High Sensitive Digital-Bipolar Hall Effect Sensor

1. Features

- Ultra-high sensitivity
- Built-in Pull-up resistor
- High chopping frequency
- Supports a wide voltage range: 2.5~24V
- Wide operating temperature range: -40~125℃
- Solid-state reliability
- Small package
  - 3-pin TO-92S (UA)
  - 3-pin SOT23-3L (SO)

2. Applications

- Power tools
- BLDC motor commutation
- Flow meters
- Valve and solenoid status
- Proximity sensing
- Tachometers

3. Description

The SC2202 is a Hall-effect latch designed in mixed signal BiCMOS technology. The device integrates a voltage regulator, Hall sensor with dynamic offset cancellation system, Schmitt trigger and an open-drain output driver, all in a single package.

The low operating voltage and extended choice of temperature range make it suitable for use in automotive, industrial and consumer low voltage applications.

An onboard regulator permits with supply voltages of 2.5 to 24V which makes the device suitable for a wide range of industrial and automotive applications

The device is available in a 3-pin SIP package (UA) and a 3-pin SOT-23 style package (SO). Both are lead (Pb) free, with 100% matte tin lead frame plating.

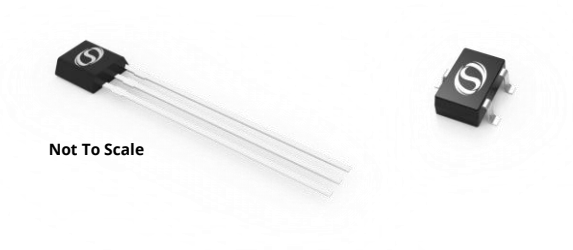

Fig.1 Package Outline

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4. Terminal Configuration

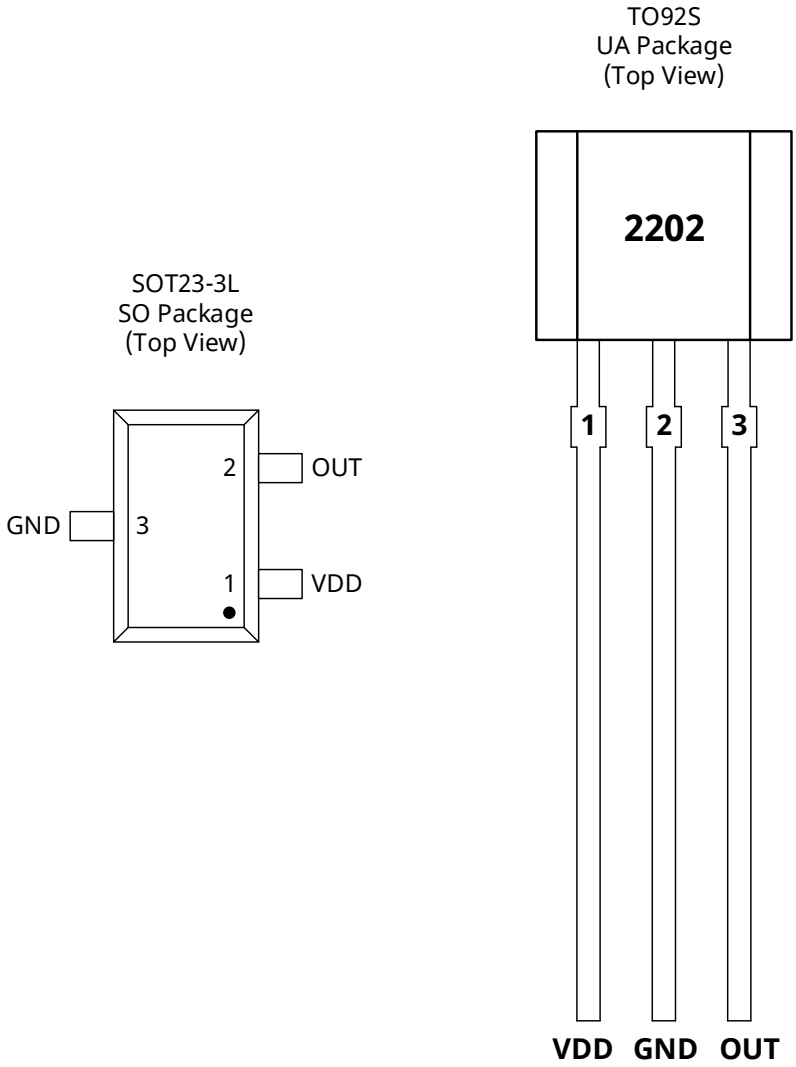


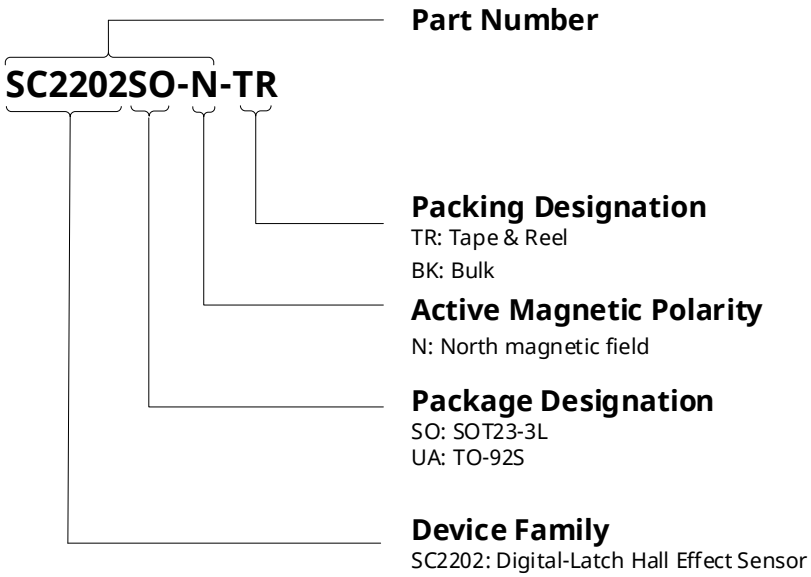
Fig. 2: Terminal Configuration

Terminal		Name	Type	Description
UA	SO			
1	1	VDD	Power	2.5V ~ 24 V power supply
2	3	GND	Ground	Ground terminal
3	2	OUT	Output	Built-in pull-up resistor output

5. Ordering Information

Order Information	Mark	Option	Ambient, T_A(℃)	Package	Packing	Quantity
SC2202SO-N-TR	2202	N	-40~125	SOT23-3L	TR	3000/reel
