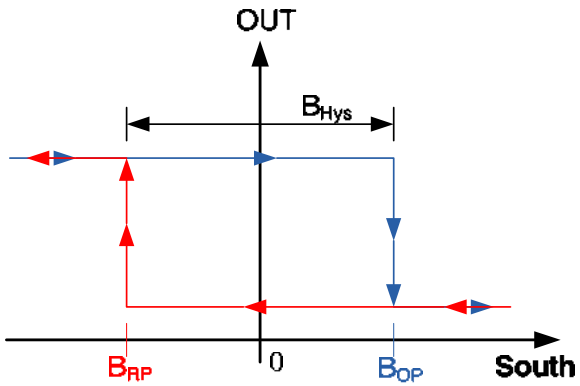
High Sensitive Digital-Latch Hall Effect Sensor 2442,2446,2448

Features

- Digital latch Hall sensor
- High chopping frequency
- Supports a wide voltage range
  - 2.5 to 24V
  - Operation from unregulated supply
- Wide operating temperature range
- Factory-programmed at end-of-line for optimum
- Reverse battery protection (up to 28V)
- Over-voltage protection at all pins
- Robust EMC performance
- Solid-state reliability
- Small package
  - 3-pin SIP -(UA)
  - 3-pin SOT23 -(SO)

Output state



Applications

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

Description

The 244X family, produced with BiCMOS 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 on 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 20mA.

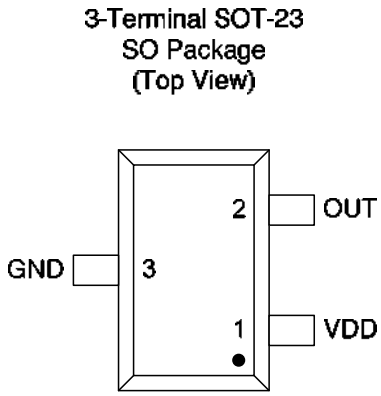
An onboard regulator permits with supply voltages of 2.5 to 24V which makes the device suitable for a wide range of industrial and atuomotive applications

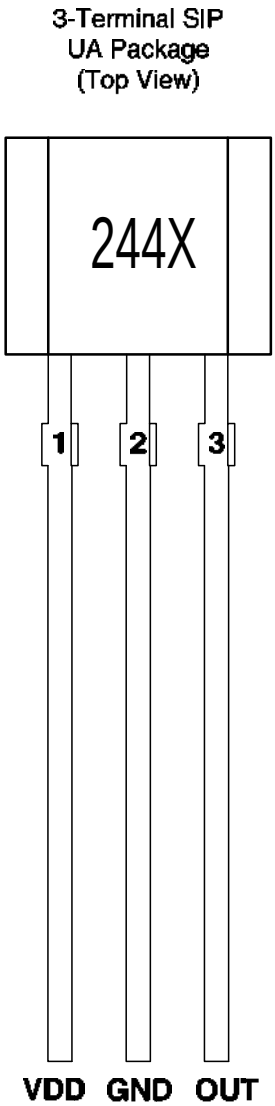
The device is available in a 3-pin SIP package (UA) and a 3-pin SOT-23 style package (SO). Both are lead (Pb) free, with 100% matte tin leadframe plating.

Device Information

Part Number	Packing	Mounting	Ambient, T_A	B_{OP}(Typ.)	B_{RP}(Typ.)
2442	Bulk, 1000 pieces/bag	3-pin SIP	-40℃ to 150℃	+2.0mT	-2.0mT
2442	Reel, 3000pieces/reel	3-pin SOT23			
2442	Reel, 3000pieces/reel	3-pin SOT23		-2.0mT	+2.0mT
2446	Bulk, 1000 pieces/bag	3-pin SIP	-40℃ to 150℃	+4.0mT	-4.0mT
2446	Reel, 3000pieces/reel	3-pin SOT23			
2448	Bulk, 1000 pieces/bag	3-pin SIP	-40℃ to 150℃	+8.0mT	-8.0mT
2448	Reel, 3000pieces/reel	3-pin SOT23			

Terminal configuration and functions





Terminal			Type	Description
Name	Number			
	UA	SO		
VDD	1	1	PWR	2.5 to 24 V power supply
GND	2	3	Ground	Ground terminal
OUT	3	2	Output	Open-drain output.

