High Performance Dual Channel Hall Effect Sensor

1. Features

- AEC-Q100 qualified.
- 2.8 V to 40 V supply voltage operation
- High sensitivity and high stability of the magnetic switching points
- Output Current Limitation: 40mA
- Reverse battery protection (up to 27 V)
- Superior temperature stability
- Excellent matching between the 2 Hall probes
- Hall plate distance 1.33 mm
- The optimum magnetic pitch for 90°phase difference: 2.5mm
- Output Function Option
  - Speed + Direction
  - Speed + Speed
- Direction signal switches before the speed signal: 400ns
- Package available.
  - SOT23-6L(S6)
  - TO-94(VB)

2. Applications

- Automotive, Industrial and Consumer
- Windows lifter with Anti-Pinch feature
- Rotation speed & direction detection
- Angular position detection
- Power closures with Anti-Pinch features

3. Description

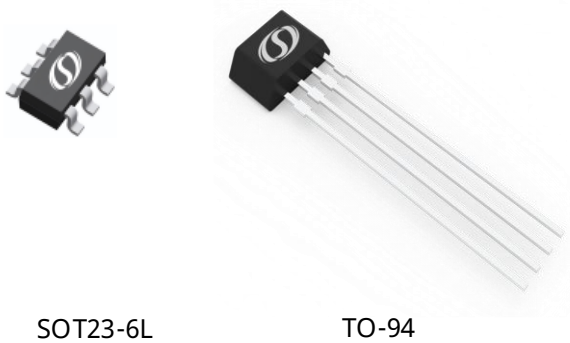
SC252X is a Dual-Channel Hall effect sensor which is designed and manufactured at the advanced 60V BCD process platform. It is ideally suited for speed and direction sensing applications containing encoded ring magnet targets. Precise magnetic switching points and high temperature stability are achieved by adopting active compensation circuits and chopper techniques. For Speed + Direction output option, they provide a speed signal at Q2 for every magnetic pole pair and a direction information at Q1, which is provided 400ns before the speed signal, And for Speed + Speed output option, both Q2 and Q1 are speed signal with 90°phase difference.

An on-chip voltage regulator allows the device to be used over a wide operating voltage range of 2.8V to 40V.

The SC252X Hall elements are spaced 1.33mm apart and are recommended to be used in conjunction with their adapted ring magnets.

The SC252X is available in 6-pin SOT23-6L and 4-pin TO-94 plastic packages which are 100% lead-free, matte tinned lead packages.