SC2202UA-BK	2202		-40~125	TO-92S	BK	1000/bag

Ordering Information Format:



6. Absolute Maximum Ratings

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

Symbol	Parameter	Test Condition	Min.	Max.	Units
V_{DD}	Power supply voltage		-0.5	28	V
V_{OUT}	Output terminal voltage	For 5 Min. @1.2K pull-up resistor	-0.5	28	V
I_{SINK}	Output terminal current sink		0	30	mA
T_A	Operating ambient temperature		-40	125	℃
T_J	Maximum junction temperature		-55	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 Condition	Min.	Max.	Units
V_{ESD_HBM}	HBM	according to: standard ANSI/ESDA/JEDEC-001	-3	3	kV
V_{ESD_CDM}	CDM	according to: standard ANSI/ESDA/JEDEC-002	-750	750	V

8. Thermal Characteristics

Symbol	Parameter	Test Conditions	Rating	Units
$R_{\theta JA}$	UA Package thermal resistance	Single-layer PCB, with copper limited to solder pads	166 (1)	℃/W
	SO Package thermal resistance	Single-layer PCB, with copper limited to solder pads	228 (1)	℃/W

Note:

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

9. Operating Characteristics

9.1. Electrical Characteristics

over operating free-air temperature range (V_{DD} = 5.0V, unless otherwise noted)

Symbol	Parameter	Test Conditions	Min.	Typ.(1)	Max.	Units
V_{DD}	Operating voltage (2)	$T_J < T_{J(Max.)}$	2.5	5.0	24	V
$I_{DD\ (off)}$	Operating supply current	V_{DD}=2.5 to 24 V, T_A=25℃	0.8	1.3	2.0	mA
$I_{DD\ (on)}$			0.8	2.6	4.4	mA
t_{on}	Power-on time	V_{DD}≥5.0V	-	35	50	μs
I_{QL}	Off-state leakage current	Output Hi-Z	-	-	3	μA
$R_{DS\ (on)}$	FET on-resistance	V_{DD} =5V, I_O=10mA, T_A=25℃	-	20	-	Ω
		V_{DD} =5V, I_O=10mA, T_A=125℃		30	-	Ω
t_d	Output delay time	B=B_{RP} to B_{OP}	-	15	25	μs
t_r	Output rise time (10% to 90%)	R1=1Kohm Co=50pF	-	-	0.5	μs
t_f	Output fall time (90% to 10%)	R1=1Kohm Co=50pF	-	-	0.2	μs

