High-Performance Latching Hall Switch IC

1. Features

- AEC-Q100 Qualified
- Latch-type switch Hall
- Excellent magnetic field symmetry
- High chopping frequency 800kHz
- Wide voltage range: 2.5V to 24V
- Reverse battery protection: -28V
- Wide operating temperature range:
  - -40℃ to 150℃
- Over-voltage protection at all pins
- Small package:
  - 3-pin TO-92S (UA)
  - 3-pin SOT23-3L (SO)

2. Applications

- Automotive and Industrial
- BLDC motor commutation
- Seat motor adjuster
- Window lifter
- Sunroof/Tailgate opener
- Tachometers

3. Description

SC244X series employs high-frequency chopping technology to provide excellent magnetic field consistency and symmetry over the full operating voltage and temperature range. Overvoltage protection is integrated on both the V_{DD} supply pin and the output pin, delivering strong EMC performance and high reliability.

SC244X integrates a voltage regulator, Hall sensor array, amplifier, hysteresis comparator, output driver, and other functional modules. Hall signal path employs high-frequency chopping technology, which not only reduces the offset voltage of the Hall sensing array and signal processing circuits, but also minimizes the effects of stress and temperature on offset voltage, while lowering system propagation delay and output jitter to a minimum.SC244X features an open-drain output stage with a 20 mA sink current capability.

SC244X integrates an on-chip voltage regulator, allowing a wide supply voltage range from 2.5V to 24V to meet the requirements of industrial and automotive electronic applications.

