High Sensitivity Latching Hall Switch IC

1. Features

- Latch-type switch Hall
- Ultra-high sensitivity
- High chopping frequency
- Wide voltage range: 2.5V to 18V
- Wide operating temperature range:
  - -40℃ to 125℃
- Small package:
  - 3-pin TO-92S (UA)
  - 3-pin SOT23-3L (SO)

2. Applications

- Smart Home Appliance
- Power Tools
- BLDC motor commutation
- Flow Meter
- Tachometers

3. Description

SC2402 is a Hall-effect latch designed using mixed-signal BiCMOS technology. The chip integrates a voltage regulator, a Hall sensor with a dynamic offset cancellation system, a Schmitt trigger, and an open-drain output driver in a single package.

SC2402 features an integrated voltage regulator that enables the chip to operate over a wide supply voltage range from 2.5V to 18V, making it ideally suited for applications in household appliances and consumer electronics.SC2402 integrates an on-chip voltage regulator, allowing a wide supply voltage range from 2.5V to 18V to meet the requirements of industrial and automotive electronic applications.

SC2402 device is available in either a TO-92S package (UA), or a SOT23-3L package (SO). All are lead (Pb) free, with 100% matte tin lead frame plating.

Not To Scale

Fig.1 Package Outline

CONTENTS

4. Terminal Configuration

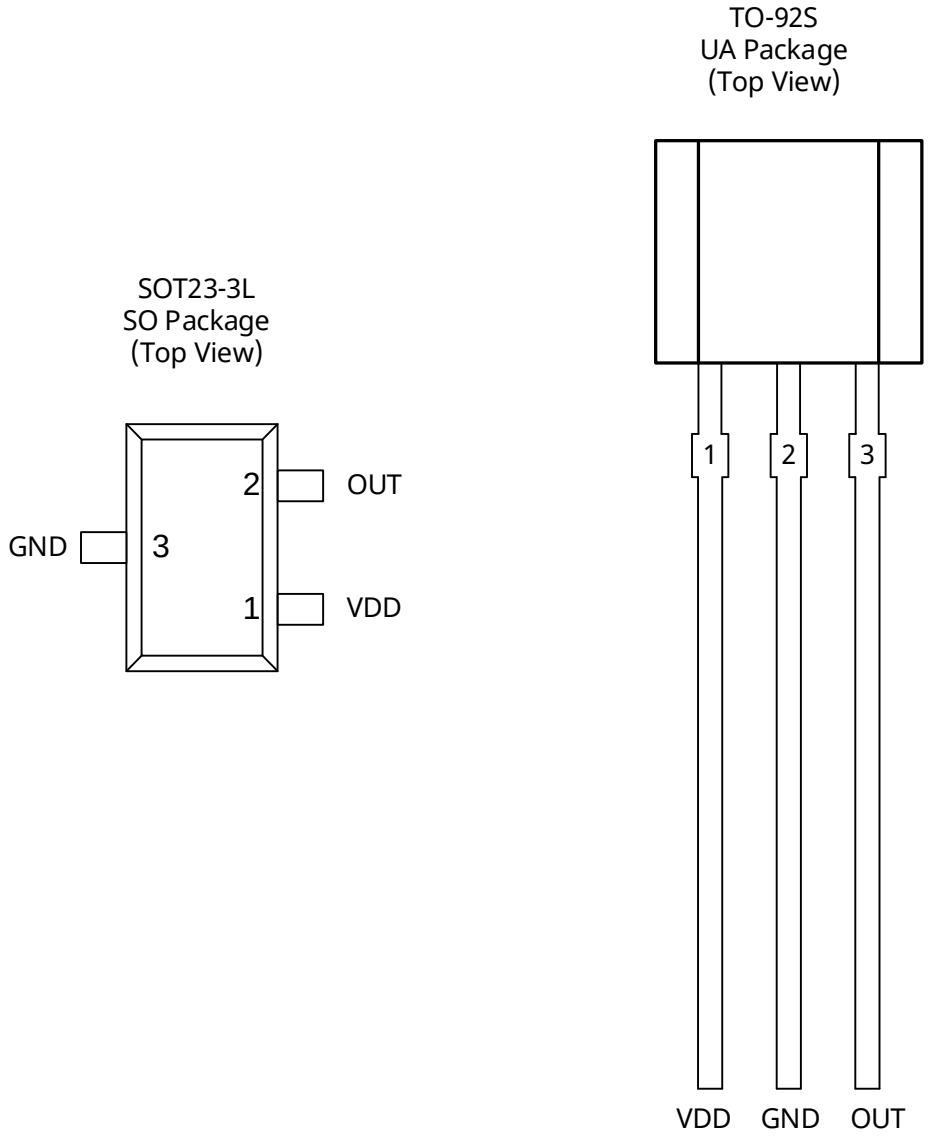


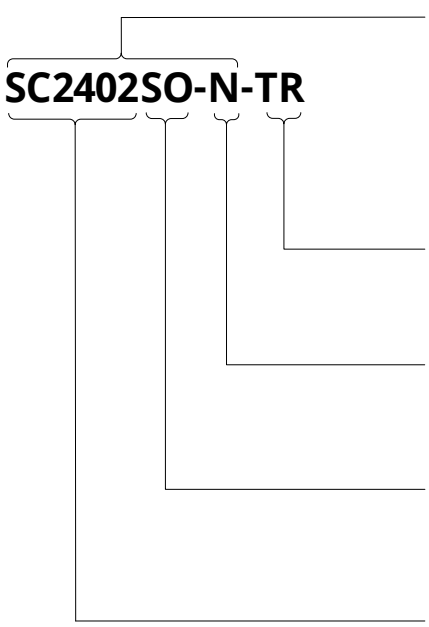
Fig.2 Pin Definition Diagram

Terminal			Type	Description
Name	UA	SO		
VDD	1	1	Power	2.5V to 18V power supply
GND	2	3	Ground	Ground terminal
OUT	3	2	Output	Open-drain output. The open drain requires a pull-up resistor

5. Ordering Information

Ordering Information	Marking	Option	B_{OP}(mT)	B_{RP}(mT)	Ambient, T_A(℃)	Package	Packing	Quantity
SC2402SO-N-TR	2402	North	-2.0	2.0	-40~125	SOT23-3L	Reel	3000/reel
SC2402UA-BK	2402	South	2.0	2.0	-40~125	TO-92S	Bulk	1000/bag

Ordering Information Format



