High Sensitive Digital-Latch Hall Effect Sensor

FEATURES

- Digital latch Hall sensor
- High chopping frequency
- Supports a wide voltage range
- Wide operating temperature range
- Factory-programmed at end-of-line for magnetic optimum
- Reverse battery protection (up to 28V)
- Over-voltage protection at all pins
- Solid-state reliability
- Small package
  - 3-pin SIP -(UA)
  - 3-pin SOT23 -(SO)

APPLICATIONS

- Power tools
- Flow meters
- Valve and solenoid status
- BLDC motors with sensors
- Proximity sensing
- Tachometers

DESCRIPTION

The SC244X family, produced with BiC MOS technology, is a chopper-stabilized Hall Effect Sensor that offers a magnetic sensing solution with superior sensitivity stability over temperature and integrated protection features.

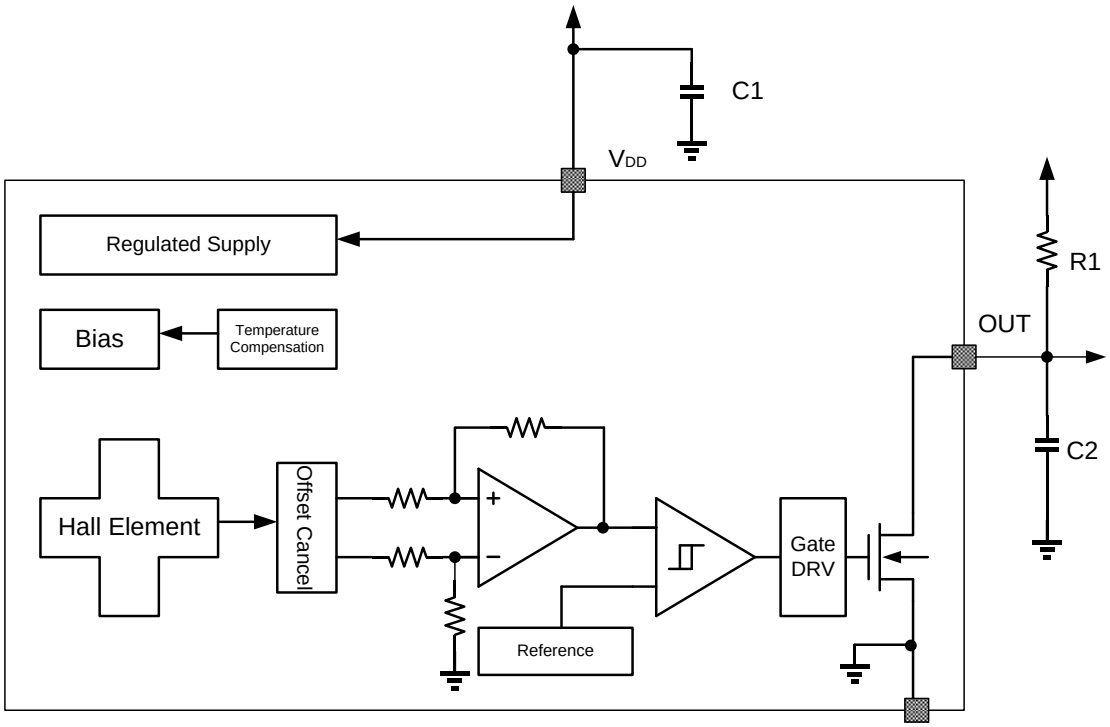
Superior high-temperature performance is made possible through dynamic offset cancellation, which reduces the residual offset voltage normally caused by device over molding, temperature dependencies, and thermal stress. Each device includes a single silicon chip a voltage regulator, Hall-voltage generator, small-signal amplifier, chopper stabilization, Schmitt trigger, and an open-drain output to sink up to 30mA.

An onboard regulator permits with supply voltages of 2.5V 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.