Note:

(1) Typical values are defined at T_A = 25°C and V_{DD} = 5.0V

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

9.2. Magnetic Characteristics

over operating free-air temperature range (V_{DD} = 5.0V, unless otherwise noted)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
f_{BW}	BW		20	-	-	kHz
SC2202						
B_{OP}	Operating point	T_A=-40˚C to 125˚C	-	+1.5	+3.0(1)	mT(2)
B_{RP}	Release point		-3.0	-2.0	-	mT
B_{HYS}	Hysteresis		-	3.0	-	mT

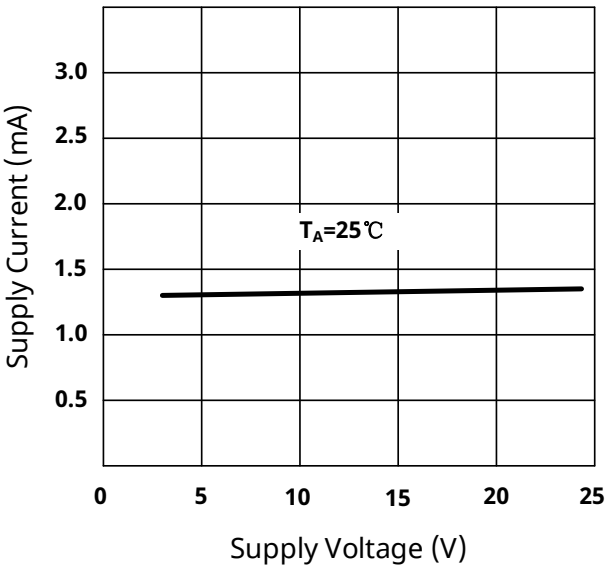
Note:

(1) Magnetic flux density, B is indicated as a negative value for North-polarity magnetic fields, and as a positive value for South-polarity magnetic fields,