Part Number

Pack Designation
TR: Tape & Reel
BK: Bulk

Active Magnetic Polarity
N: North pole
Default: South pole

Package Designation
SO: SOT23-3L
UA: TO-92S

Device Family
SC2402: High Sensitivity Latching Hall Switch IC

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		-10	20	V
V_{OUT}	Output terminal voltage	For 5 Min. @1k pull-up resistor	-0.5	20	V
I_{SINK}	Output terminal current sink		0	20	mA
T_A	Operating ambient temperature		-40	125	℃
T_J	Maximum junction temperature		-55	150	℃
T_{STG}	Storage temperature		-55	165	℃

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 Conditions	Min.	Max.	Units
V_{ESD_HBM}	HBM	According to: standard AEC-Q100-002 HBM	-3	+3	kV
V_{ESD_CDM}	CDM	According to: standard AEC-Q100-011 CDM	-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	200(1)	℃/W
$R_{\Theta ja}$	SO Package thermal resistance	Single-layer PCB, with copper limited to solder pads	300(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	18	V
I_{DD}	Operating supply current	V_{DD}=2.5 to 18V, T_A=25℃	1.0	1.8	5.0	mA
t_{on}	Power-on time	V_{DD}≥5.0V	-	10	20	μs
I_{QL}	Off-state leakage current	Output Hi-Z	-	-	3	μA
V_{sat}	FET on-resistance	V_{DD} =5V, I_O=10mA, T_A=25℃	-	20	-	Ω
$R_{DS\,(on)}$		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%)	R_1=1kΩ, Co=50pF	-	-0.2	0.5	μs
t_f	Output fall time (90% to 10%)	R_1=1kΩ, Co=50pF	-	-0.1	0.2	μs

Note:

(1) Typical values are defined at T_A=25°C, V_{DD}=5V

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

9.2. Magnetic Characteristics

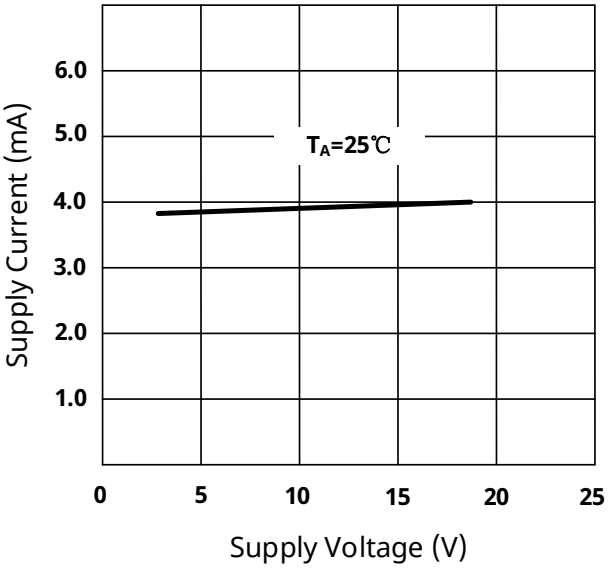
over operating free-air temperature range, V_{DD}=5.0V (unless otherwise noted)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
f_{BW}	BW		20	-	-	kHz
SC2402 2.0(1)/-2.0mT(2)						
B_{OP}	Operated point	T_A=25℃	1.0	2.0	3.0	mT
B_{RP}	Release point		-3.0	-2.0	-1.0	mT
B_{HYS}	Hysteresis		-	4.0	-	mT