CONTENTS

BLOCK DIAGRAM

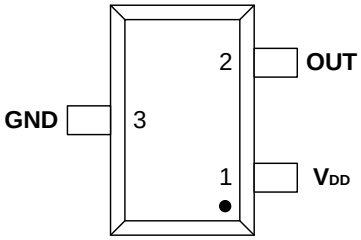


ORDERING INFORMATION

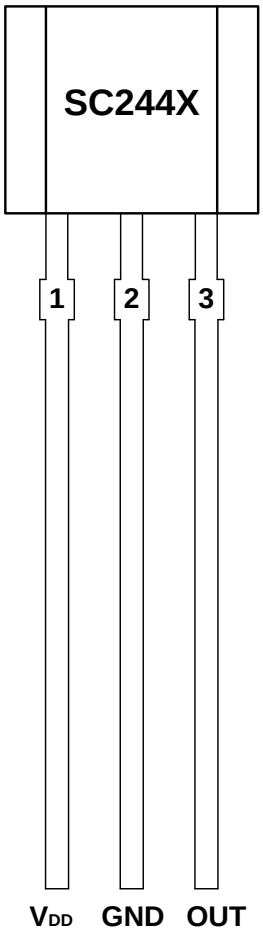
Part Number	Packing	Mounting	Ambient, T_A	B_{OP}(Typ.)	B_{RP}(Typ.)
SC2440UA	Bulk, 1000 pcs/bag	3-pin SIP	-40℃ to 150℃	+1.0mT	-2.0mT
SC2440SO-N	Reel, 3000 pcs /reel	3-pin SOT23		-1.0mT	+2.0mT
SC2442UA	Bulk,1000 pcs /bag	3-pin SIP	-40℃ to 150℃	+2.0mT	-2.0mT
SC2442SO	Reel, 3000 pcs /reel	3-pin SOT23			
SC2442SO-N	Reel, 3000 pcs /reel	3-pin SOT23		-2.0mT	+2.0mT
SC2446UA	Bulk, 1000 pcs /bag	3-pin SIP	-40℃ to 150℃	+4.0mT	-4.0mT
SC2446SO	Reel, 3000 pcs /reel	3-pin SOT23			
SC2448UA	Bulk, 1000 pcs /bag	3-pin SIP	-40℃ to 150℃	+8.0mT	-8.0mT
SC2448SO	Reel, 3000 pcs /reel	3-pin SOT23			

TERMINAL CONFIGURATION

3-Terminal SOT-23
SO Package
(Top View)



3-Terminal SIP
UA Package
(Top View)



Terminal			Type	Description
Name	Number			
	UA	SO		
V_{DD}	1	1	PWR	2.5V ~ 24 V power supply
GND	2	3	Ground	Ground terminal
OUT	3	2	Output	Open-drain output. The open drain requires a pull-up resistor

ABSOLUTE MAXIMUM RATINGS

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

Parameter	Symbol	Min.	Max.	Units
Power supply voltage	V_{DD}	-28(2)	28	V
Output terminal voltage	V_{OUT}	-0.5	28	V
Output terminal current sink	I_{SINK}	0	30	mA
Operating ambient temperature	T_A	-40	150	℃
Maximum junction temperature	T_J	-55	165	℃
Storage temperature	T_{STG}	-65	175	℃
ESD-Protection	V_{ESD}	-4	4	KV

(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.

(2) Ensured by design.

ESD PROTECTION

Human Body Model (HBM) tests according to: standard AEC-Q100-002 HBM

Parameter	Symbol	Min.	Max.	Units
ESD-Protection	V_{ESD}	-4	4	KV

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	℃/W
$R_{\theta JA}$	SO Package thermal resistance	Single-layer PCB, with copper limited to solder pads	228	℃/W

OPERATING CHARACTERISTICS

Electric Characteristics

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
V_{DD}	Operating voltage (1)	$T_J < T_{J(Max.)}$	2.5	--	24	V
V_{DDR}	Reverse supply voltage		-28	--	--	V
$IDD_{(off)}$	Operating supply current	V_{DD}=2.5 to 24 V, T_A=25℃	--	1.6	2.5	mA
$IDD_{(on)}$		V_{DD}=2.5 to 24 V, T_A=125℃	--	1.6	2.5	mA
t_{on}	Power-on time		--	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℃	--	10	--	Ω
t_d	Output delay time	B=B_{RP} to B_{OP}	--	15	25	μS
t_r	Output rise time (10% to 90%)	R_L=1Kohm Co=50pF	--	--	0.5	μS
t_f	Output fall time (90% to 10%)	R_L=1Kohm Co=50pF	--	--	0.2	μS