SC244X 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

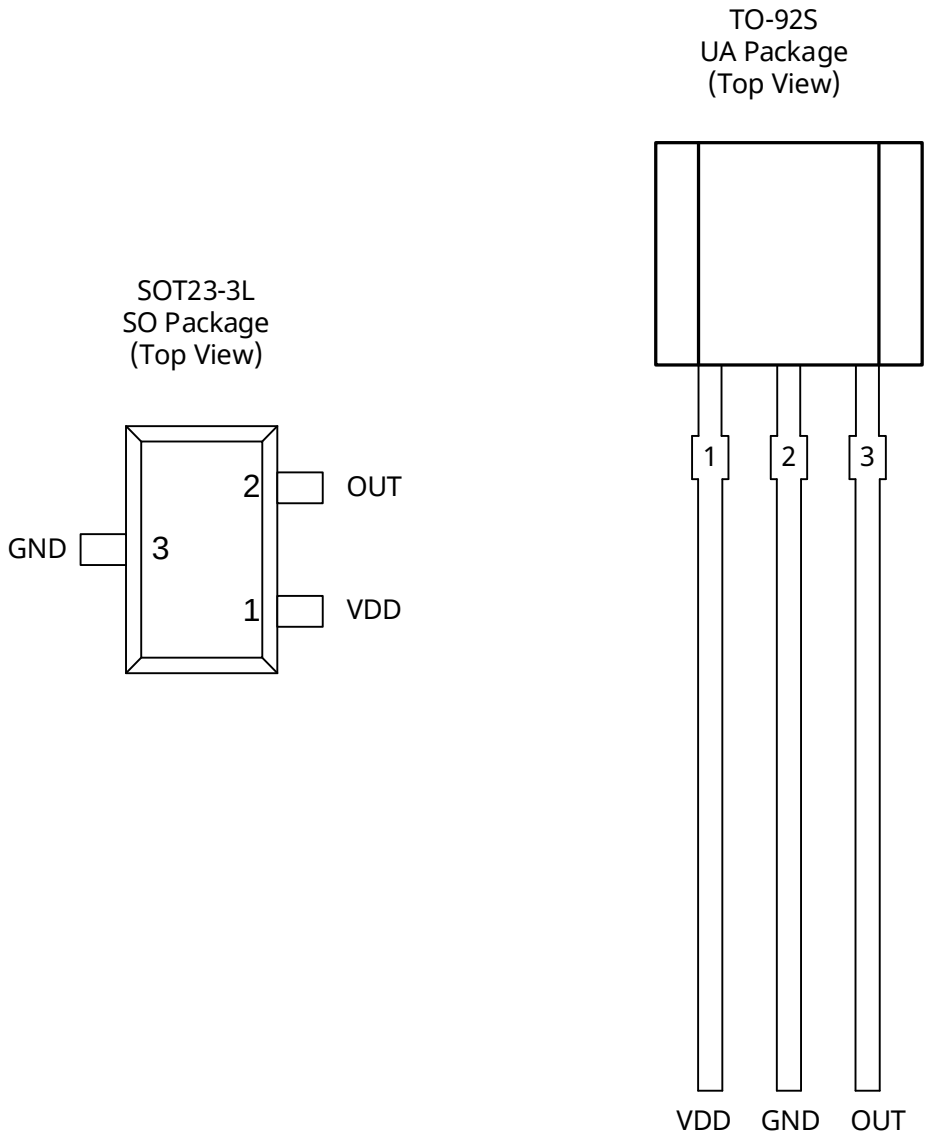


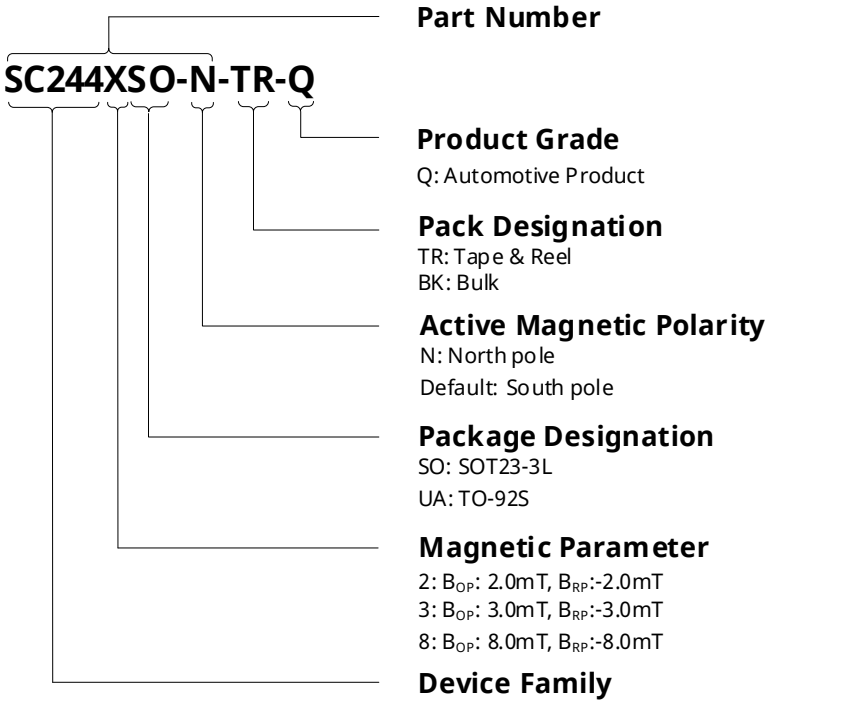
Fig.2 Pin Definition Diagram

Terminal			Type	Description
Name	UA	SO		
VDD	1	1	Power	2.5V to 24V 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
SC2442SO-TR-Q	2442	South	2.0	-2.0	-40~150	SOT23-3L	Reel	3000/reel
SC2442SO-N-TR-Q	2442	North	-2.0	2.0	-40~150	SOT23-3L	Reel	3000/reel
SC2442UA-BK-Q	2442	South	2.0	2.0	-40~150	TO-92S	Bulk	1000/bag
SC2443SO-TR-Q	2443	South	3.0	-3.0	-40~150	SOT23-3L	Reel	3000/reel
SC2443UA-BK-Q	2443	South	3.0	-3.0	-40~150	TO-92S	Bulk	1000/bag
SC2448SO-TR-Q	2448	South	3.0	-3.0	-40~150	SOT23-3L	Reel	3000/reel
SC2448UA-N-BK-Q	2448	North	8.0	-8.0	-40~150	TO-92S	Reel	1000/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		-28	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	150	℃
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 Conditions	Min.	Max.	Units
V_{ESD_HBM}	HBM	According to: standard AEC-Q100-002 HBM	-4	+4	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	24	V
I_{DD}	Operating supply current	V_{DD}=2.5 to 24V, T_A=25℃	0.9	1.3	2.2	mA
t_{on}	Power-on time	V_{DD}≥5.0V	-	35	50	μs
I_{QL}	Off-state leakage current	Output Hi-Z	-	-	3	μA
V_{sat}	Output Saturation Voltage	V_{DD} =5V, I_O=20mA,	-	180	500	mV
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	-	-	0.5	μs
t_f	Output fall time (90% to 10%)	R_1=1kΩ, Co=50pF	-	-	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

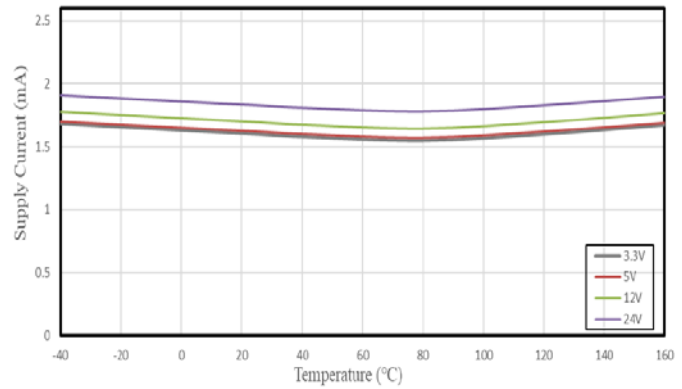
over operating free-air temperature range, V_{DD}=5.0V (unless otherwise noted)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
f_{BW}	BW		20	-	-	kHz
SC2442 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
B_O	Magnetic offset	$B_O=(B_{OP}+B_{RP})/2$	-1.0	0	1.0	mT
SC2443 3.0/-3.0mT						
B_{OP}	Operated point	T_A=25℃	2.0	3.0	4.0	mT
B_{RP}	Release point		-4.0	-3.0	-2.0	mT
B_{HYS}	Hysteresis		-	6.0	-	mT
B_O	Magnetic offset	$B_O=(B_{OP}+B_{RP})/2$	-1.5	0	1.5	mT
SC2448 8.0/-8.0mT						
B_{OP}	Operated point	T_A=25℃	6.0	8.0	10.0	mT
B_{RP}	Release point		-10.0	-8.0	-6.0	mT
B_{HYS}	Hysteresis		-	16.0	-	mT
B_O	Magnetic offset	$B_O=(B_{OP}+B_{RP})/2$	-2.0	0	2.0	mT

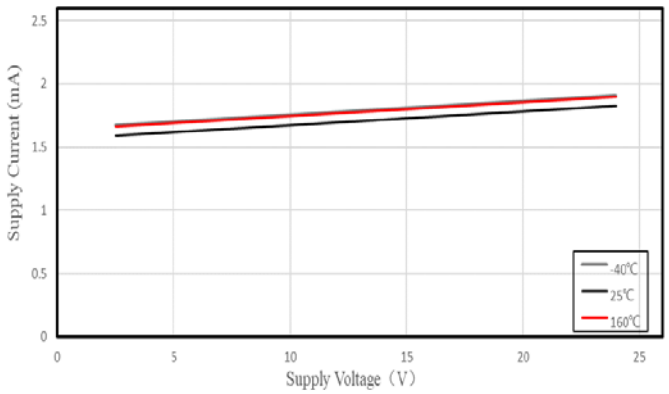
Note:
(1) Magnetic flux density, B is indicated as a negative value for North-polarity magnetic fields, and as a positive value for South-polarity magnetic fields
(2) 1mT=10Gs