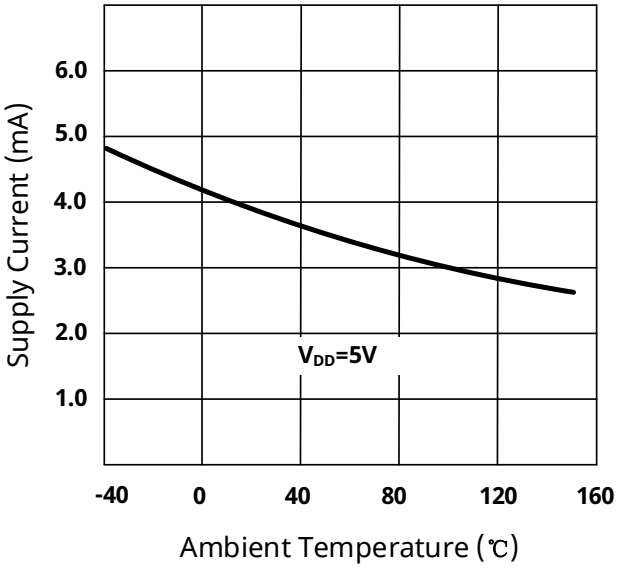
Note:
(1) Magnetic flux density, B is indicated as a negative value for North-polarity magnetic fields, and as a positive value for South-polarity magnetic fields
(2) 1mT=10Gs