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	℃

(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 EIA/JESD22-A114-B 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

Electrical 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
I_{DD}	Operating supply current	V_{DD}=2.5 to 24 V, T_A=25℃	0.8	1.6	2.0	mA
		V_{DD}=2.5 to 24 V, T_A=125℃	0.8	1.7	2.0	mA
t_{on}	Power-on time		--	35	50	μS
I_{QL}	Off-state leakage current	Output Hi-Z	--	--	1	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

(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)

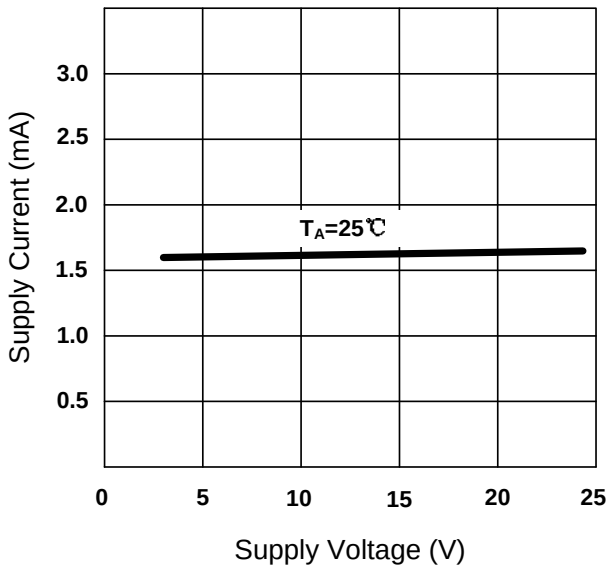
f_{BW}	Bandwidth		20	--	--	kHz
2442 +2.0 / -2.0 mT						
B_{OP}	Operated point	T_A=-40℃ to 150℃	+1.0	+2.0	+3.0	mT
B_{RP}	Release point		-3.0	-2.0	-1.0	mT
B_{HYS}	Hysteresis		3.0	4.0	5.0	mT
B_O	Magnetic offset	$B_O=(B_{OP}+B_{RP})/2$	-1.0	0	+1.0	mT
2446 +4.0 / -4.0 mT						
B_{OP}	Operated point	T_A=-40℃ to 150℃	+2.0	+4.0	+6.0	mT
B_{RP}	Release point		-6.0	-4.0	-3.0	mT
B_{HYS}	Hysteresis		6.0	8.0	10.0	mT
B_O	Magnetic offset	$B_O=(B_{OP}+B_{RP})/2$	-1.0	0	+1.0	mT
2448 +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		14.0	16.0	18.0	mT
B_O	Magnetic offset	$B_O=(B_{OP}+B_{RP})/2$	-2.0	0	+2.0	mT

1mT=10Gs

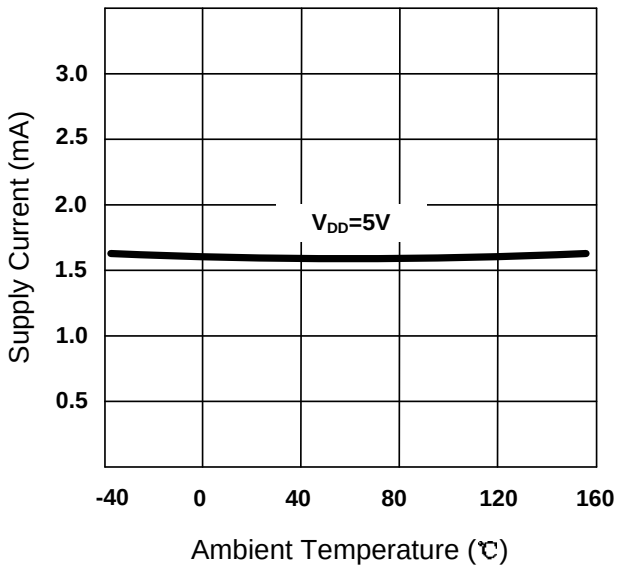
Magnetic flux density, B, is indicated as a negative value for North-polarity magnetic fields, and as a positive value for South-polarity magnetic fields.