Not to scale



SOT23-6L TO-94

Fig.1 The Package Outline

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4. Terminal Configuration

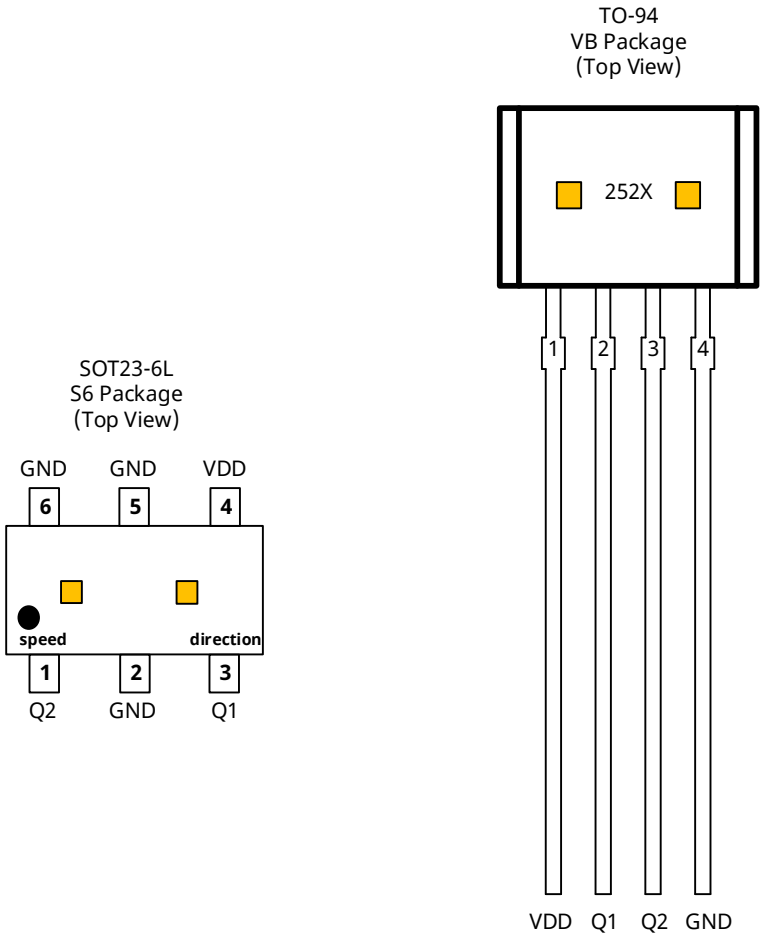


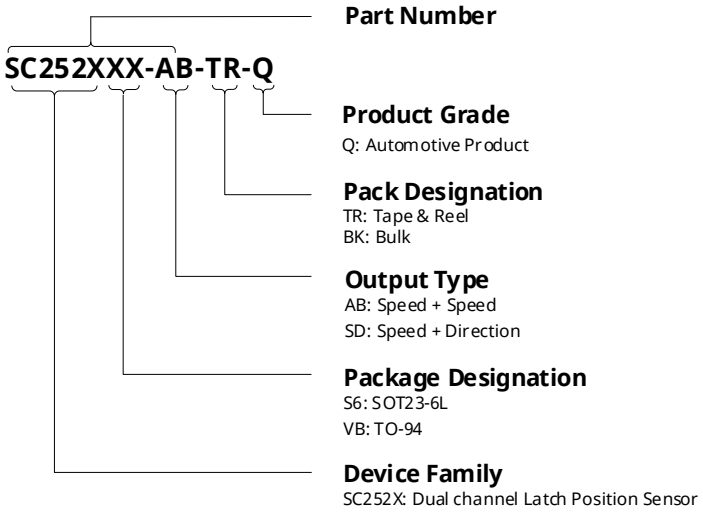
Fig.2 Terminal Configuration

Name	Terminal		Type	Description
	SOT23-6L	TO-94		
Q2	1	3	Output	Speed
GND	2	4	Ground	GND
Q1	3	2	Output	Direction / Speed
VDD	4	1	Power	Supply voltage
GND	5		Ground	GND
GND	6		Ground	GND

5. Ordering Information

Ordering Information	Mark	Option	B_{OP}(Gs)	B_{RP}(Gs)	Ambient, (℃)	Package	Pack	Quantity
SC2527S6-SD-TR-Q	2527	SD	30	-30	-40-150	SOT23-6L	Reel	3000 pieces/reel
SC2527S6-AB-TR-Q	2527	AB	30	-30	-40-150	SOT23-6L	Reel	3000 pieces/reel
SC2526VB-SD-BK	2526	SD	-30	30	-40-150	TO-94	Bulk	1000 pieces/bag
SC2526VB-AB-BK	2526	AB	-30	30	-40-150	TO-94	Bulk	1000 pieces/bag

Ordering Information Format



6. Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted) (1)

Symbol	Parameter	Test Conditions	Min.	Max.	Units
V_{DD}	Power supply voltage	*For 5 min @ Rs≥200Ω*	-27	60	V
V_{OUT}	Output voltage	*For 5 min @ 1.2 kΩ pull up resistor*	-0.5	60	V
I_{OUT}	Continuous output current		-	50	mA
T_A	Operating ambient temperature		-40	150	℃
T_J	Maximum junction temperature	*For 168 h max*	-	165	℃
T_{STG}	Storage temperature		-65	175	℃

Note:

(1) 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 Conditon	Min.	Max.	Units
V_{ESD}	HBM	according to standard AEC-Q100-002 HBM	-4	+4	KV
	CDM	according to standard AEC-Q100-011 CDM	-750	750	V

8. Thermal Characteristics

Symbol	Parameter	Test Conditions	Rating	Units
$R_{\theta JA}$	SOT23-6L Package Thermal Resistance	Single-layer PCB, with copper limited to solder pads	300 (1)	℃/W
	TO-94 Package Thermal Resistance		177 (1)	

Note:

(1) Maximum voltage must be adjusted for power dissipation and junction temperature, see Thermal Characteristics

9. Operating Characteristics

9.1. Electrical Characteristics

DC Operating Parameters VDD = 2.8V to 40V and T_A =-40°C to 150°C (unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.(1)	Max.	Units
V_{DD}	Supply Voltage		2.8	12	40	V
I_{DD}	Supply Current		-	2.04	2.7	mA
I_{DDR}	Reverse Supply Current		-	-	1	mA
$UVLO_H$	Under Voltage Protection (High)		2.2	2.3	2.5	V
$UVLO_L$	Under Voltage Protection (Low)		1.9	-	2.2	V
$UVLO_{HYS}$	Under Voltage Hysteresis		150	-	650	mV
T_{DGL}	Under Voltage Deglitch Time		-	10	-	μs
V_{SAT}	Output Saturation Voltage	VDD=3V, I_{Q1}=20mA, I_{Q2}=20mA, B_{OP}=50G	-	0.2	0.4	V
		VDD=3V, I_{Q1}=30mA, I_{Q2}=30mA, B_{OP}=50G	-	-	0.5	
I_{LKG}	Output Leakage Current	VDD=5V,B<BRP-20G, GND=0V, V_{Q1}=40V, V_{Q2}=40V	-	-	10	μA
I_O	Output Sink Current	VDD=3V, I_{Q1}=2V, I_{Q2}=2V, B_{OP}=50G	30	40	50	mA
t_F(3)	Output Falling Time	VDD=12V, GND=0V, V_{PU}(4)=12V, QX Connected To R_{PU}(4)=2K, B<BRP-20G.	-	-	1	μs
t_R(3)	Output Rising Time	VDD=12V, GND=0V, V_{PU}=12V, QX Connected To R_{PU}=2K, B>BOP+20G.	-	-	1	us
T_{PO}	Enable Time of Q1 Or Q2 After Exceeding Of V_{UV}	VDD：Step Up From 0V To 5V, GND=0V, Q1 And Q2 Connected With RL=2K, B>BOP+20G.	-	20	50	μs
T_D(2)	Systematic Delay Between Magnetic Threshold Reached and Output Switching.	Guaranteed By Design	-	20	40	μs
T_{SAMP}(2)	The Sampling Period	Guaranteed By Design	-	4	-	μs
F_C(2)	The Chopper Frequency	Guaranteed By Design	-	1	-	MHz
T_{DC}	Count Signal Delay After Direction (5)		200	400	600	ns
T_{JIT}(2)	Output Jitter	Typ. value for square wave signal 1 k Magnetic Field.	-	2.6	-	μS_{RMS}