10. Characteristic Curves

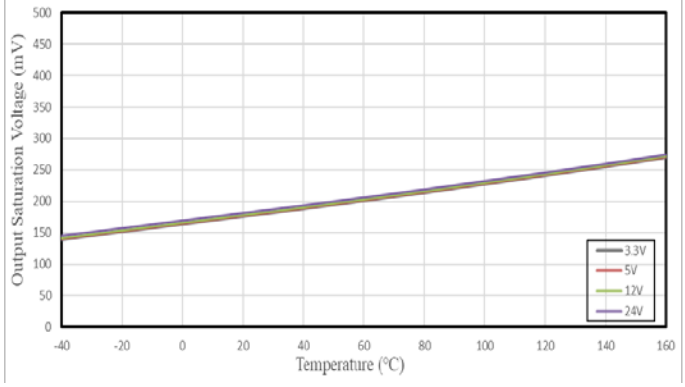
Supply current VS. Temperature



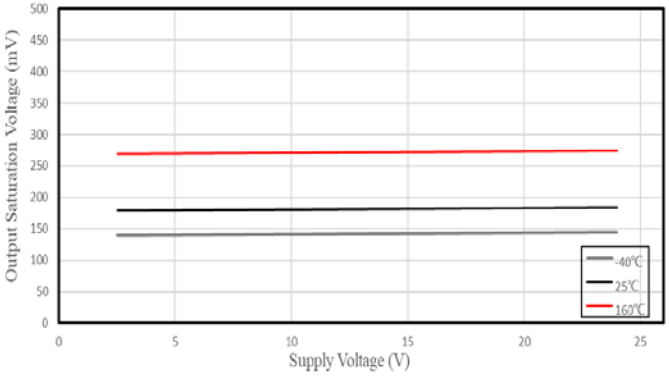
Supply current VS. Supply voltage



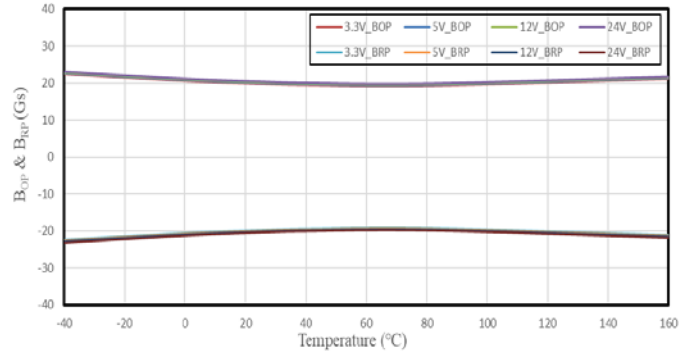
Output Saturation Voltage VS. Temperature



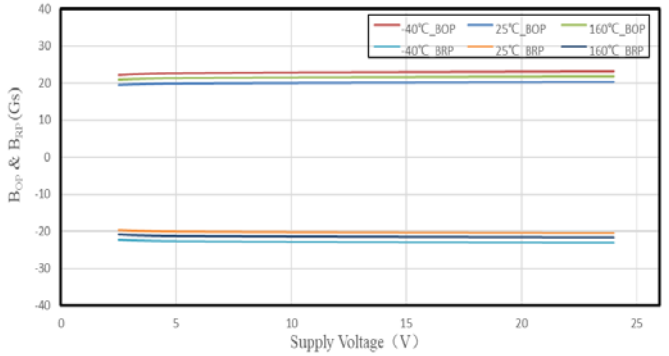
Output Saturation Voltage VS. Supply Voltage



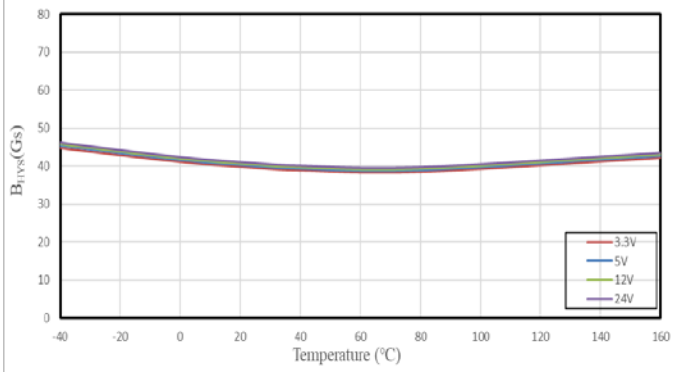
SC2442 B_{OP} & B_{RP} VS. Temperature



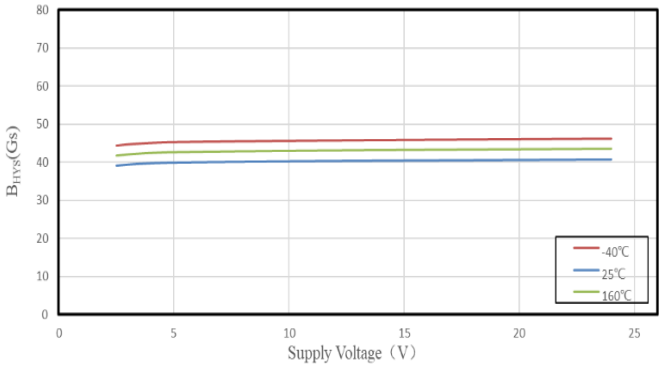
SC2442 B_{OP} & B_{RP} VS. Supply Voltage