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

Magnetic Characteristics

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

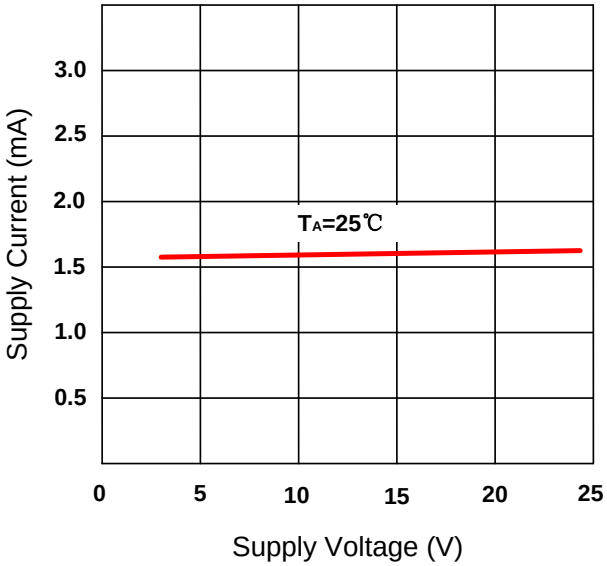
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
f_{BW}	Bandwidth		20	--	--	kHz
SC2440 +1.0 / -1.0 mT						
B_{OP}	Operated point	T_A=-40℃ to 150℃	--	+1.0	+2.0	mT
B_{RP}	Release point		-2.0	-1.0	--	mT
B_{HYS}	Hysteresis		--	2.0	--	mT
B_O	Magnetic offset	$B_O=(B_{OP}+B_{RP})/2$	-1.0	0	+1.0	mT
SC2442 +2.0 / -2.0 mT						
B_{OP}	Operated point	T_A=-40℃ to 150℃	+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
SC2446 +4.0 / -4.0 mT						
B_{OP}	Operated point	T_A=-40℃ to 150℃	+2.0	+4.0	+6.0	mT
B_{RP}	Release point		-6.0	-4.0	-2.0	mT
B_{HYS}	Hysteresis		--	8.0	--	mT
B_O	Magnetic offset	$B_O=(B_{OP}+B_{RP})/2$	-2.0	0	+2.0	mT
SC2448 +8.0 / -8.0 mT						
B_{OP}	Operated point	T_A=-40℃ to 150℃	+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

(1)1mT=10Gs

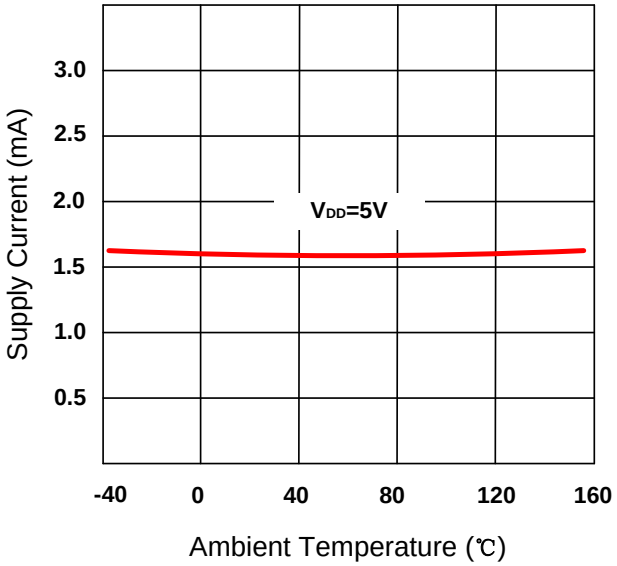
(2) Magnetic flux density, B, is indicated as a negative value for North-polarity magnetic fields, and as a positive value for South-polarity magnetic fields.