10. Characteristic Curves

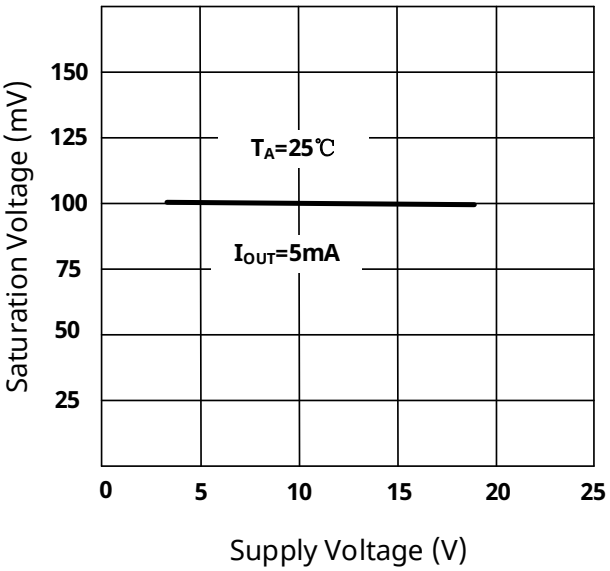
I_{DD} vs V_{DD}



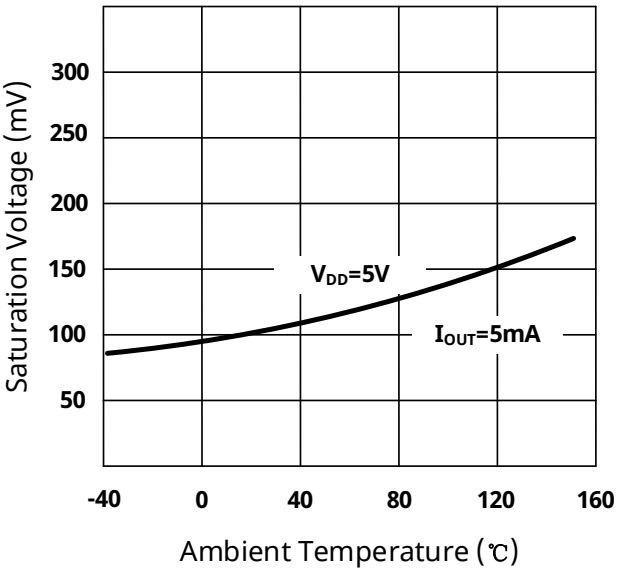
I_{DD} vs T_A



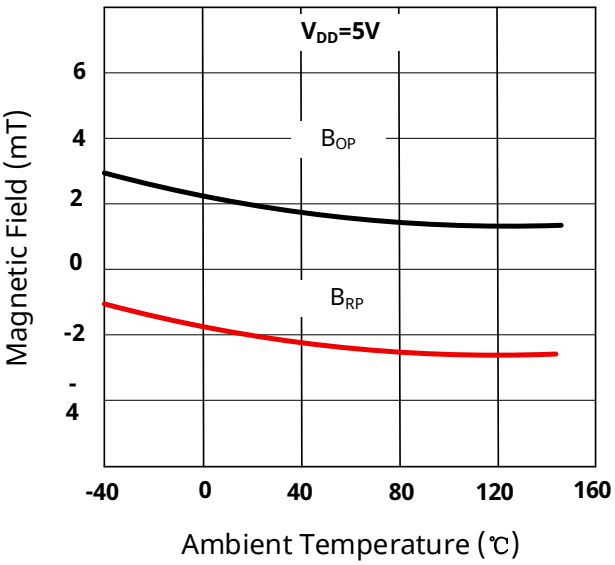
$V_{Q(sat)}$ vs V_{DD}



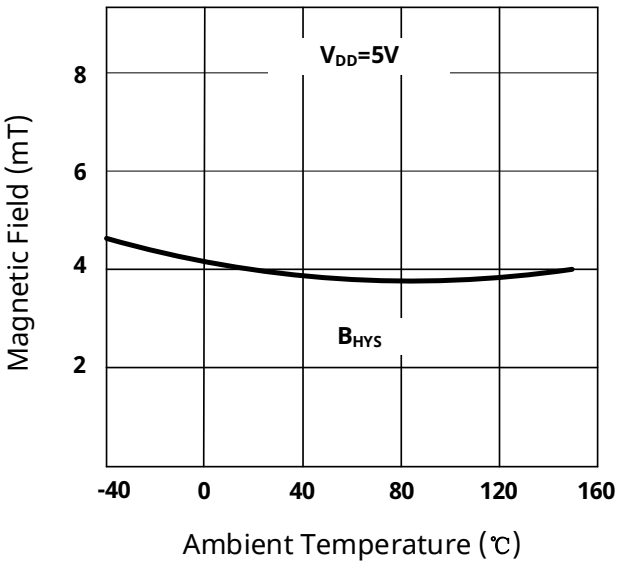
$V_{Q(sat)}$ vs T_A



B_{OP} and B_{RP} vs T_A



B_{HYS} vs T_A



11. Block Diagram