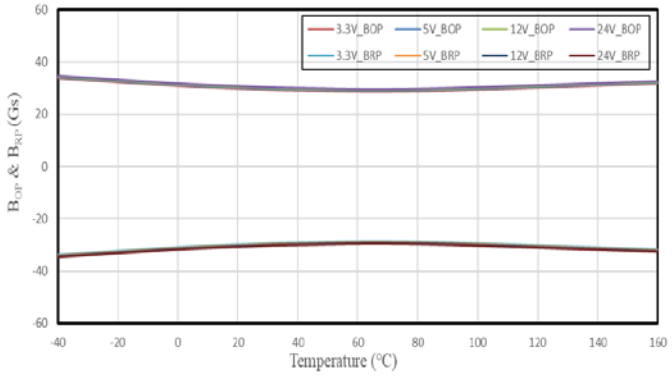
SC2442 B_{HYS} VS. Temperature



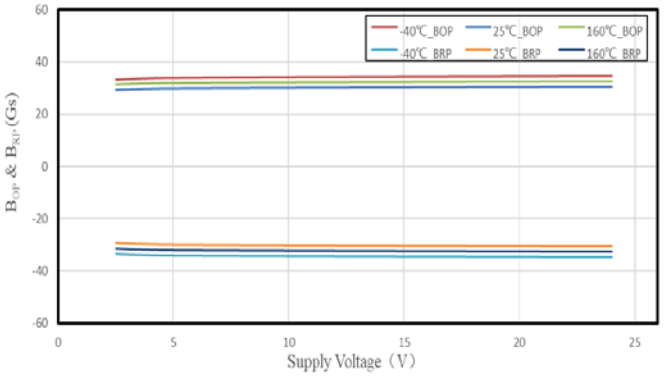
SC2442 B_{HYS} VS. Supply Voltage



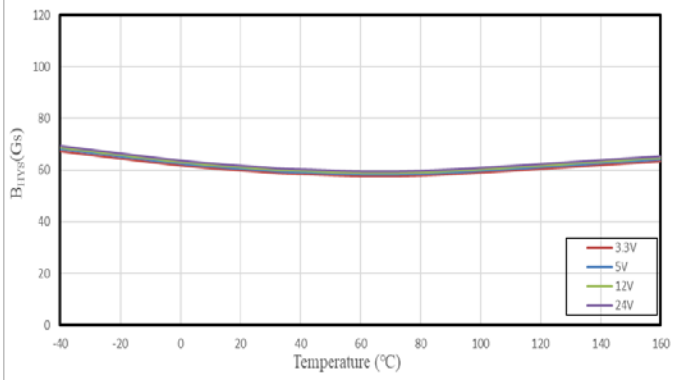
SC2443 B_{OP} & B_{RP} VS. Temperature



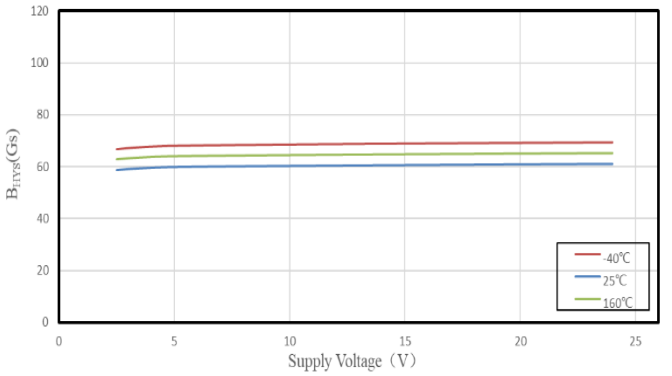
SC2443 B_{OP} & B_{RP} VS. Supply Voltage