Characteristic Data

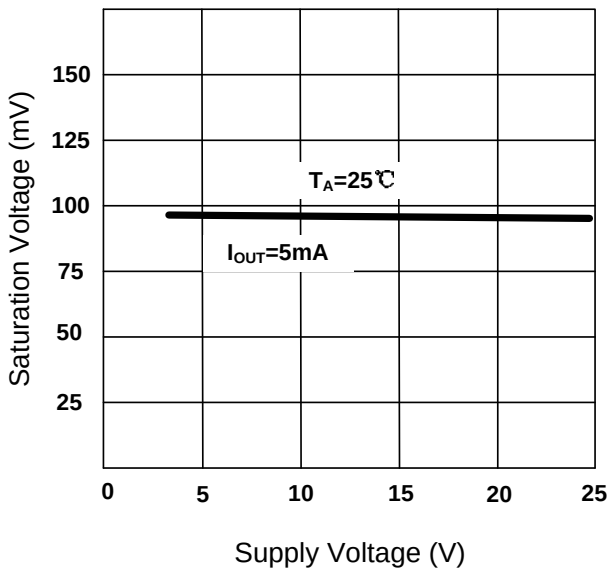
I_{DD} vs V_{DD}



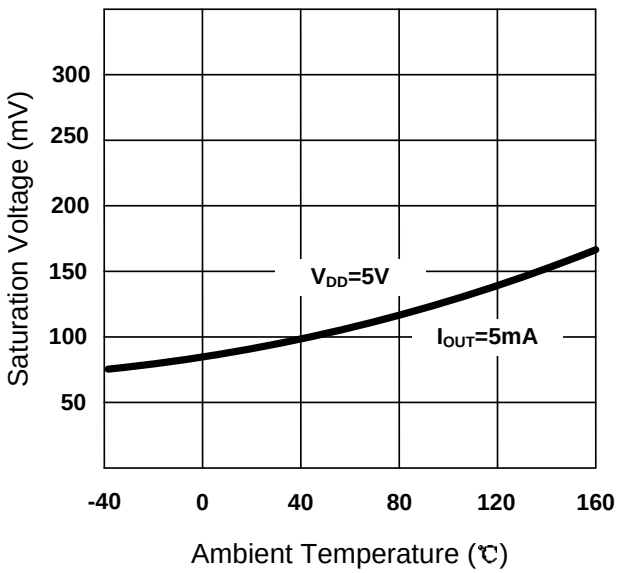
I_{DD} vs T_A



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



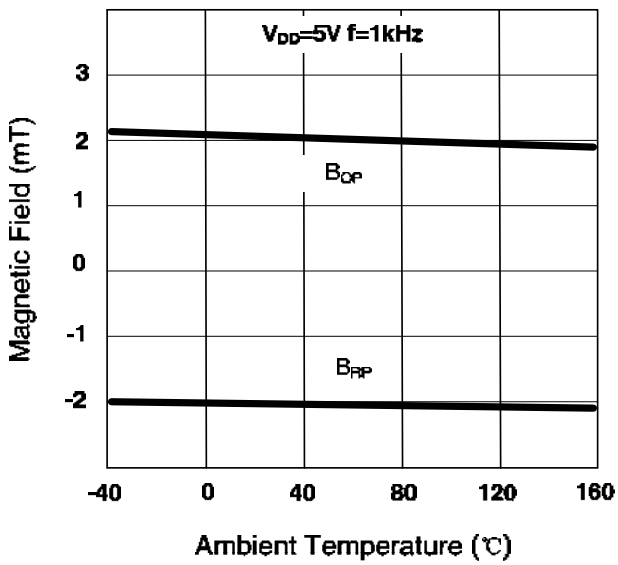
$V_{Q(sat)}$ vs T_A



Characteristic Data (Continued)