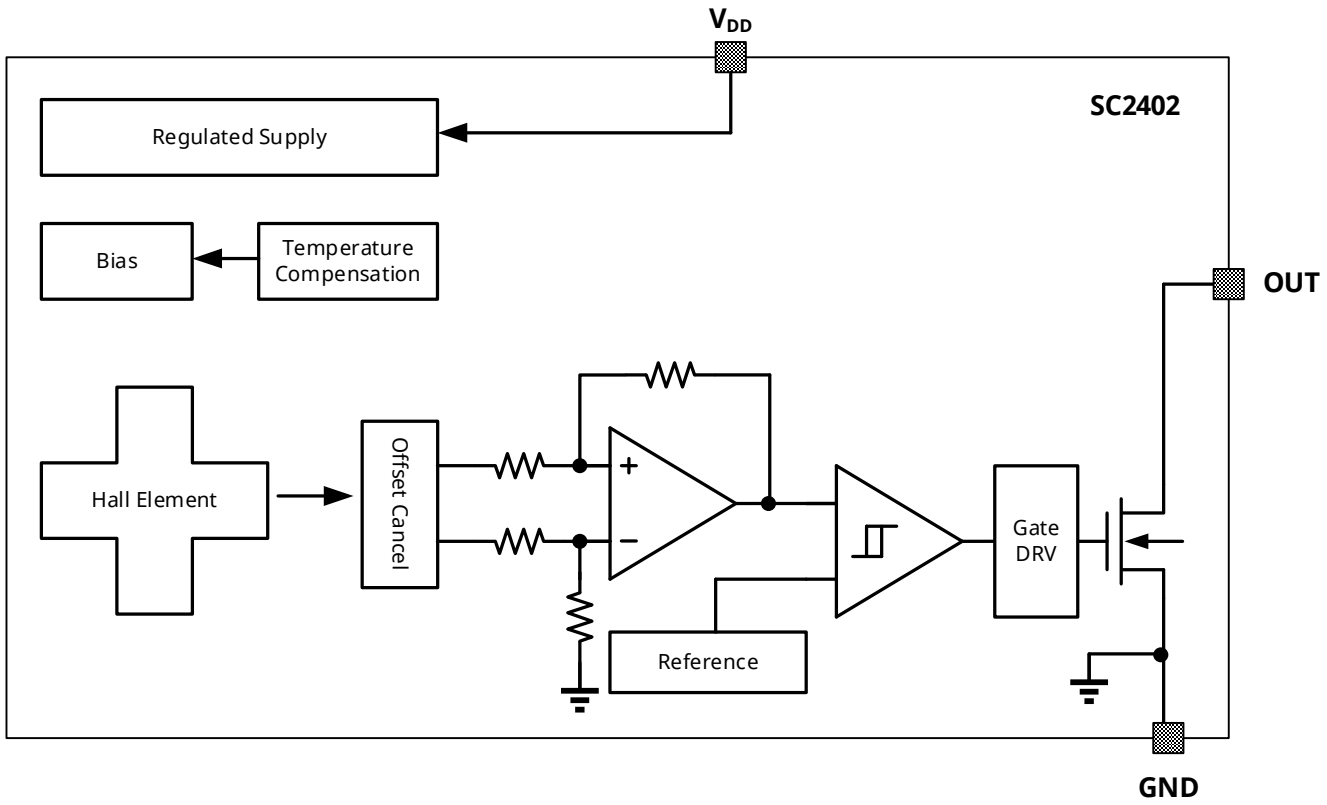


Fig. 3 Functional block diagram

12. Function Description

SC2402 is a chopper-stabilized latching Hall-effect sensor designed for magnetic field sensing applications. The device operates over a supply voltage range of 2.5V to 18V and can continuously withstand a reverse supply voltage of -10V.