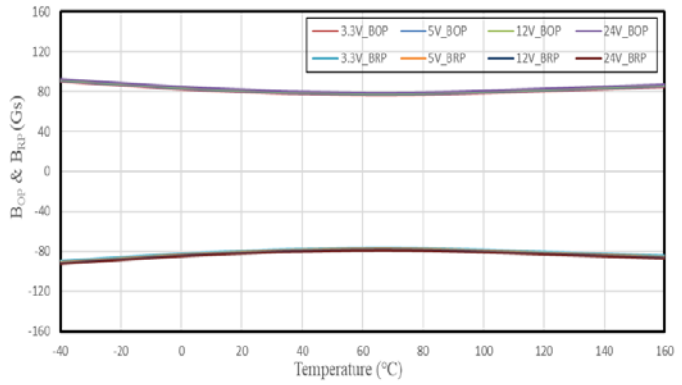
SC2443 B_{HYS} VS. Temperature



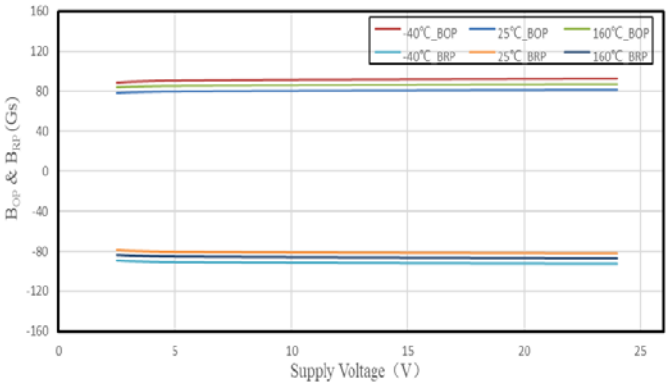
SC2443 B_{HYS} VS. Supply Voltage



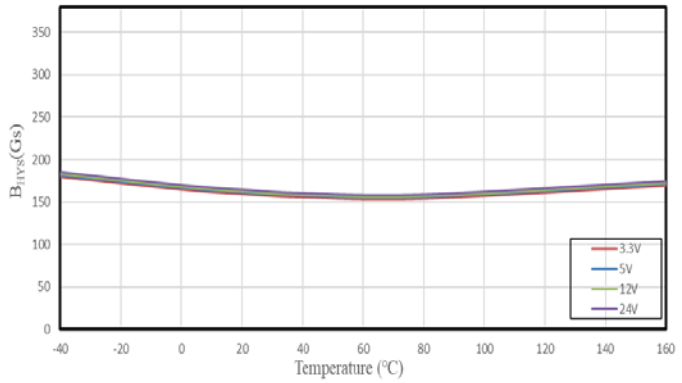
SC2448 B_{OP} & B_{RP} VS. Temperature



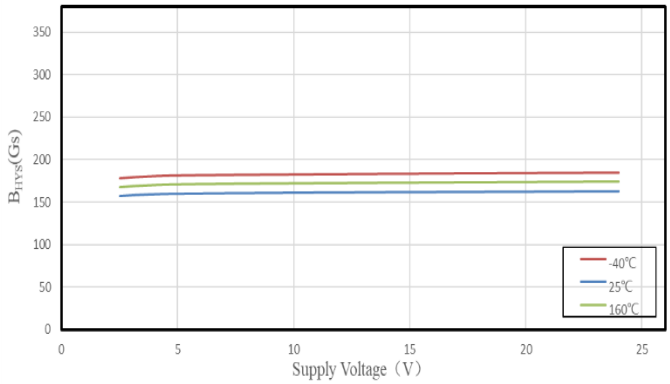
SC2448 B_{OP} & B_{RP} VS. Supply Voltage



SC2448 B_{HYS} VS. Temperature



SC2448 B_{HYS} VS. Supply Voltage



11. Block Diagram

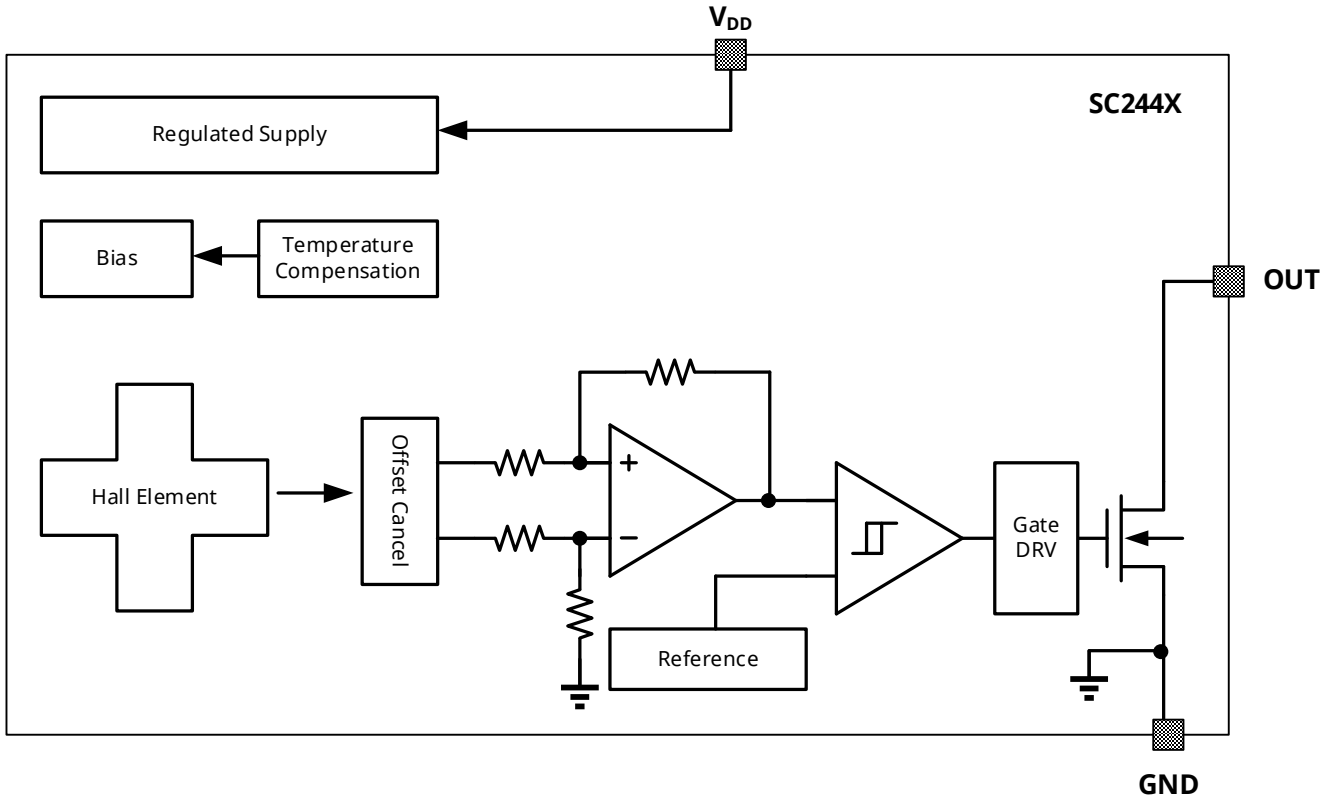


Fig. 3 Functional block diagram

12. Function Description

SC244X 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 24V and can continuously withstand a reverse supply voltage of -28V.

When the absolute value of the magnetic field intensity applied perpendicularly to the Hall element exceeds the operating point (B_{OP}) threshold, the SC244X outputs a low level (ON state), with the output capable of sinking up to 20 mA at the saturation voltage $V_{Q(sat)}$. 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.