TYPICAL CHARACTERISTICS

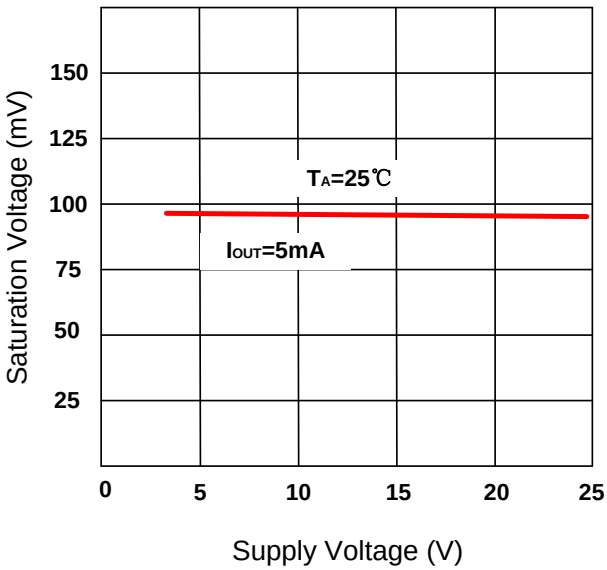
I_{DD} vs V_{DD}



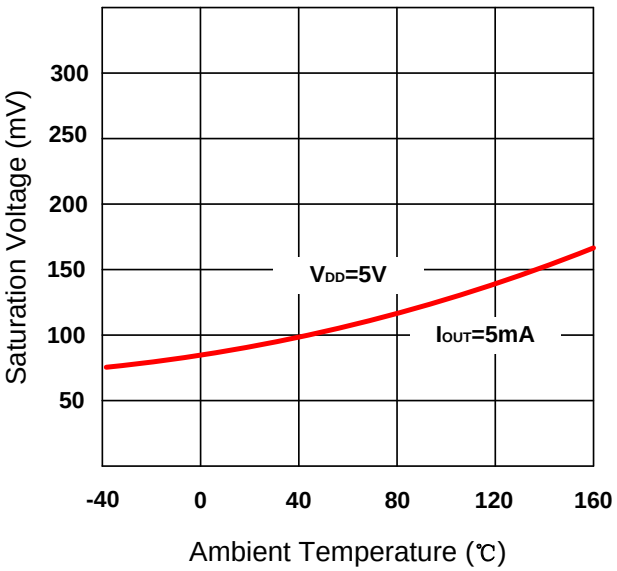
I_{DD} vs T_A



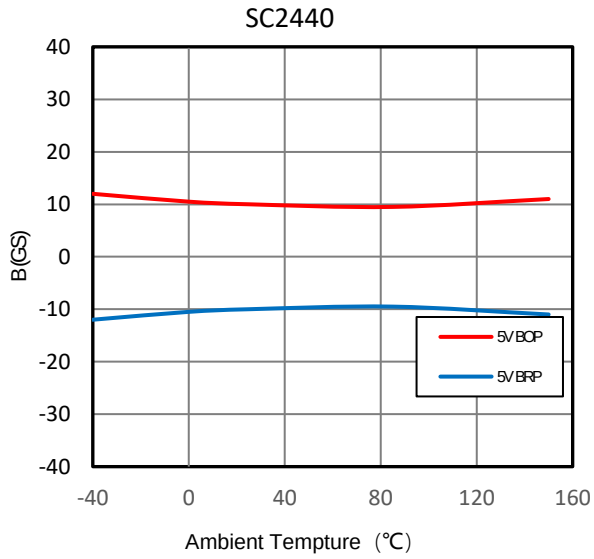
$V_{Q(sat)}$ vs V_{DD}



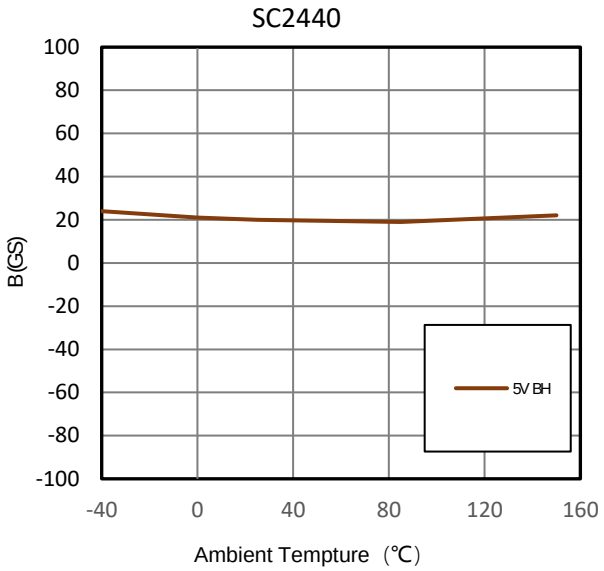
$V_{Q(sat)}$ vs T_A



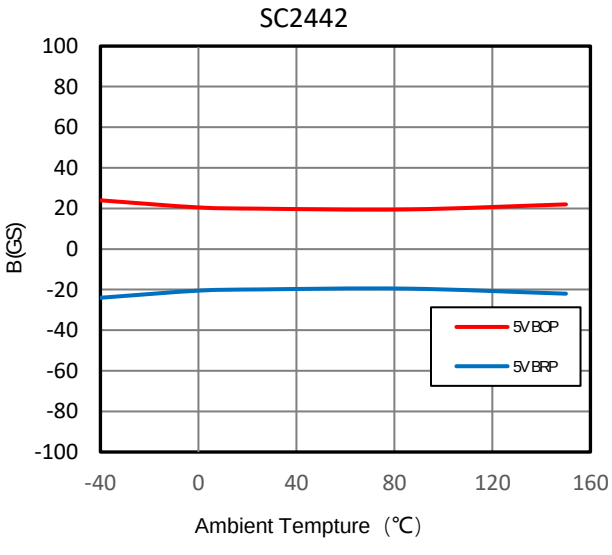
TYPICAL CHARACTERISTICS(continued)