When the absolute value of the magnetic field intensity applied perpendicularly to the Hall element exceeds the operating point (B_{OP}) threshold, the SC2402 outputs a low level (ON state), When the magnetic field intensity decreases below the absolute value of the release point (B_{RP}), the device outputs a high level (OFF state). The difference between the magnetic operating point and the release point is the magnetic hysteresis (B_{HYS}) of the device. This internal hysteresis makes the device immune to external mechanical vibrations and electrical noise interference.

12.1. Magnetic Field Direction Definition

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

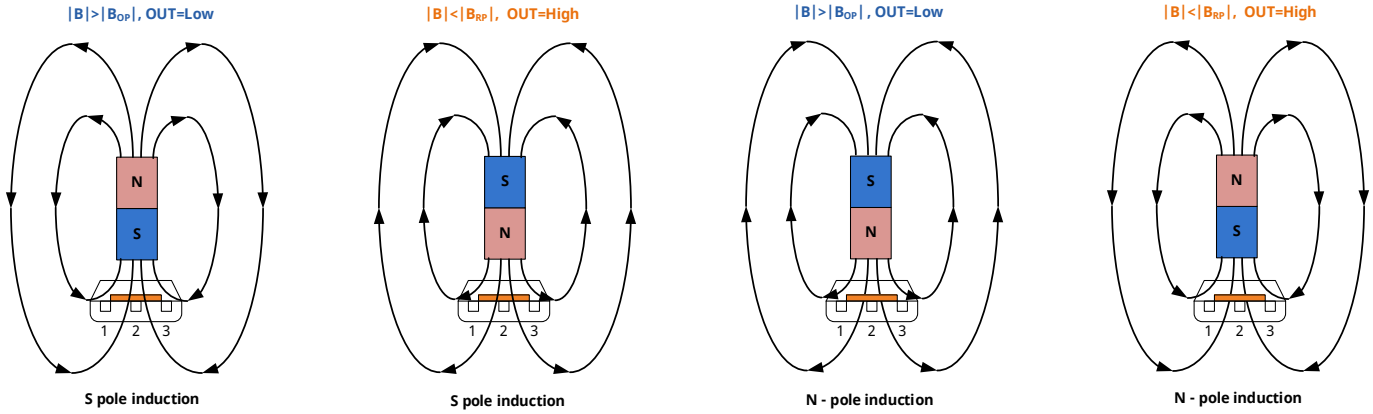


Fig.4 Magnetic Field Direction Definition

12.2. Transfer Function

Powering-on the device in the hysteresis region, less than B_{OP} 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}. 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.