Note:

(1) Typical values are defined at T_A = +25°C and V_{DD} = 12V

(2) Based on device characterization results, not subject to production test

*(3) Measured between 0.1*V_{PU} and 0.9*V_{PU}*

(4) R_{PU} and V_{PU} are the external pullup resistor and external pullup voltage.

(5) Controlled delay between direction (DIR) signal update and speed (SP) signal update

9.2. Magnetic Characteristics

DC Operating Parameters VDD = 2.8V to 40V and TA =-40°C to 150°C (unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
f_{BW}	Magnetic Switching Frequency		-	-	20	kHz
dHall	Hall Plate Spacing		-	1.33	-	mm
SC2527S6 +3mT/-3mT						
B_{OP}	Operating Point		2	3	4	mT(1)
B_{RP}	Release Point		-4	-3	-2	mT
B_{HYS}	Magnetic Hysteresis		4	6	8	mT
B_{MATCH}	Magnetic Match	B_{OP1}-B_{OP2} and B_{RP1}-B_{RP2}	-2	-	2	mT
		(B_{OP}+B_{RP})/2	-2	-	2	mT
TC (2)	Temperature Coefficient		-	1000	-	ppm/℃
SC2526VB -3mT/+3mT						
B_{OP}	Operating Point		-4	-3	-2	mT
B_{RP}	Release Point		2	3	4	mT
B_{HYS}	Magnetic Hysteresis		4	6	8	mT
B_{MATCH}	Magnetic Match	B_{OP1}-B_{OP2} and B_{RP1}-B_{RP2}	-2	-	2	mT
		(B_{OP}+B_{RP})/2	-2	-	2	mT
TC	Temperature Coefficient		-	1000	-	ppm/℃

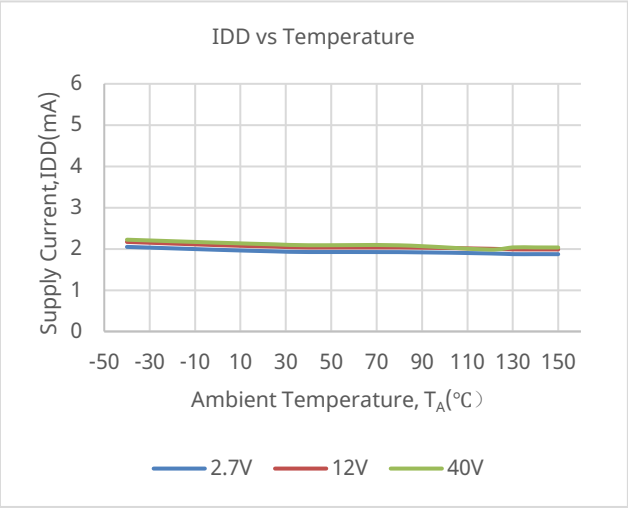
Note:

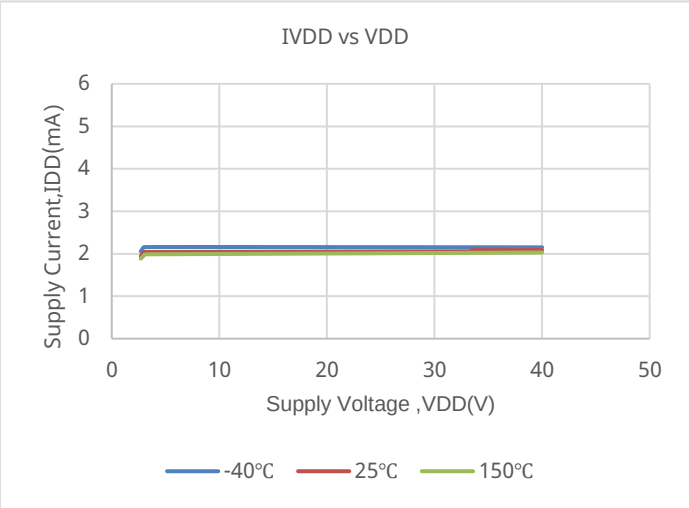
(1) 1mT=10GS

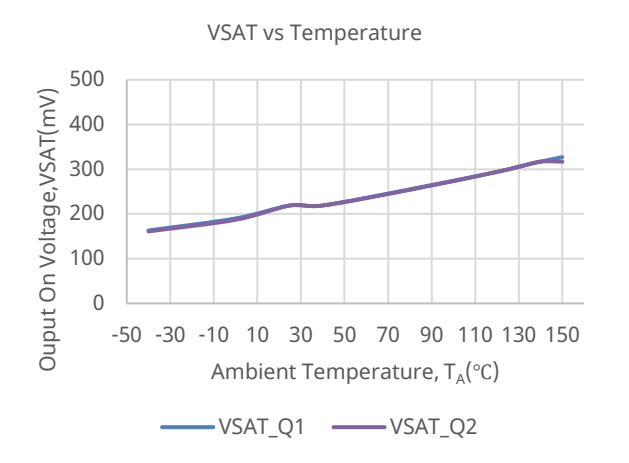
(2) Temperature coefficient value is guaranteed by design and verified by characterization and is calculated using the following formula:

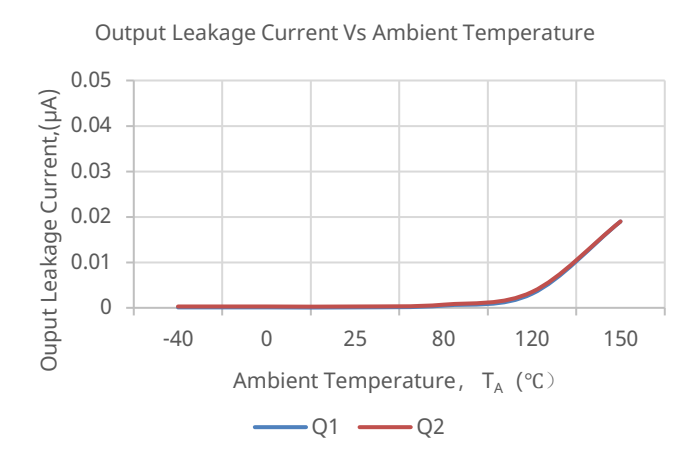
$$TC = \frac{BT2 - BT1}{BT1 \times (T2 - T1)} \times 10^6, ppm/℃, T1 = 25℃, T2 = 150℃$$

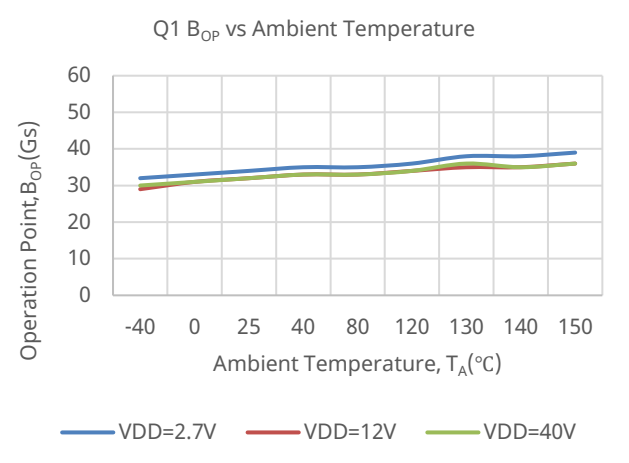
10. Typical Characteristic

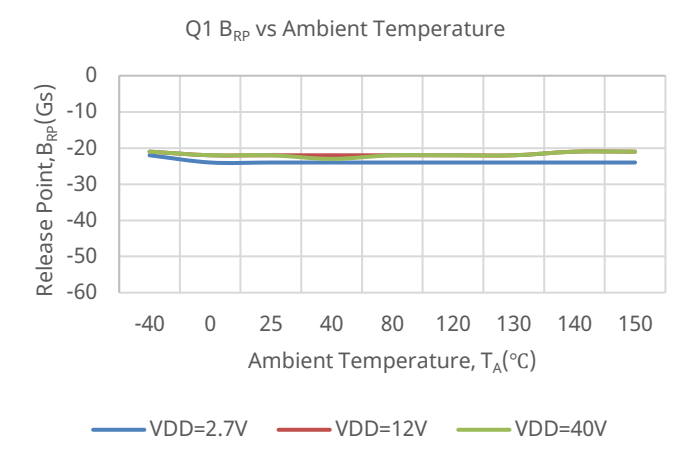


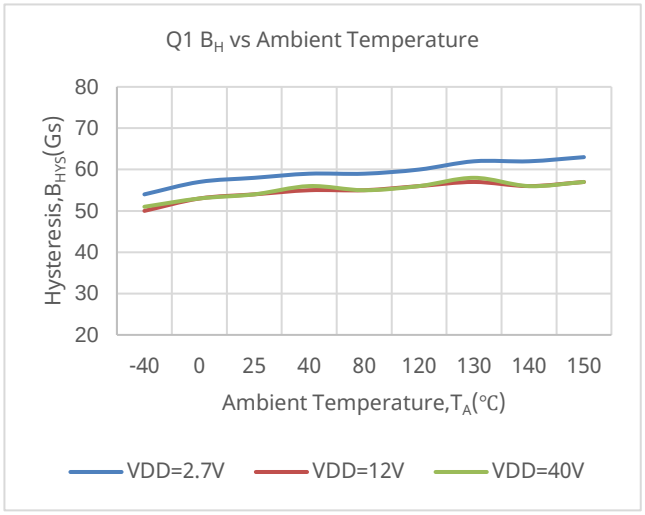


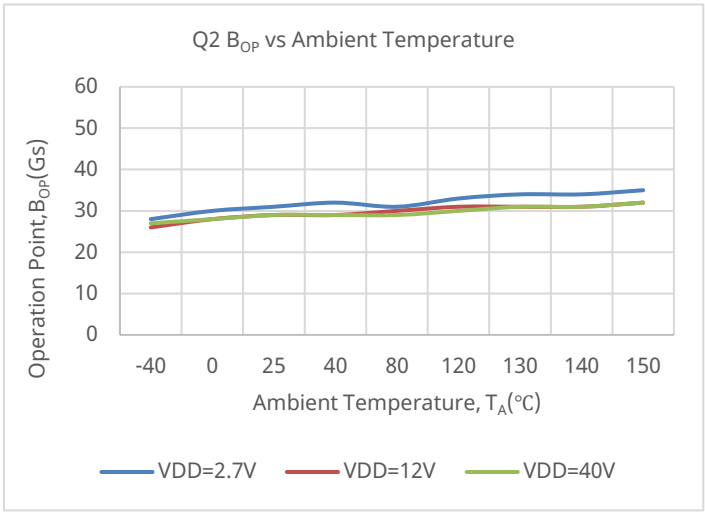


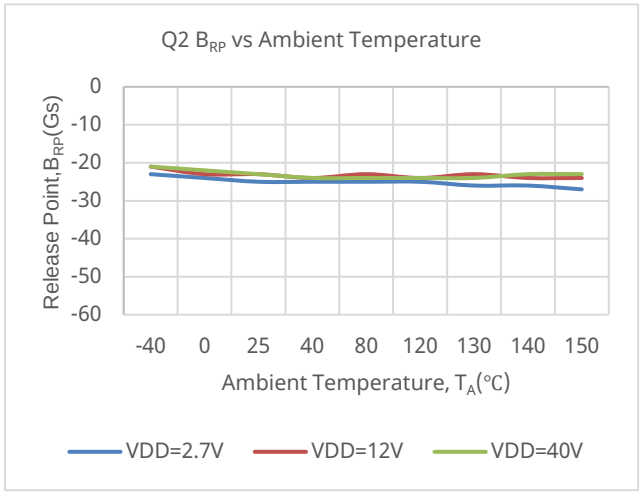


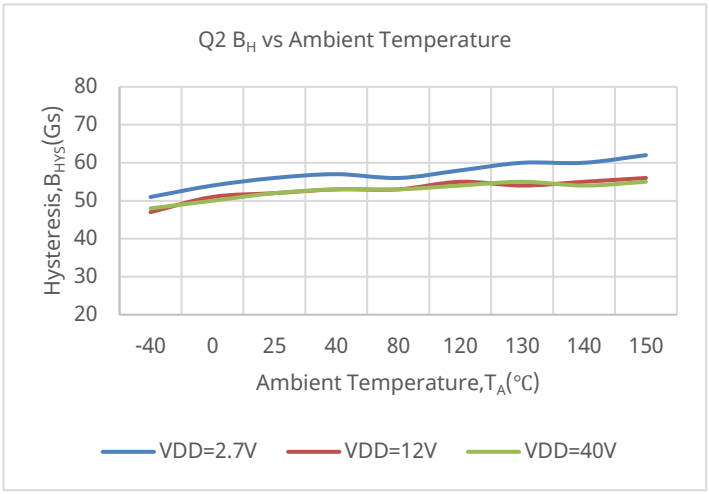


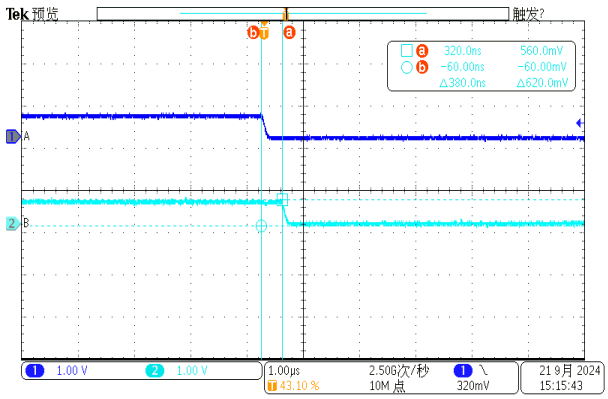




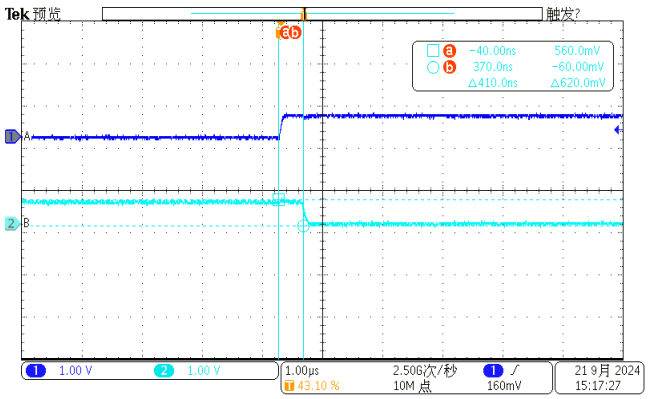








The Direction Ahead 380ns Before Speed



The Direction Ahead 410ns Before Speed

11. Block Diagram

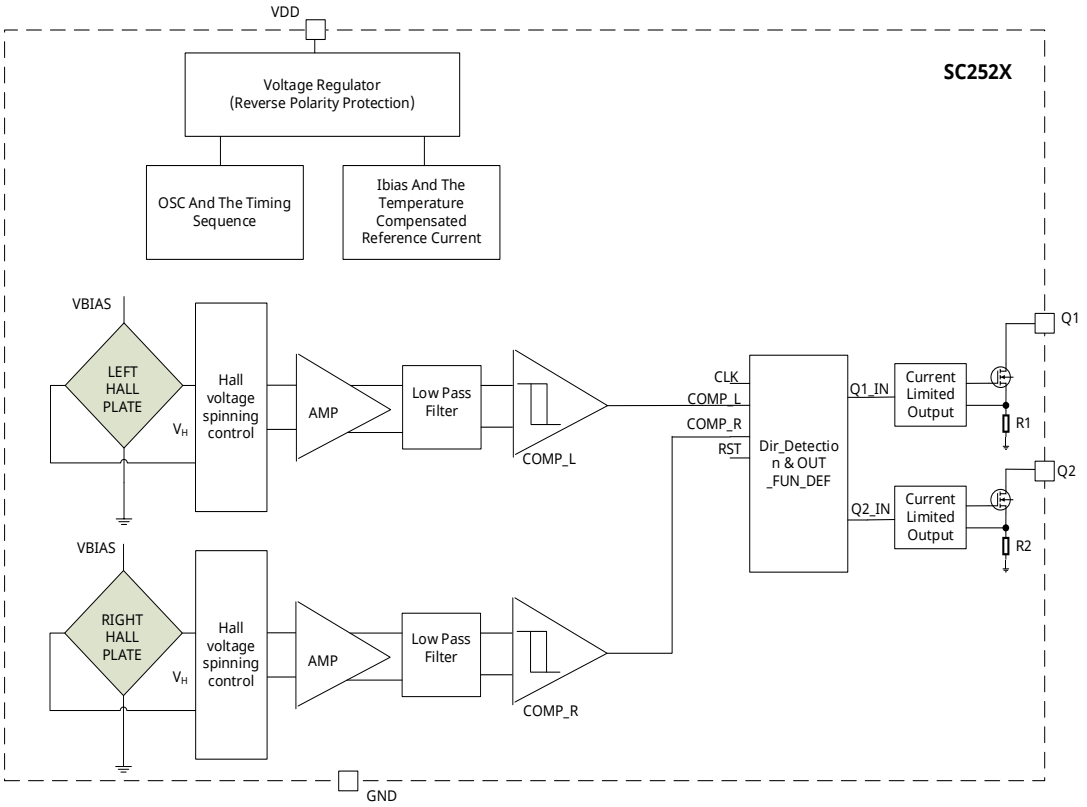


Fig. 3 Functional block diagram

12. Function Description

The chopped Double Hall Switch comprises the voltage regulator, two Hall probes, bias generator, compensation circuit, oscillator, amplifier, filter, hysteresis comparator and the current