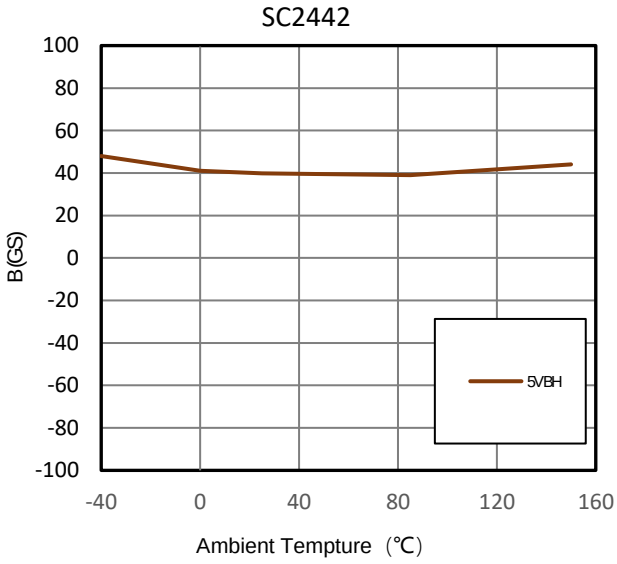
B vs TA



BHYS vs TA

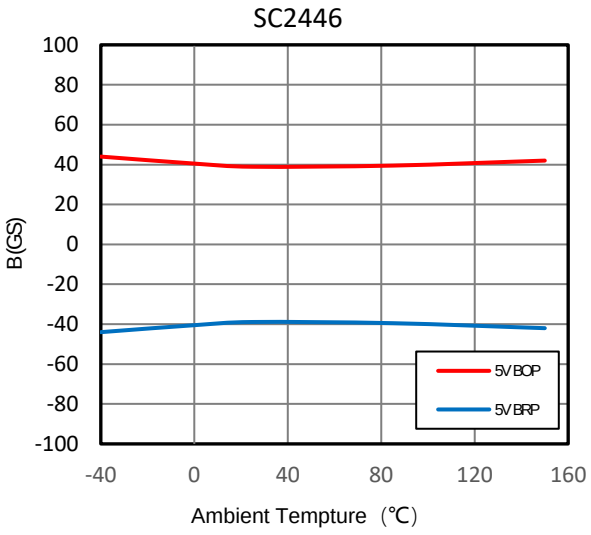


B vs TA

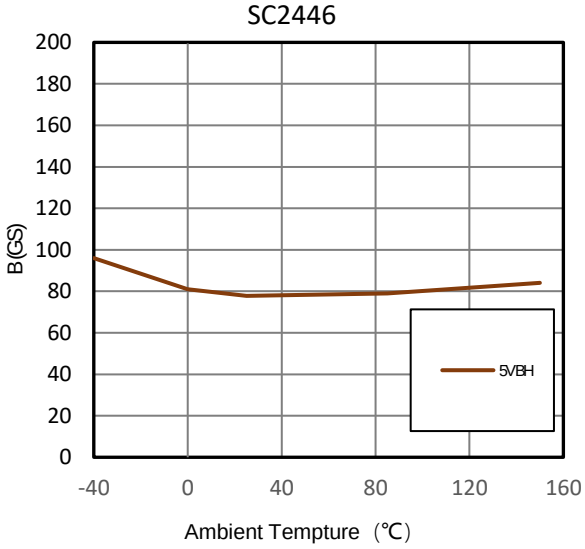


BHYS vs TA

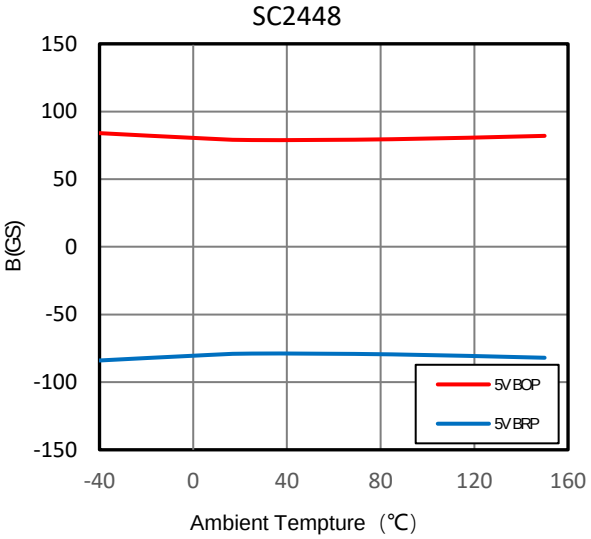
TYPICAL CHARACTERISTICS (continued)



