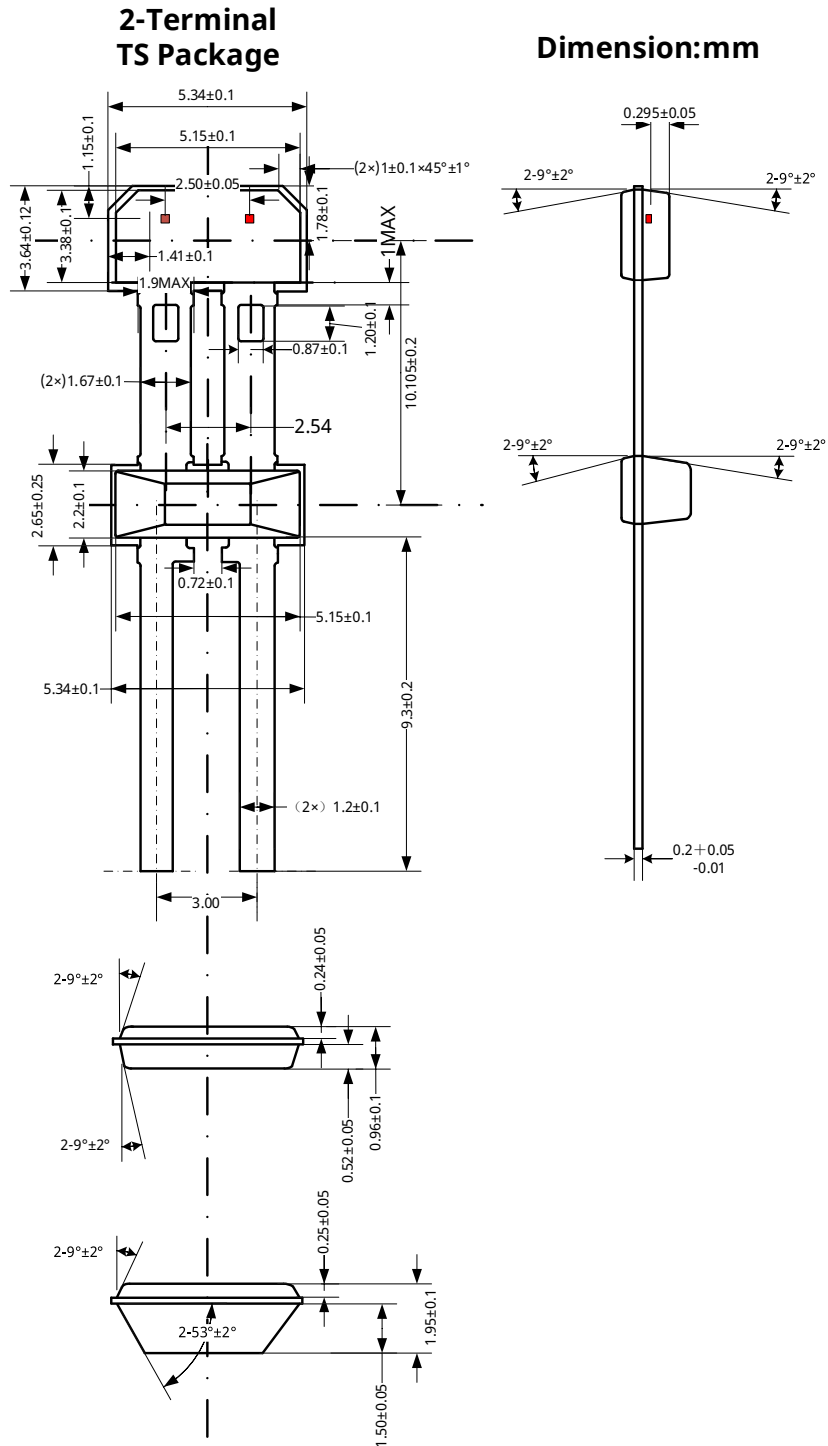


Fig.5 Typical Application

12. Package Information TS-2

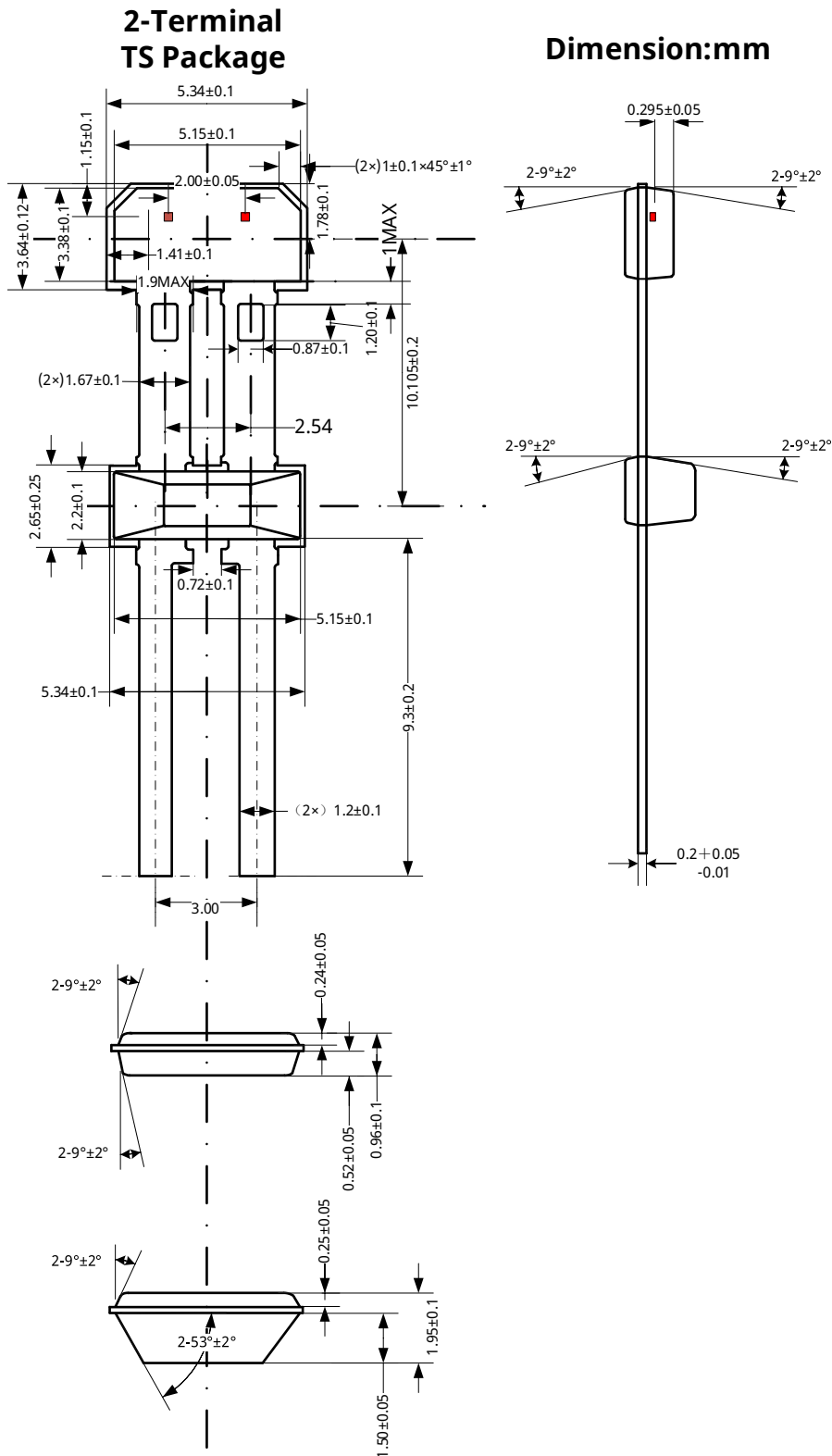


Notes:

1. Exact body and lead configuration at vendor's option within limits shown.
2. Height does not include mold gate flash.
3. The spacing between two hall plates is 2.5mm, for option=blank

Where no tolerance is specified, dimension is nominal.

Fig.6 Package Dimensions for option=blank



Notes:

1. Exact body and lead configuration at vendor's option within limits shown.
2. Height does not include mold gate flash.
3. The spacing between two hall plates is 2.0mm, for option=P or PC

Where no tolerance is specified, dimension is nominal.

Fig.7 Package Dimensions for option=P or PC

13. Revision History

Revision	Date	Description
Rev.0.1	2017-09-23	The old revision
Rev.2.3	2018-11-07	The final revision of old datasheet
Rev.A1.0	2020-11-19	Unified datasheet format
Rev.A1.1	2024-11-28	Update ordering information

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