limited open-drain output. An on-chip voltage regulator allows the device to be used over a wide operating voltage range of 2.8V to 40V which makes the device suitable for a wide range of industrial and automotive applications. The bias generator provides currents for the Hall probes and the active circuits, the compensation circuits stabilize the temperature behavior and reduce technology variations. The Hall probe, the amplifier, filter, the hysteresis comparator and the current limited open drain output compose the Hall signal process channel. The Active Error Compensation rejects offsets in signal stages and the influence of mechanical stress on the Hall probes caused by molding and soldering processes and other thermal stresses in the package. This chopper technique together with the threshold generator and the comparator ensures high accurate magnetic switching points.

SC252X is the dual channel Hall switch platform, mainly aimed at detecting the speed and direction of DC motor rotation in the automotive application.

With latching magnetic characteristics, the speed (SP) output is turned low or high respectively with a sufficiently strong South or North pole facing the package top side. When removing the magnetic field, the device keeps its previous state. The direction (DIR) output is latched in Low or High state depending on the movement direction of the applied magnetic field.

12.1. Field Direction Definition

A multipolar magnetic ring is used as the rotate target.

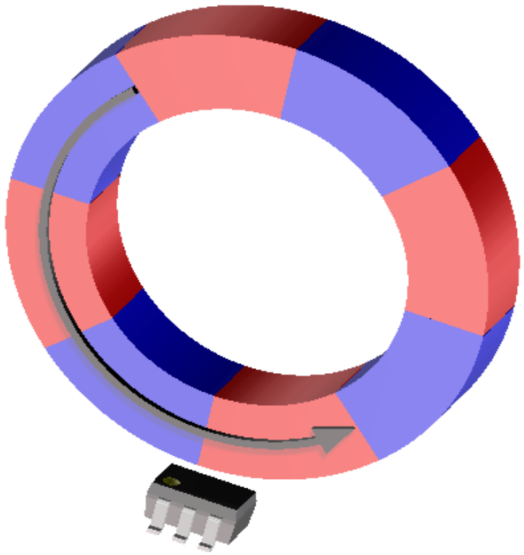


Fig. 4 Magnetic Field Direction Definition

Product No.	Rotation Direction	State of Direction Output Q1
SC2527S6-SD-TR-Q	Left to right	Low
	Right to left	High
SC2527S6-AB-TR-Q	N/A	N/A
SC2526VB-SD-BK	Left to right	Low
	Right to left	High
SC2546VB-AB-BK	N/A	N/A