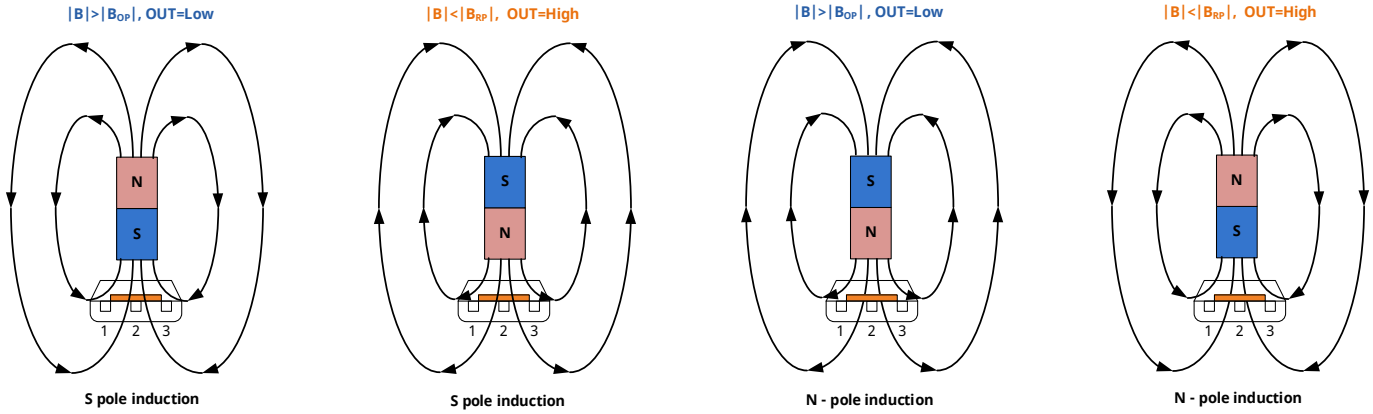


Fig.4 Magnetic Field Direction Definition

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.

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

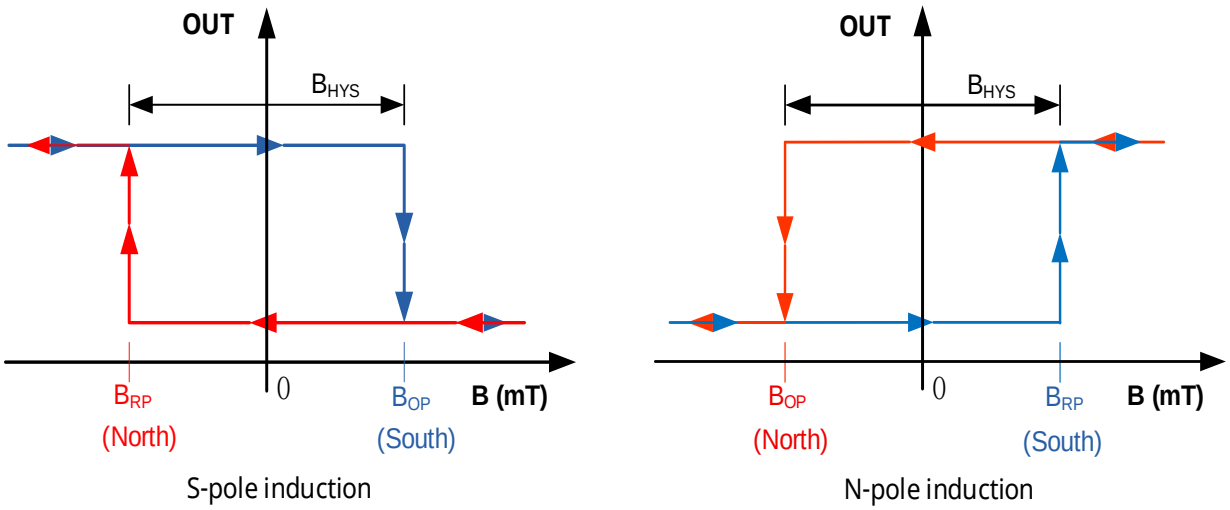


Fig.5 Transfer Characteristic Curve

13. Typical Application

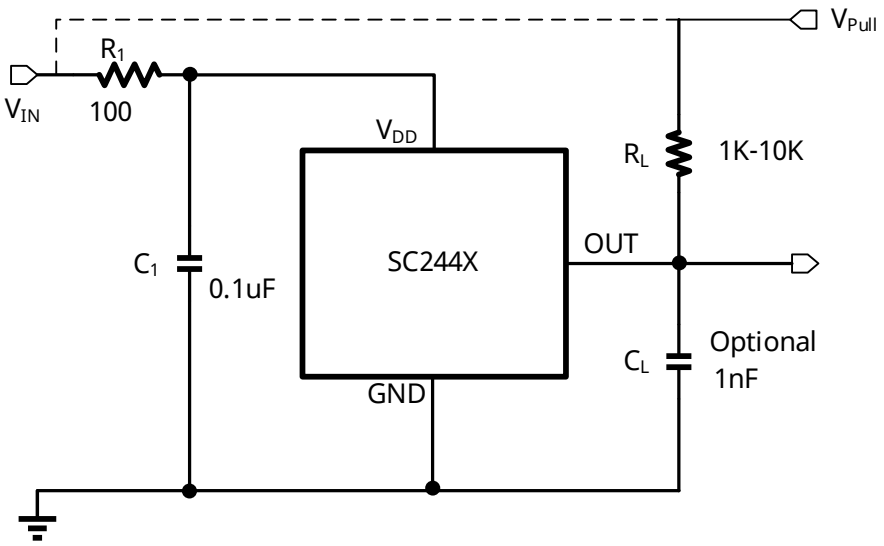


Fig.6 Typical Application Circuit

The SC244X 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 SC244X 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.