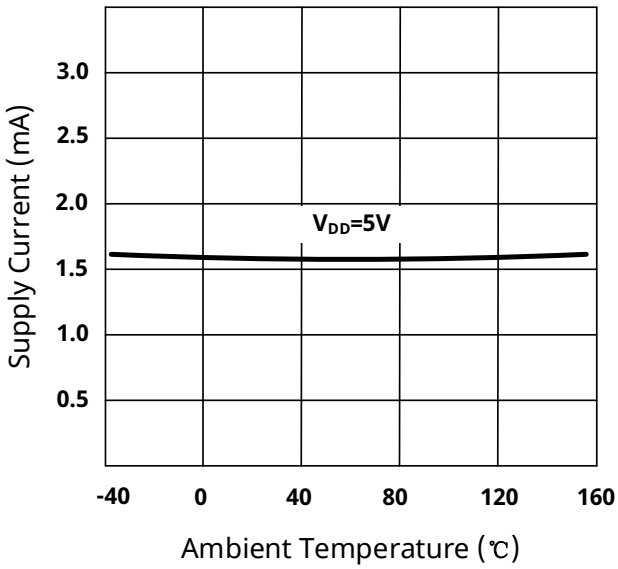
(2) 1mT=10Gs

10. Typical Characteristics

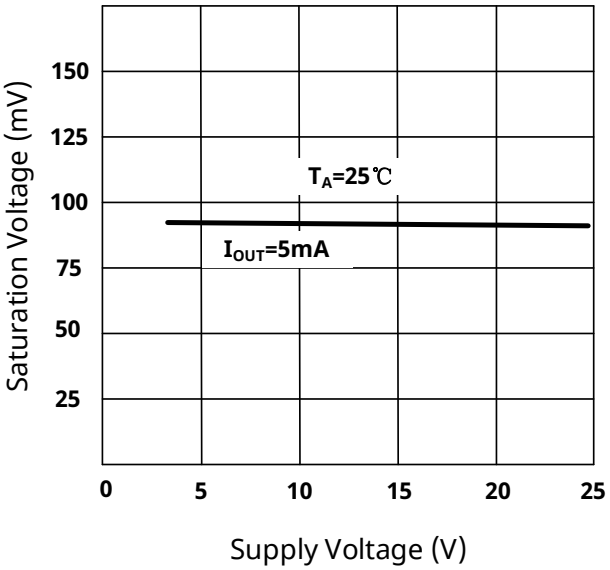
I_{DD} vs V_{DD}



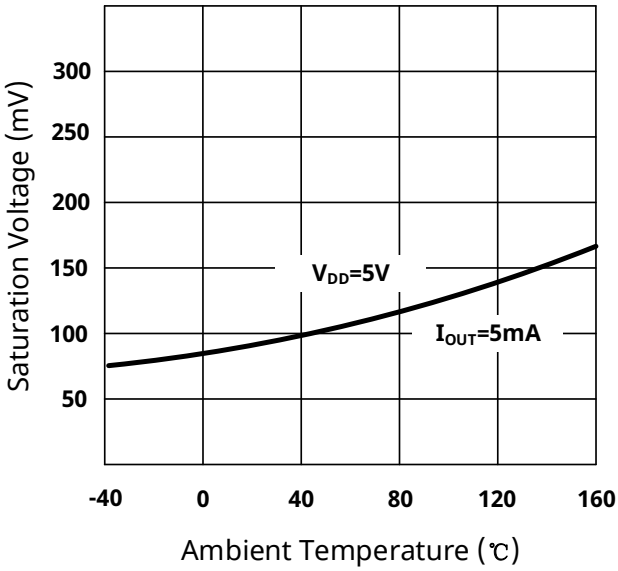
I_{DD} vs T_A



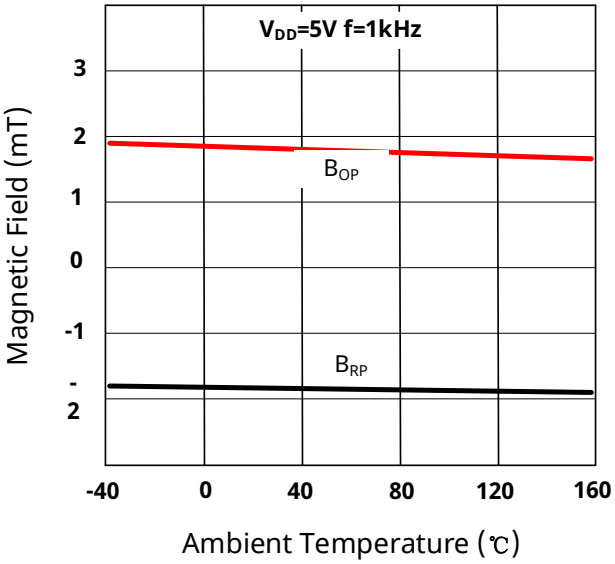
$V_{Q(sat)}$ vs V_{DD}



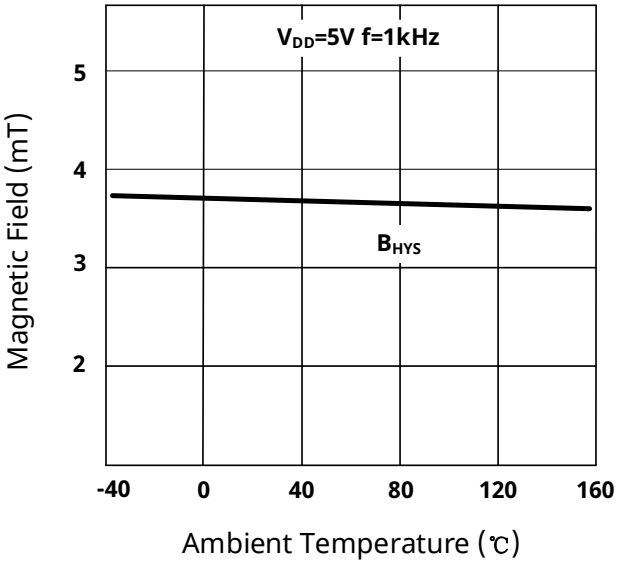
$V_{Q(sat)}$ vs T_A



B_{OP} and B_{RP} vs T_A



B_{HYS} vs T_A



11. Block Diagram

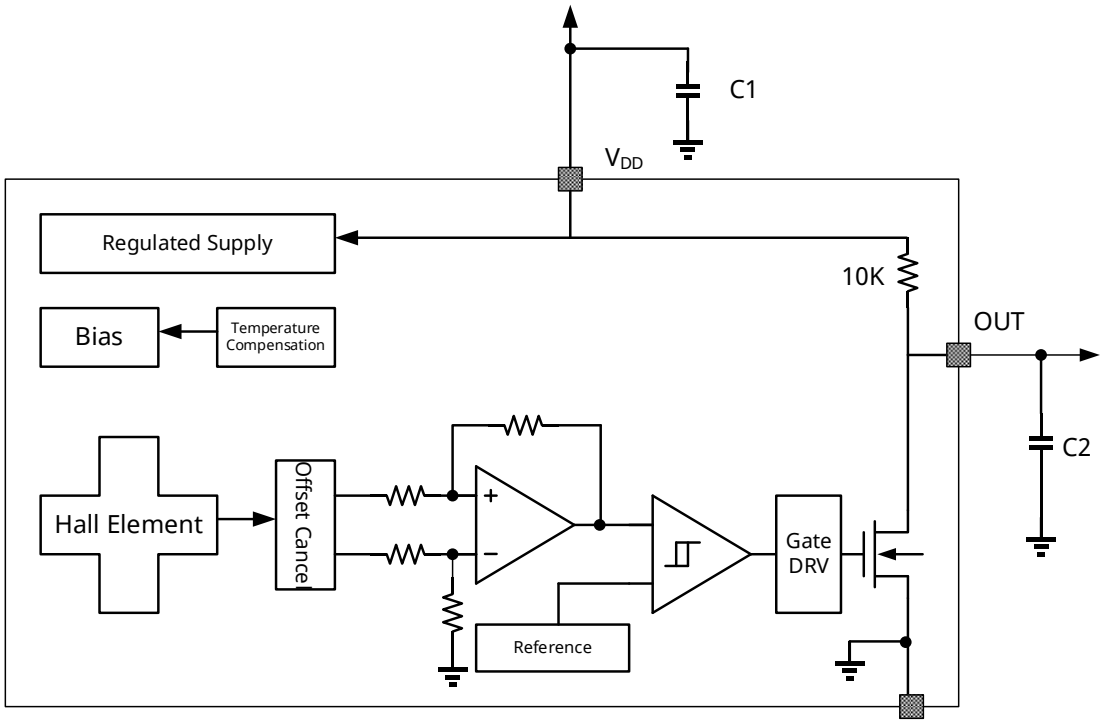


Fig. 3: Function Block Diagram

12. Function Description

The SC2202 device is a chopper-stabilized Hall sensor with a digital latched output for magnetic sensing applications. The device can be powered with a supply voltage between 2.5 and 24V.

The output of SC2202 switches low (turns on) when a magnetic field (South polarity) perpendicular to the Hall element exceeds the operate point threshold, BOP. After turn-on, the output is capable of sinking 20mA and the output voltage is VQ (sat). When the magnetic field is reduced below the release point, BRP, the device output goes high (turns off). The difference in the magnetic operate and release points is the hysteresis, BHYS, of the device. This built-in hysteresis allows clean switching of the output even in the presence of external mechanical vibration and electrical noise.

12.1. Field Direction Definition

A positive magnetic field is defined as a South pole near the marked side of the package.