$B_{HYS} = B_{OP} - B_{RP}$

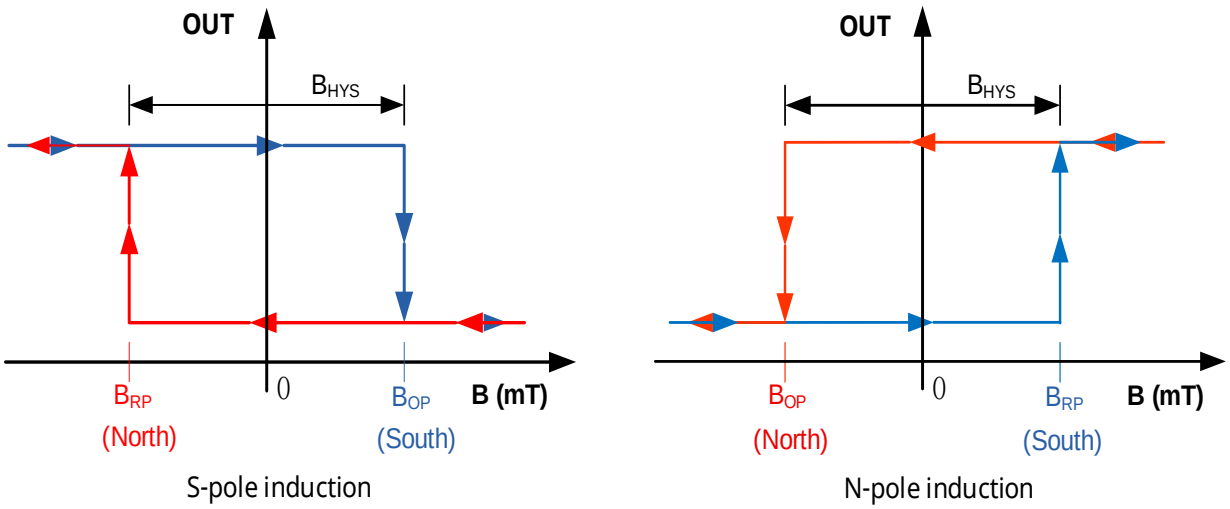


Fig.5 Transfer Characteristic Curve

13. Typical Application

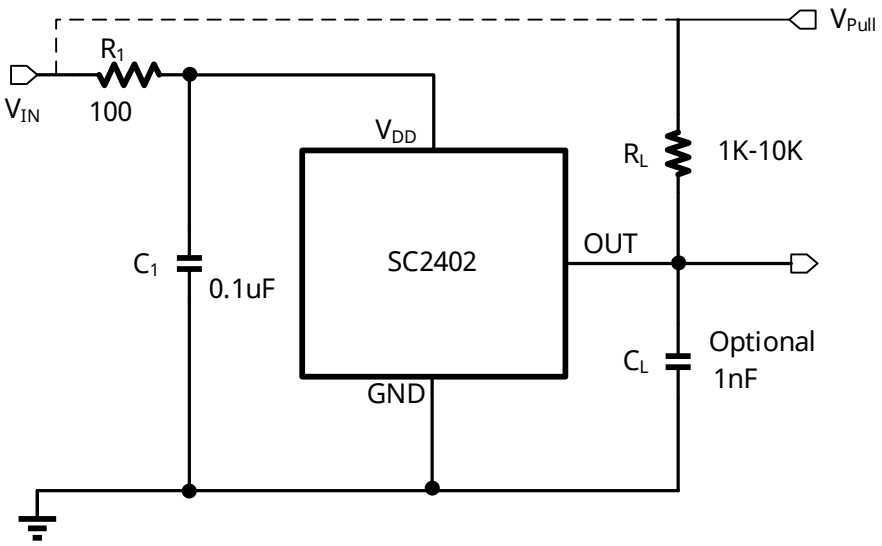


Fig.6 Typical Application Circuit

The SC2402 contains an on-chip voltage regulator which makes the device operate over a wide supply voltage range. In the applications that operate on an unregulated power supply, the external line protection should be added. And the applications using a regulated line, for the EMI/RFI protection purpose, to connect the shunt C_1 capacitors which typically is 0.1μF to the ground near the chip V_{DD} power supply as close as possible and the 100Ω external optional series resistor R_1. The output capacitor C_L used as the output filter is typically 1nF.

The SC2402 device output stage uses an open-drain NMOS, and it is rated to sink up to 20mA of current. For proper operation, calculate the value of the pull-up resistor R_L is required. The size of R_L is a tradeoff between OUT rise time and the load capacity when OUT is pulled low. A lower current is generally better, however faster transitions and bandwidth require a smaller resistor for faster switching.

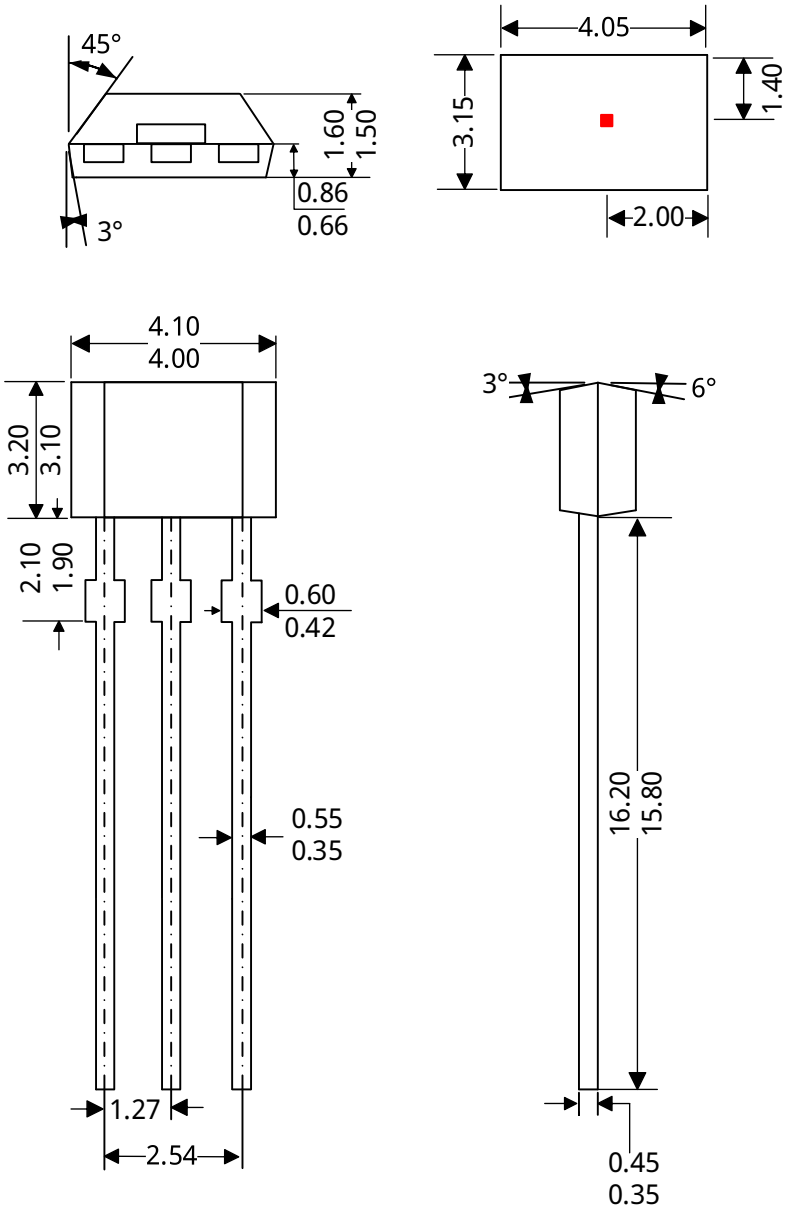
Select a value for C_L based on the system bandwidth specification as follow：