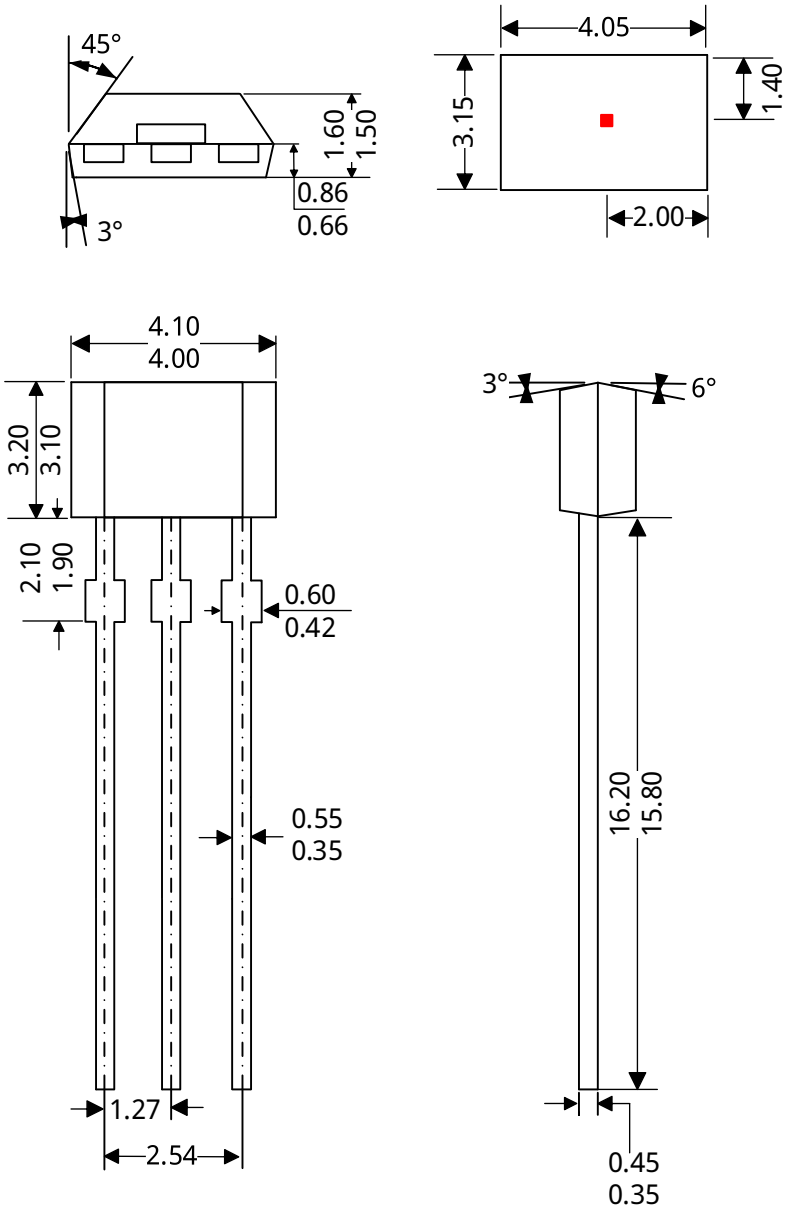
Select a value for C_L based on the system bandwidth specification as follow：