13. Typical Application

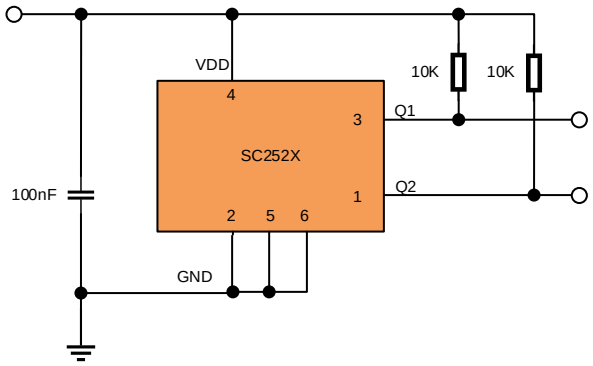


Fig. 5 The Typical Application Schematic

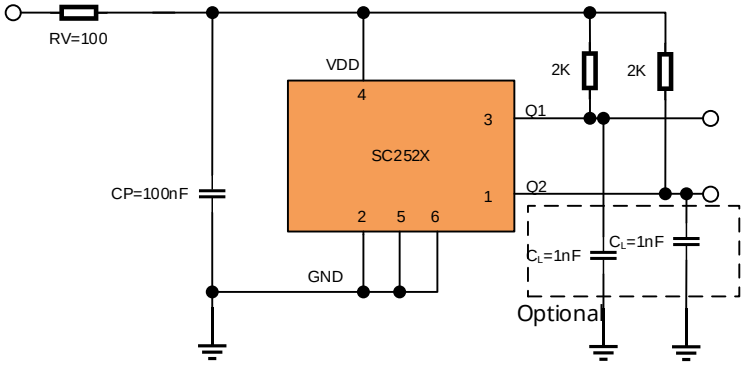


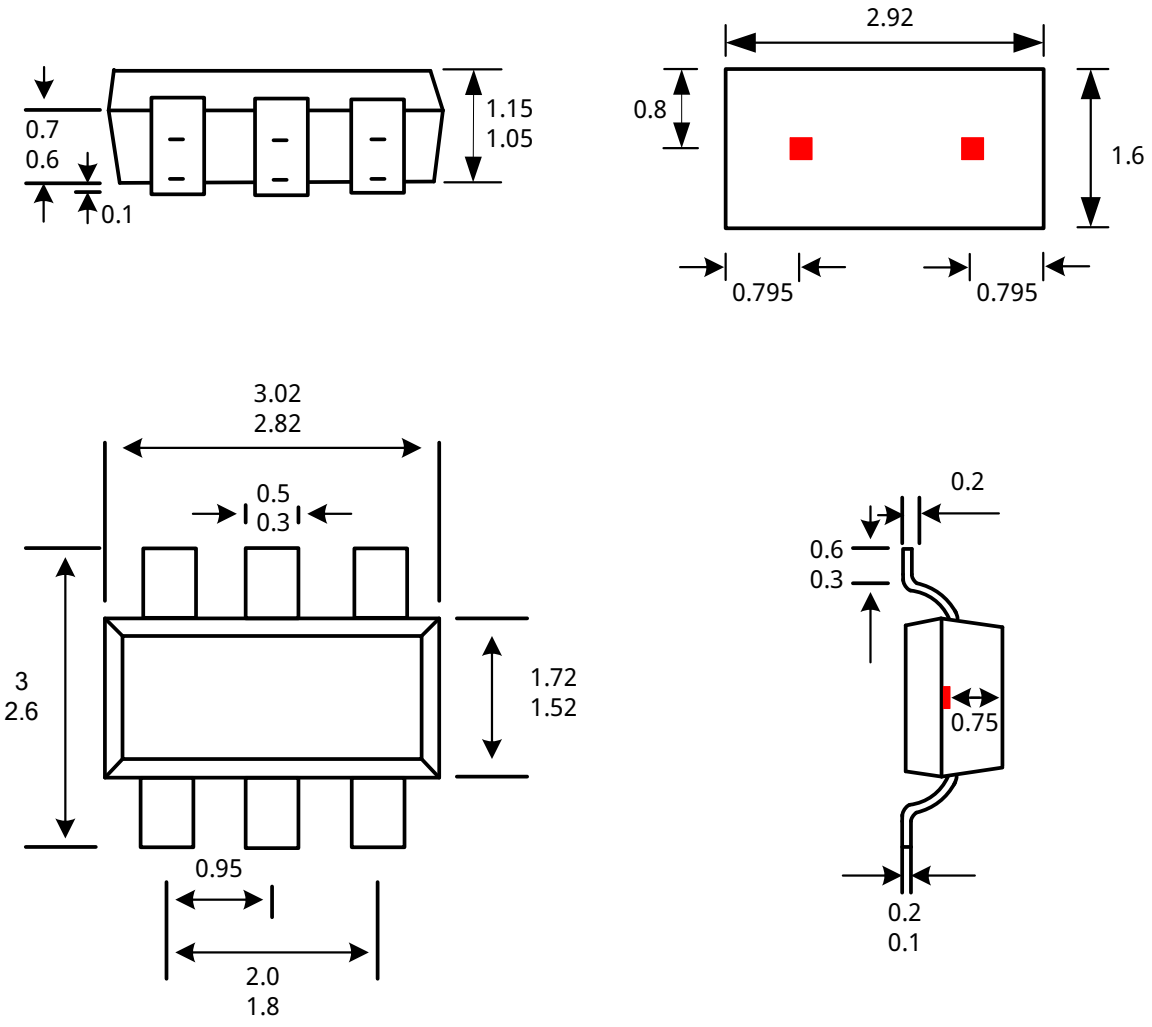
Fig. 6 The Recommended Application Schematic for ISO7637-2

Note:
1. Recommended schematic for conducted transients on supply line above 40V with duration above 500ms.
2. Recommended schematic for conducted transients on supply line above 60V.