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

V_{PULL} is not restricted to V_{DD} and could be connected to other voltage power supply. The allowable voltage range of this terminal is specified in the Absolute Maximum Ratings.

14. Package Information UA

TO-92S Package Outline Dimensions

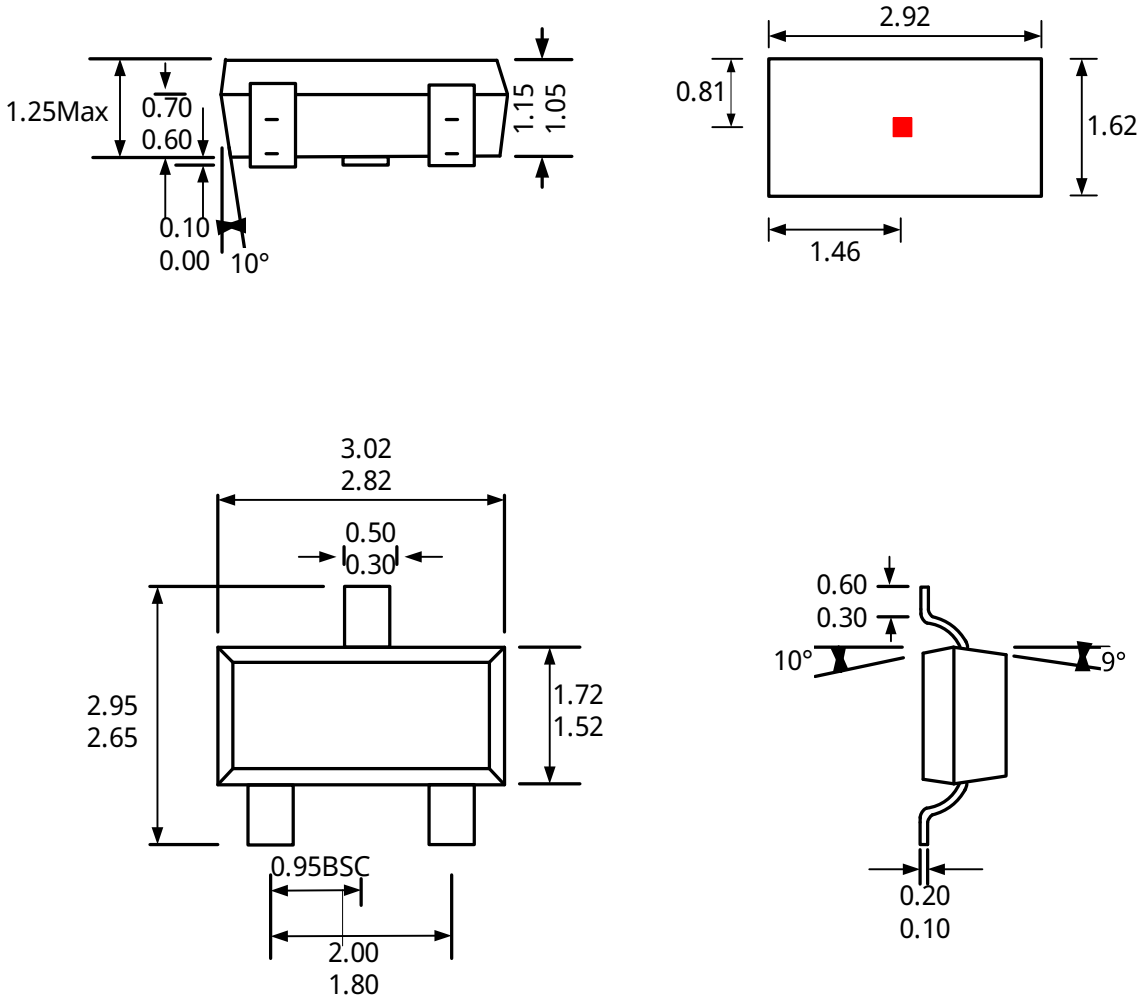


Notes:
(1)All unit in mm.
(2)Dimension does not include mold flash , protrusions or gate burrs.
(3)Allowable dambar protrusion shall be in excess at maximum material condition.

If no tolerance is specified , the dimension shall be theoretical reference value and shall not represent the exact dimension for actual measurement.

15. Package Information SO

SOT23-3L Package Outline Dimensions

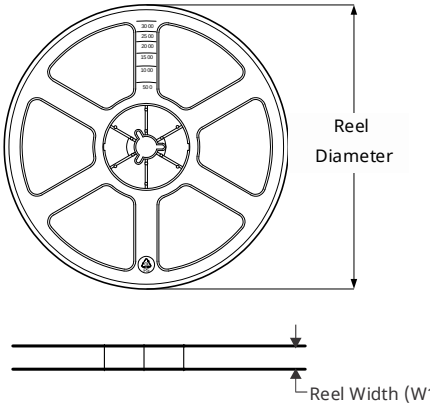


Notes:
(1)All unit in mm.
(2)Dimension does not include mold flash , protrusions or gate burrs.
(3)Allowable dambar protrusion shall be in excess at maximum material condition.

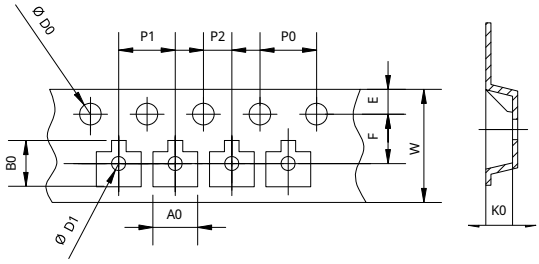
If no tolerance is specified , the dimension shall be theoretical reference value and shall not represent the exact dimension for actual measurement.

16. Tape&Reel Information

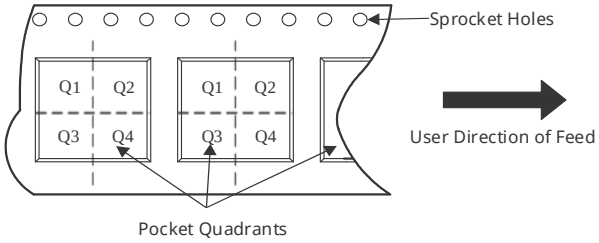
TAPE REEL DIMENSIONS



TAPE DIMENSIONS



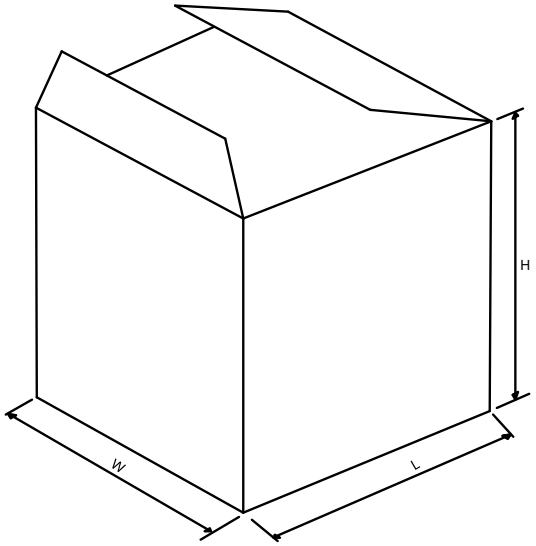
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*All dimensions are nominal

Package Type	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	P0 (mm)	P1 (mm)	P2 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	W (mm)	Pin1 Quadrant
SOT23-3L	3000	180	8.4	4.00	4.00	2.00	3.18	3.28	1.32	8.00	Q3

17. Tape&Reel Box Dimensions



*All dimensions are nominal

Package Type	SPQ	Length (mm)	Width (mm)	Height (mm)
SOT23-3L	3000ea*10tape	210	210	210

18. Revision History

Revision	Date	Description
Rev0.1	2016-08-19	Preliminary datasheet
Rev2.3	2018-05-06	The final revision of old datasheet
Rev.V1.0	2020-11-19	Modify format
Rev.V1.1	2024-05-07	Add DFN package
Rev.V1.2	2024-11-27	Update ordering information and update POD dimensions.
Rev.V1.3	2026-04-01	Remove the DN package, and add packaging information and declarations.

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