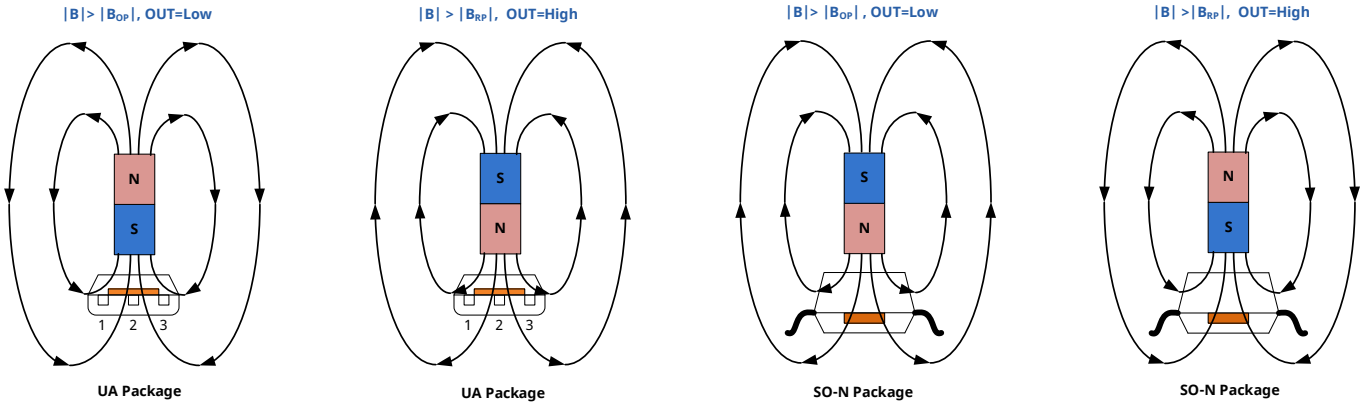


Fig. 4: Magnetic Field Direction Definition

12.2. Transfer Function

Powering-on the device in the hysteresis region, less than BOP and higher than B_{RP}, allows an indeterminate output state. The correct state is attained after the first excursion beyond B_{OP} or B_{RP}.

TO-92S package as an example, if the field strength is greater than B_{OP}, then the output is pulled low. If the field strength is less than B_{RP}, the output is released.

B_{OP}—magnetic threshold for activation of the device output, turning in ON (low) state

B_{RP}—magnetic threshold for release of the device output, turning in OFF (high) state.

B_{HYS}= B_{OP} – B_{RP}

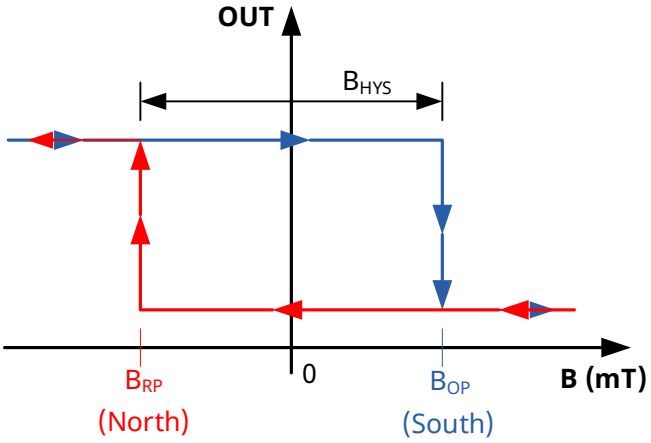


Fig. 5: TO-92S (UA) Package Magnetic Transfer Function

13. Typical Application

R_1&R_2 are the current limit resistor for the SC2202 chipset application，It is highly recommend to add R_1 and R_2 in application circuit, especially R_2.