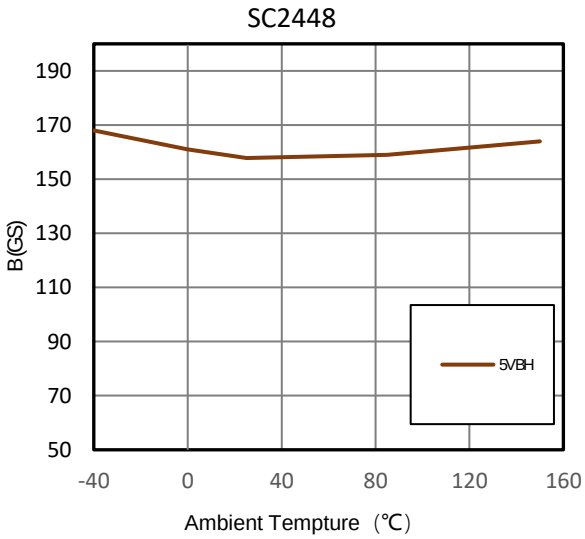
B vs TA



BHYS vs TA



B vs TA



BHYS vs TA

FUNCTION DESCRIPTION

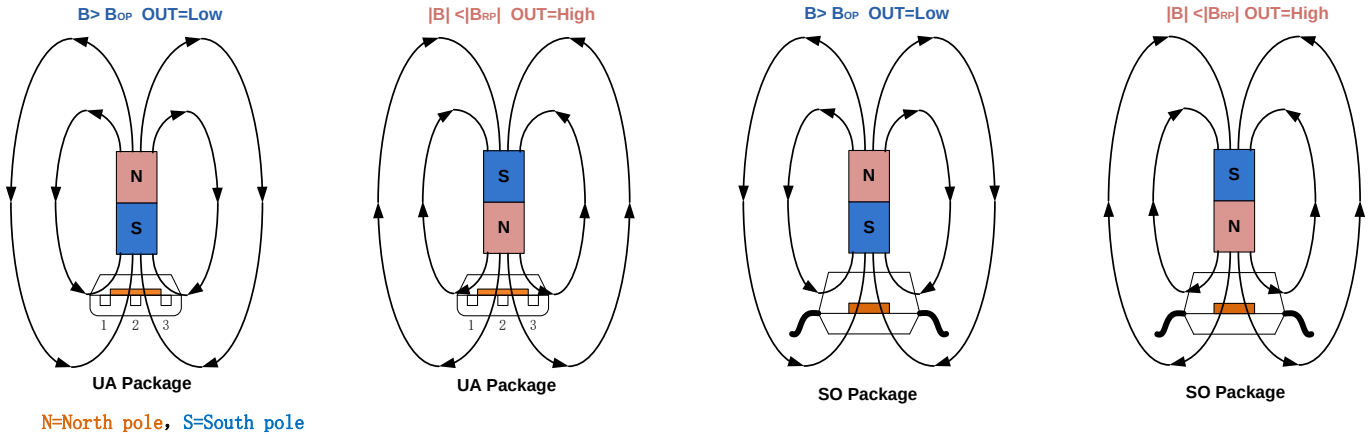
The SC244X device is a chopper-stabilized Hall sensor with a digital latched output for magnetic sensing applications. The device can be powered with a supply voltage between 2.5 and 24V, and continuously survives continuous -28V reverse-battery conditions.

The output of SC244X switches low (turns on) when a magnetic field (South polarity) perpendicular to the Hall element exceeds the operate point threshold, B_{OP}. After turn-on, the output is capable of sinking 20mA and the output voltage is $V_{Q(sat)}$. When the magnetic field is reduced below the release point, B_{RP}, the device output goes high (turns off). The difference in the magnetic operate and release points is the hysteresis, B_{HYS}, of the device. This built-in hysteresis allows clean switching of the output even in the presence of external mechanical vibration and electrical noise.

An external output pull-up resistor is required on the OUT terminal. The OUT terminal can be pulled up to V_{DD} or to a different voltage supply. This allows for easier interfacing with controller circuits.

Field Direction Definition

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



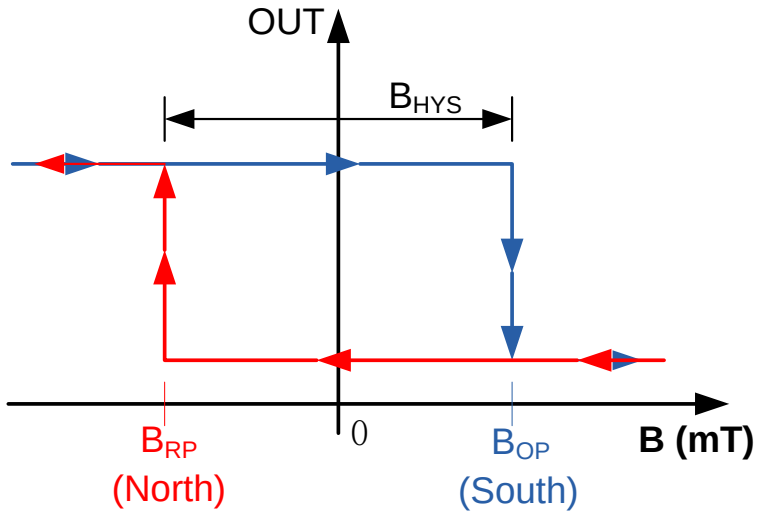
Transfer Function

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.