14. Package Information "S6"

SOT23-6L
S6 Package

Unit：mm

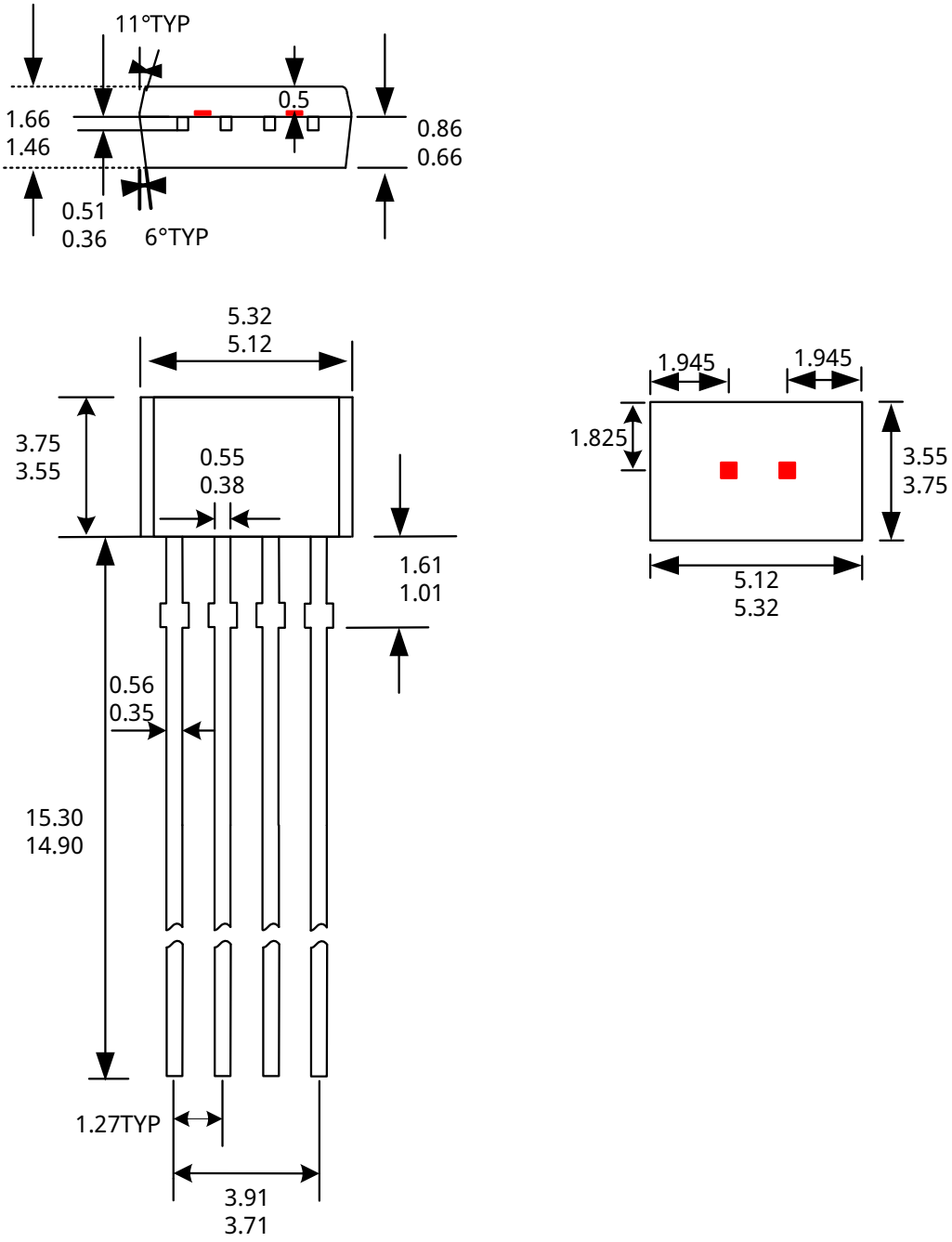


Notes:
1.Exact body and lead configuration at vendor's option within limits shown.
2.Height does not include mold gate flash, Where no tolerance is specified, dimension is nominal.

15. Package Information "VB"

TO-94
VB Package

Unit: mm



Notes:
1.Exact body and lead configuration at vendor's option within limits shown.
2.Height does not include mold gate flash. Where no tolerance is specified, dimension is nominal.

16. Revision History

Revision	Date	Description
Rev. E0.1	2024-07-25	Preliminary datasheet
Rev. A1.0	2024-11-27	Initial Release