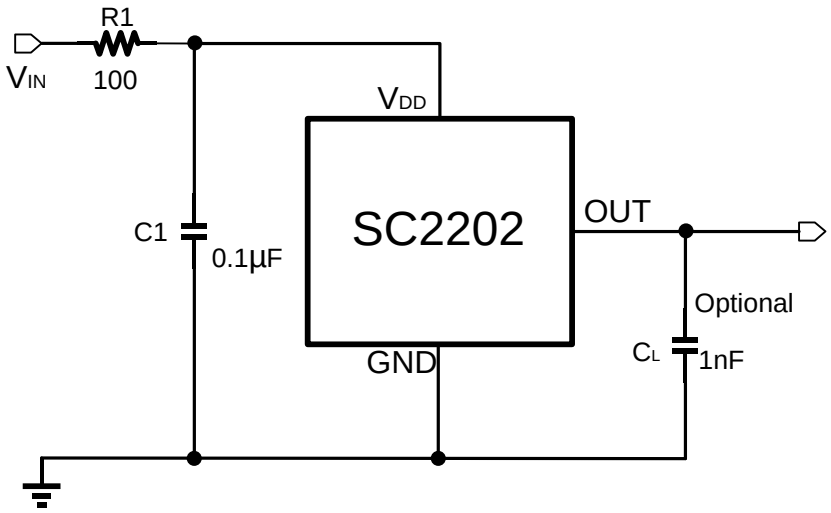


Fig. 6: Typical Application Circuit

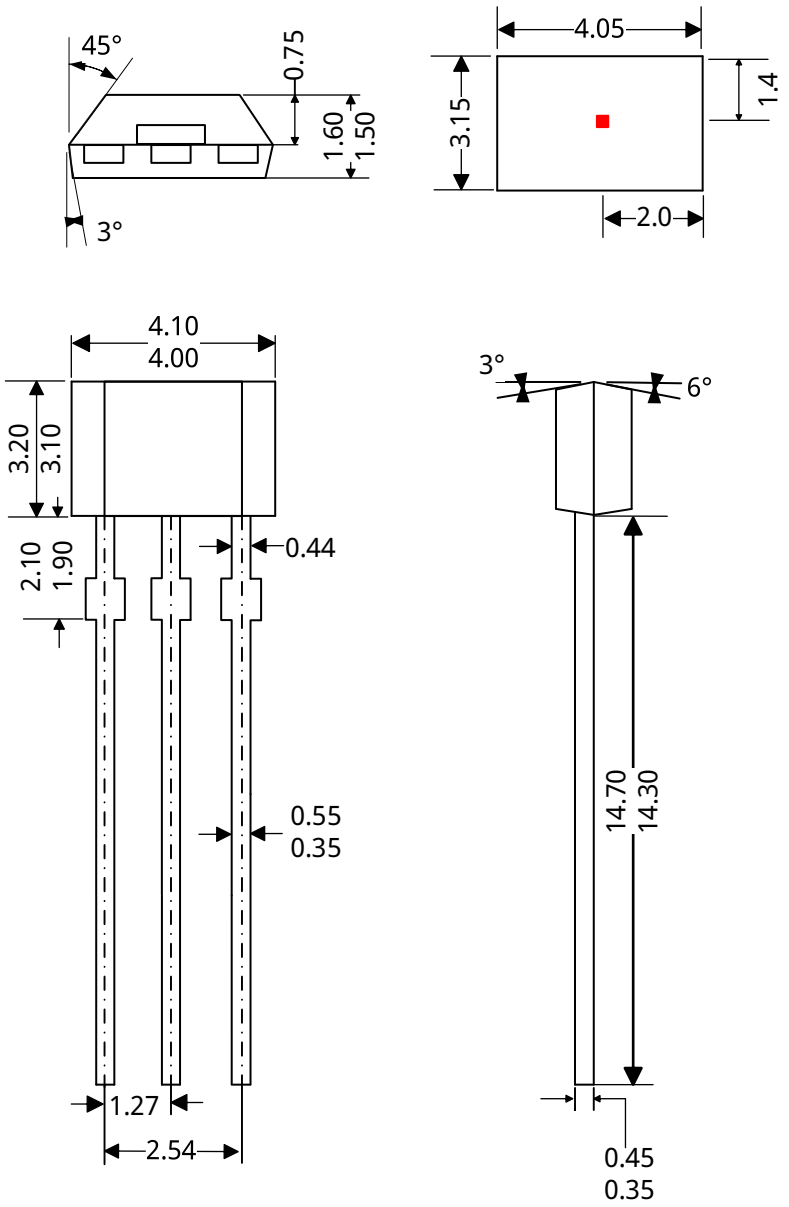
The SC2202 contains an on-chip voltage regulator and can operate over a wide supply voltage range. In applications that operate the device from an unregulated power supply, transient protection must be added externally. For applications using a regulated line, EMI/RFI protection may still be required. It is recommended to shunt C1 capacitors to the ground near the chip VDD power supply, with a typical value of 0. 1μF.At the same time in the external optional series resistor R1 their typical values for 100Ω.The output capacitor CL is used as the output filter, typically 1nF.Select a value for C_L based on the system bandwidth specifications such as:

$$C_L < \frac{1}{2\pi \times R_L \times 2 \times f_{BW}(Hz)}$$

14. Package Information "UA"

3-Terminal
UA Package

Dimension:mm



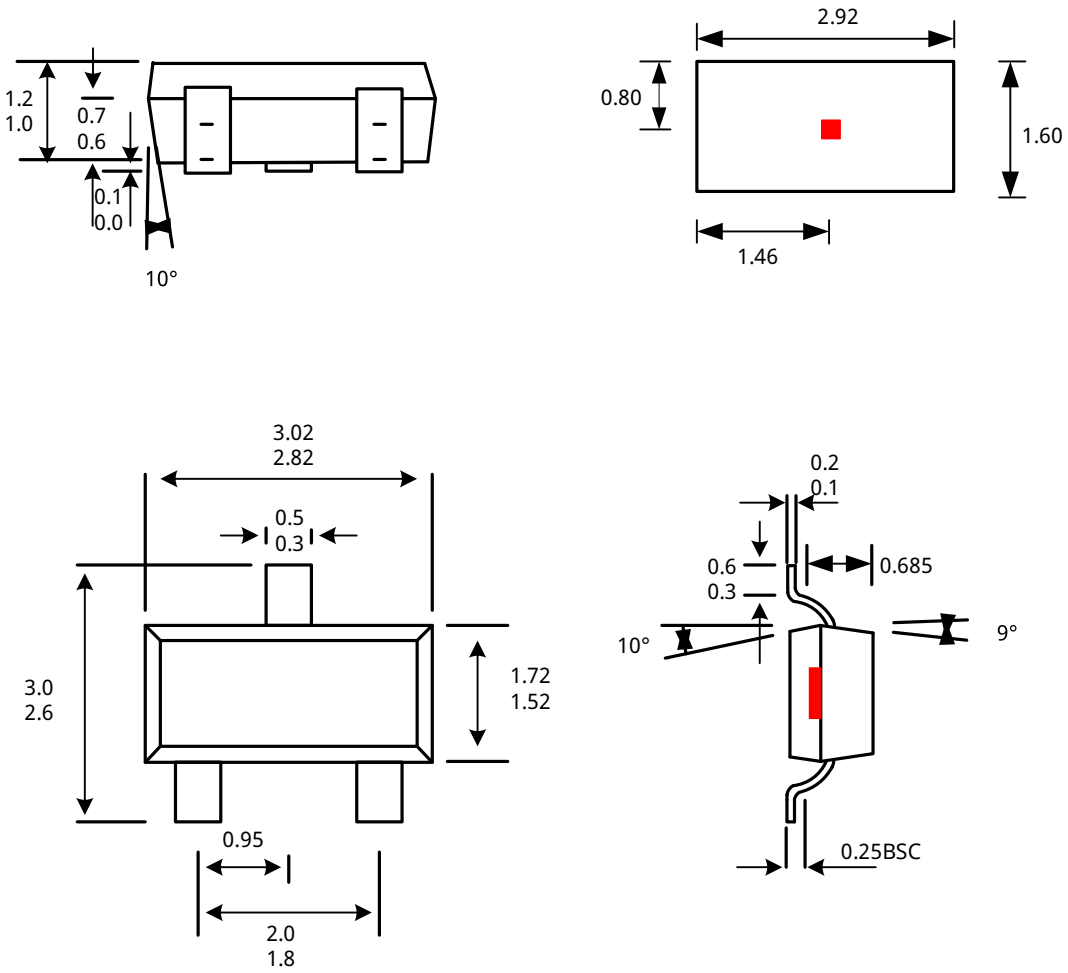
Notes:
1. Exact body and lead configuration at vendor's option within limits shown.
2. Height does not include mold gate flash.

Where no tolerance is specified, dimension is nominal.

15. Package Information "SO"

3-Terminal
SO Package

Dimension:mm



Notes:

1. *Exact body and lead configuration at vendor's option within limits shown.*
2. *Height does not include mold gate flash.*
3. *The red mark is Hale element.*

Where no tolerance is specified, dimension is nominal.

16. Revision History

Revision	Date	Description
Rev1.0	2016-05-10	Preliminary datasheet
Rev2.0	2019-05-06	The final revision of old datasheet
RevA/1.0	2024-02-21	Update EC table
RevA/1.1	2025-03-17	Modify the order information