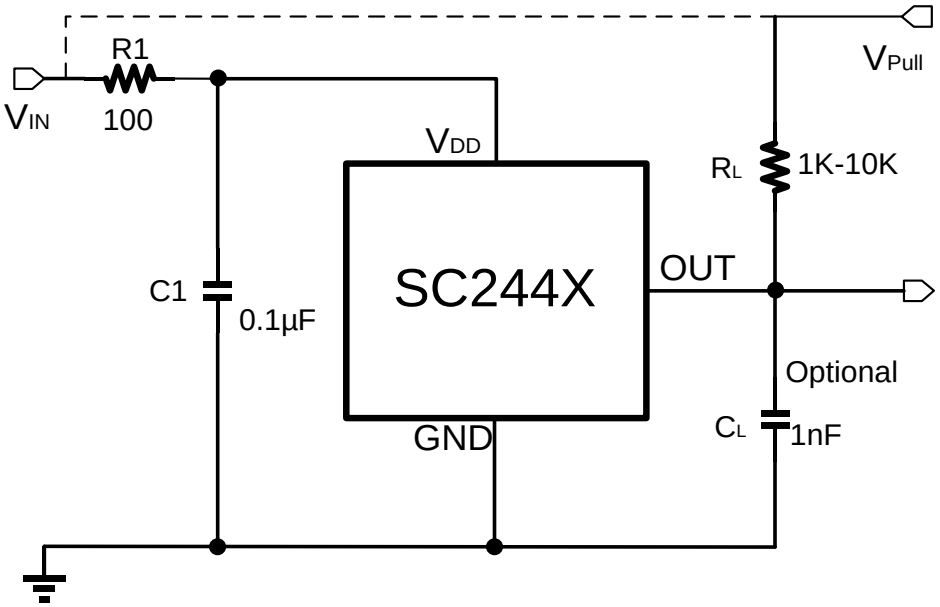
B_{OP}—magnetic threshold for activation of the device output, turning in ON (low) state

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

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



TYPICAL APPLICATION



The SC244X 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 V_{DD} 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 C_L is used as the output filter, typically 1nF.

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

$$C_L = \frac{1}{2\pi \times R \times f\ (Hz)}$$

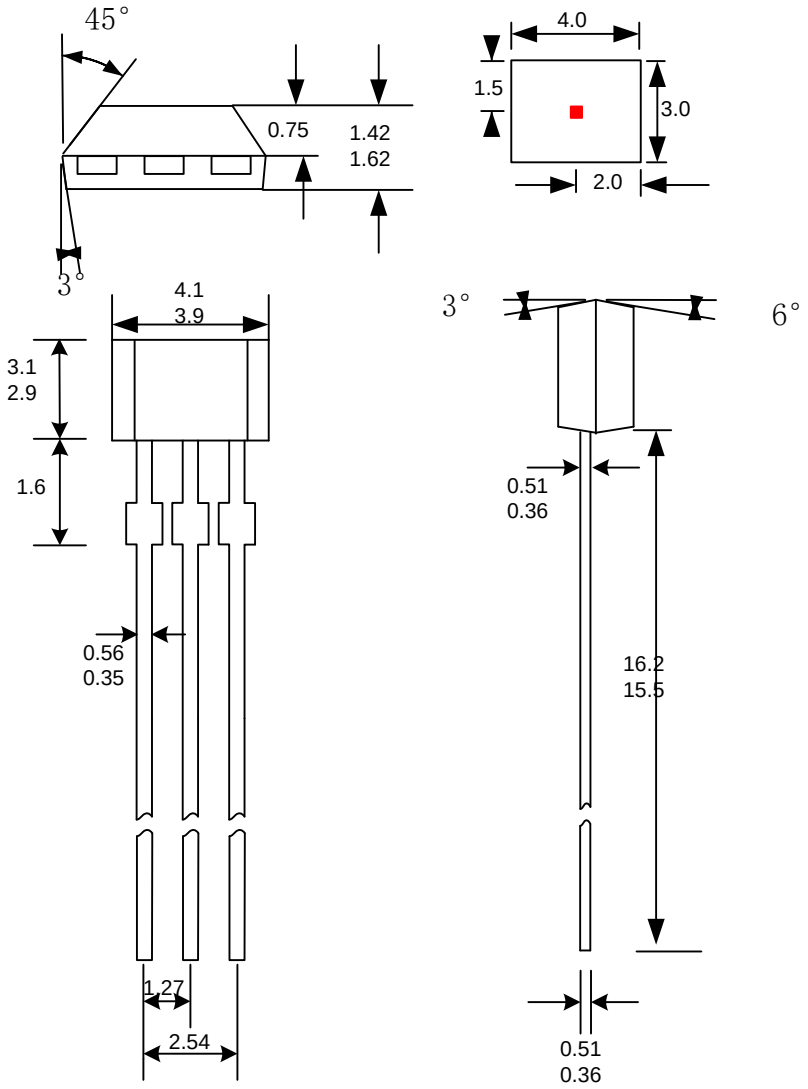
The output stage of the SC244X device is a drain open-circuit NMOS tube, which provides a load capacity of 20mA.Adjust the pull-up resistor R_L to make it work properly. The R_L provides a high level for the leak-opening output. In general, less current is better, but faster transient response and bandwidth are required, with a smaller resistor R_L for faster switching.