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

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

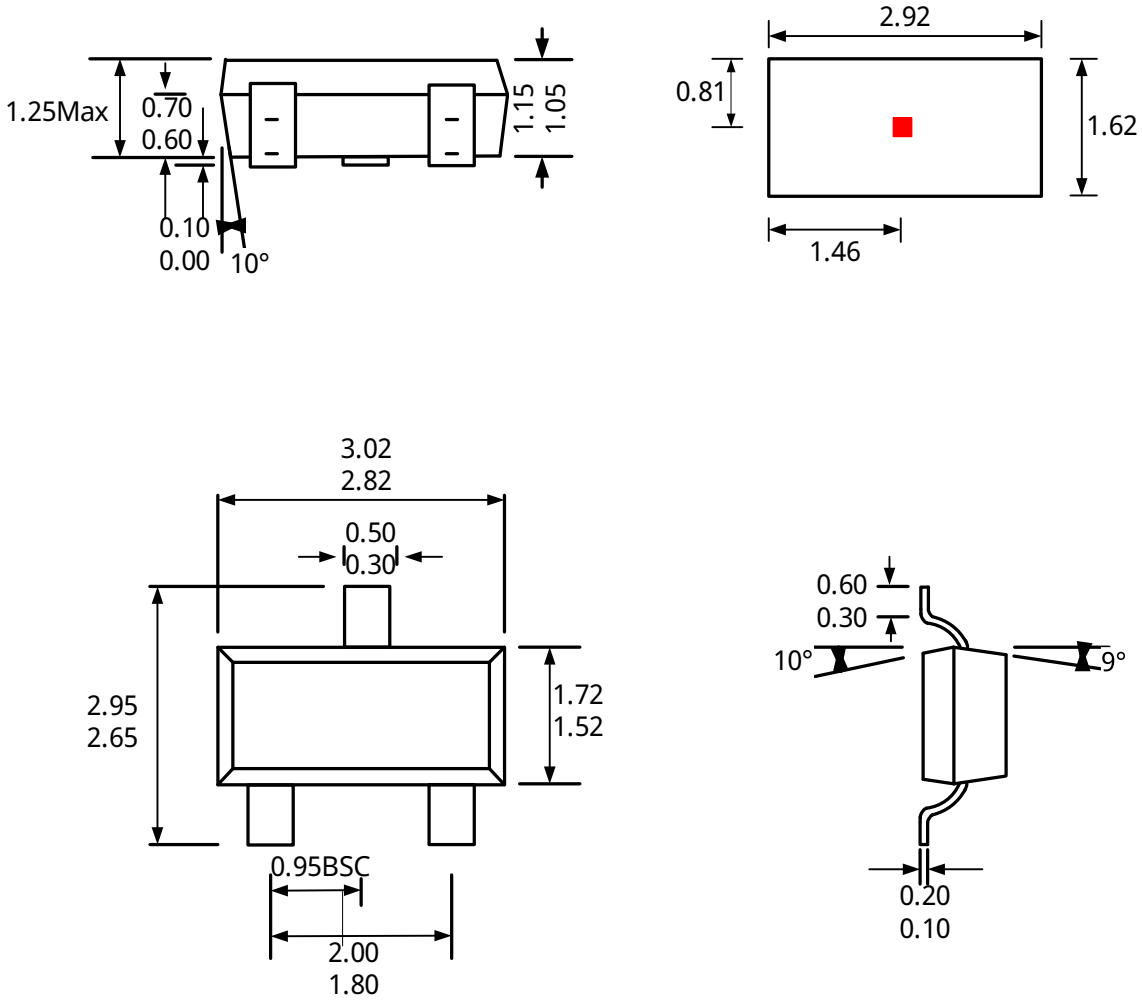


Notes:
(1)All unit in mm.
(2)Dimension does not include mold flash , protrusions or gate burrs.
(3)Allowable dambar protrusion shall be in excess at maximum material condition.

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

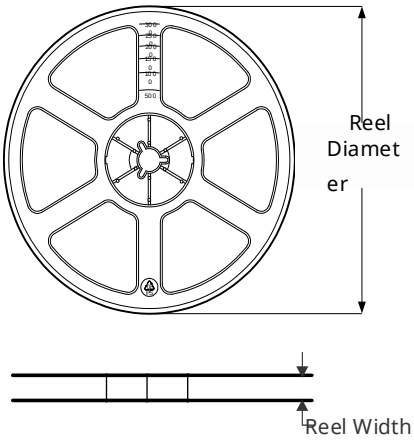


Notes:
(1)All unit in mm.
(2)Dimension does not include mold flash , protrusions or gate burrs.
(3)Allowable dambar protrusion shall be in excess at maximum material condition.

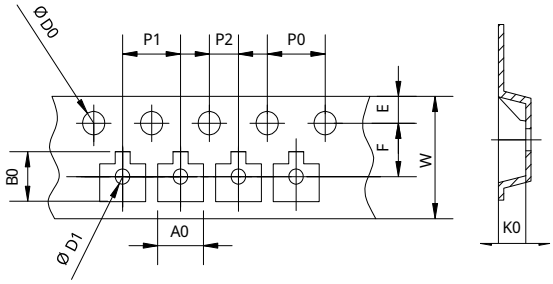
If no tolerance is specified , the dimension shall be theoretical reference value and shall not represent the exact dimension for actual measurement.

16. Tape&Reel Information

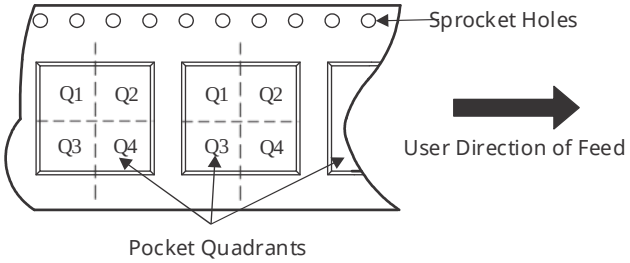
TAPE REEL DIMENSIONS



TAPE DIMENSIONS



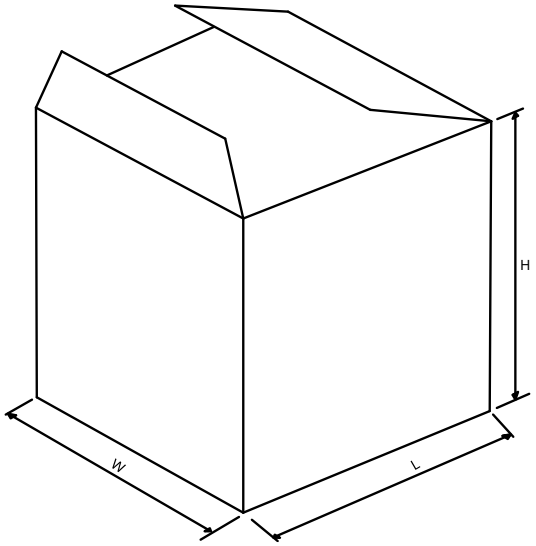
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
SOT-23-3L	3000	180	8.4	4.00	2.00	4.00	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)
SOT-23-3L	3000ea*10tape	210	210	210

18. Revision History

Revision	Date	Description
Rev.1.0	2016-05-10	Preliminary datasheet
Rev.1.1	2017-08-06	Add ordering information SC2448SO
Rev.1.2	2019-05-06	The final revision of old datasheet
Rev.A1.0	2021-10-09	Unified datasheet format, update AEC-Q100
Rev.A1.1	2022-04-03	Add ordering information of SC2443SO and SC2443UA
Rev.A1.2	2023-02-10	Add IDD Minimum limit / Update sensing point vertical position
Rev.A1.3	2023-06-08	Add order information of SC2442SE
Rev.A1.4	2023-08-07	Add R2=50 ohm in application circuit Update part number in order information
Rev.A1.5	2024-11-28	Update part number in order information
Rev.A1.6	2025-03-12	Update TO-92S POD，modify ICC range
Rev.A1.7	2025-04-25	Add order information SC2442UA-BK
Rev.A1.8	2025-07-25	Unify the format of automotive product specifications
Rev.A1.9	2026-03-21	Remove SC2442SE and add packaging information and statements

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