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

PACKAGE INFORMATION "UA"

3-Terminal
UA Package

Dimension:mm



Notes:

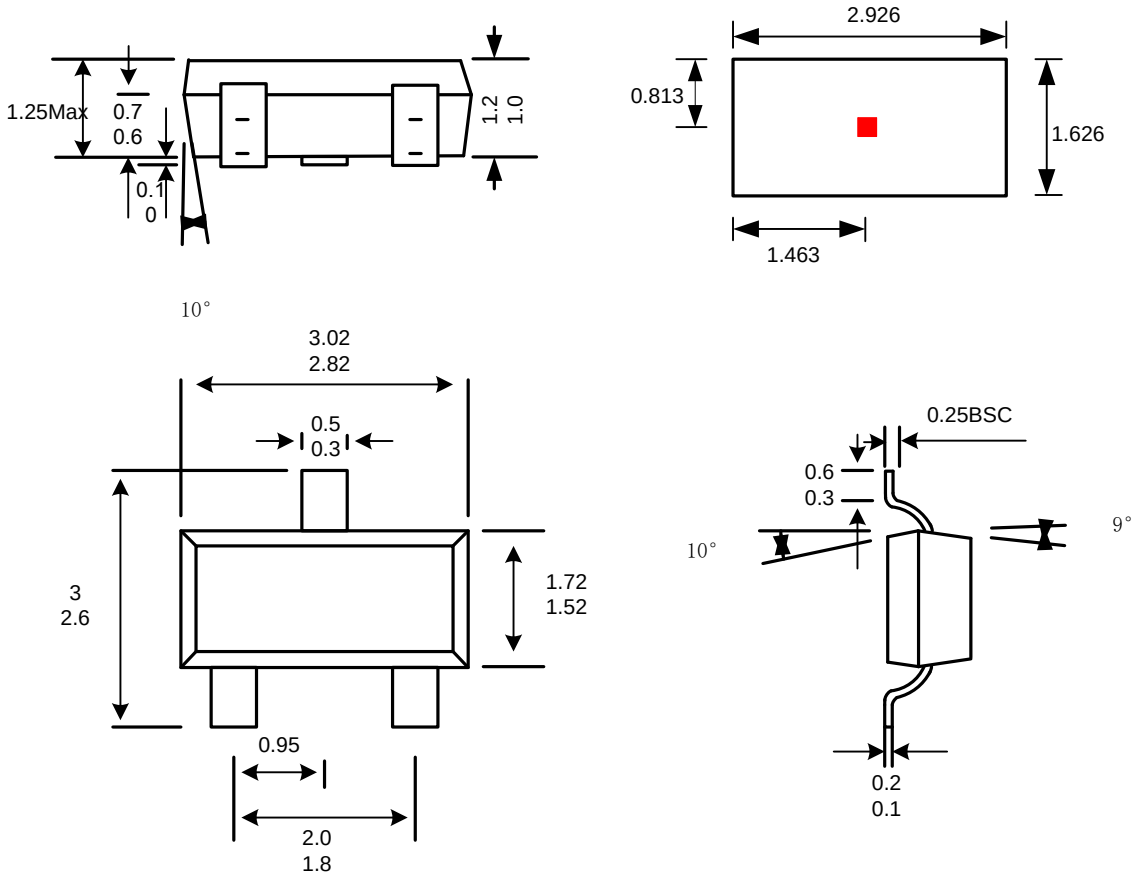
1. *Exact body and lead configuration at vendor's option within limits shown.*
2. *Height does not include mold gate flash.*

Where no tolerance is specified, dimension is nominal.

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.*

Where no tolerance is specified, dimension is nominal.

REVISION HISTORY

Revision	Date	Description
Rev1.0	2016-05-10	Preliminary Datasheet
Rev1.1	2017-08-06	Add ordering information SC2448SO
Rev2.3	2019-05-06	The final revision of old datasheet
RevA/1.0	2021-01-04	Unified datasheet format