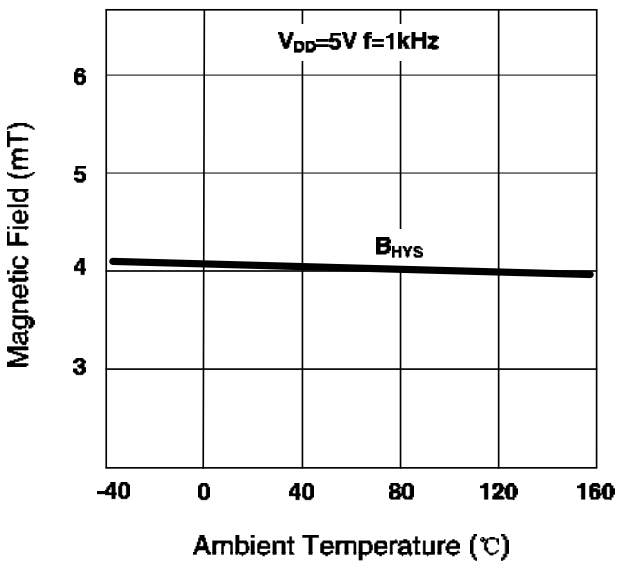
2442

B_{OP} and B_{RP} vs T_A



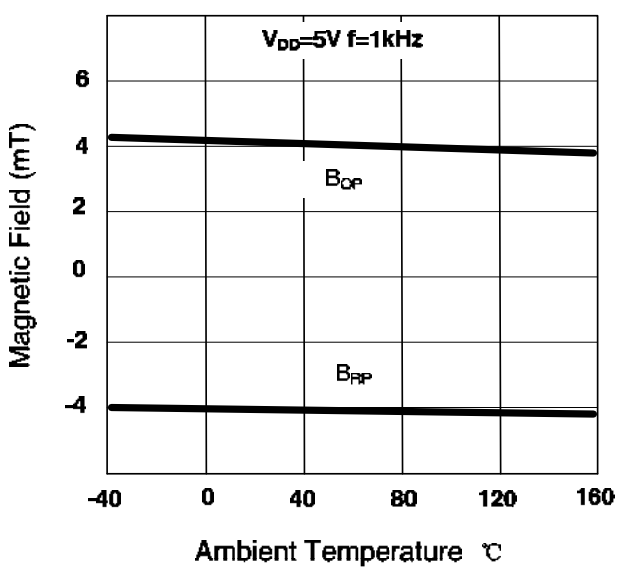
2442

B_{HYS} vs T_A



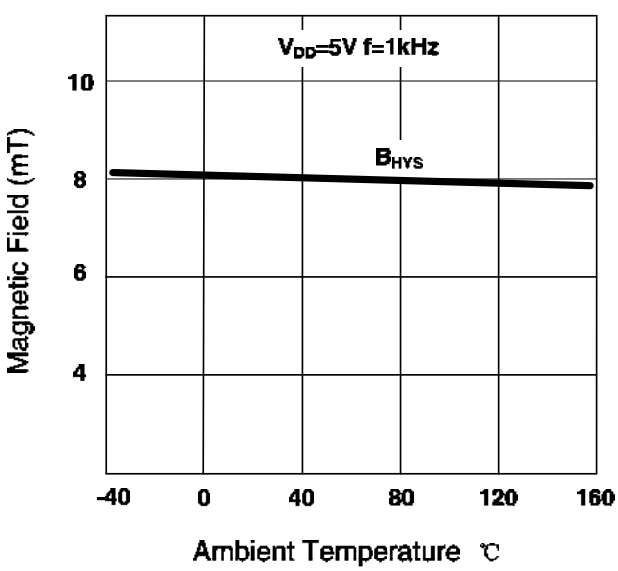
2446

B_{OP} and B_{RP} vs T_A



2446

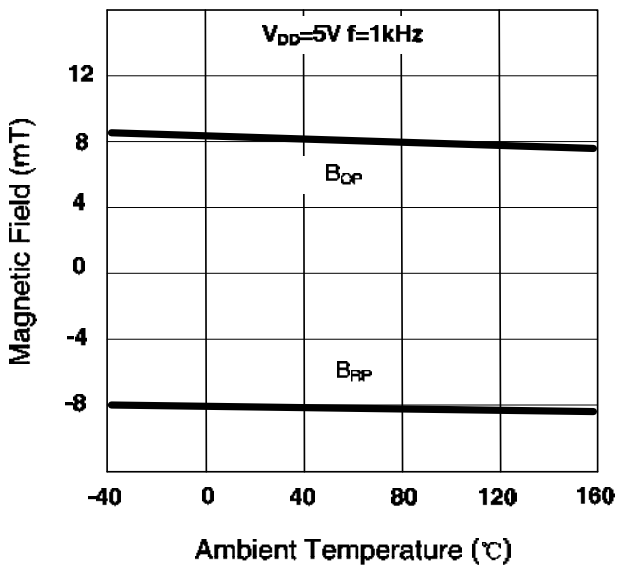
B_{HYS} vs T_A



Characteristic Data (Continued)

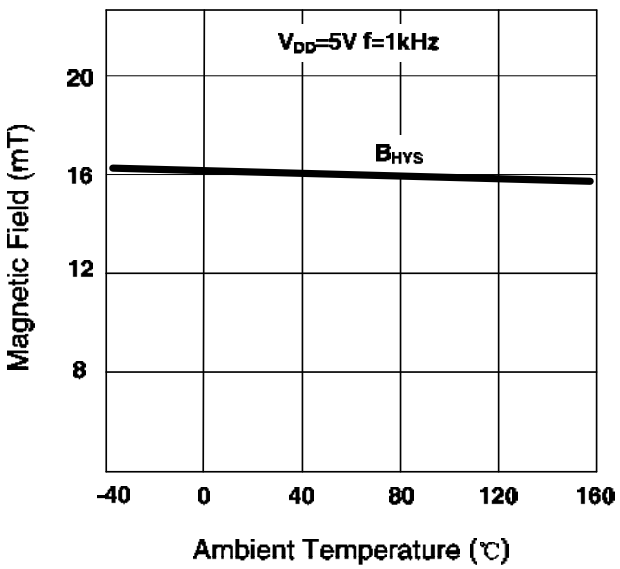
2448

B_{OP} and B_{RP} vs T_A



2448

B_{HYS} vs T_A



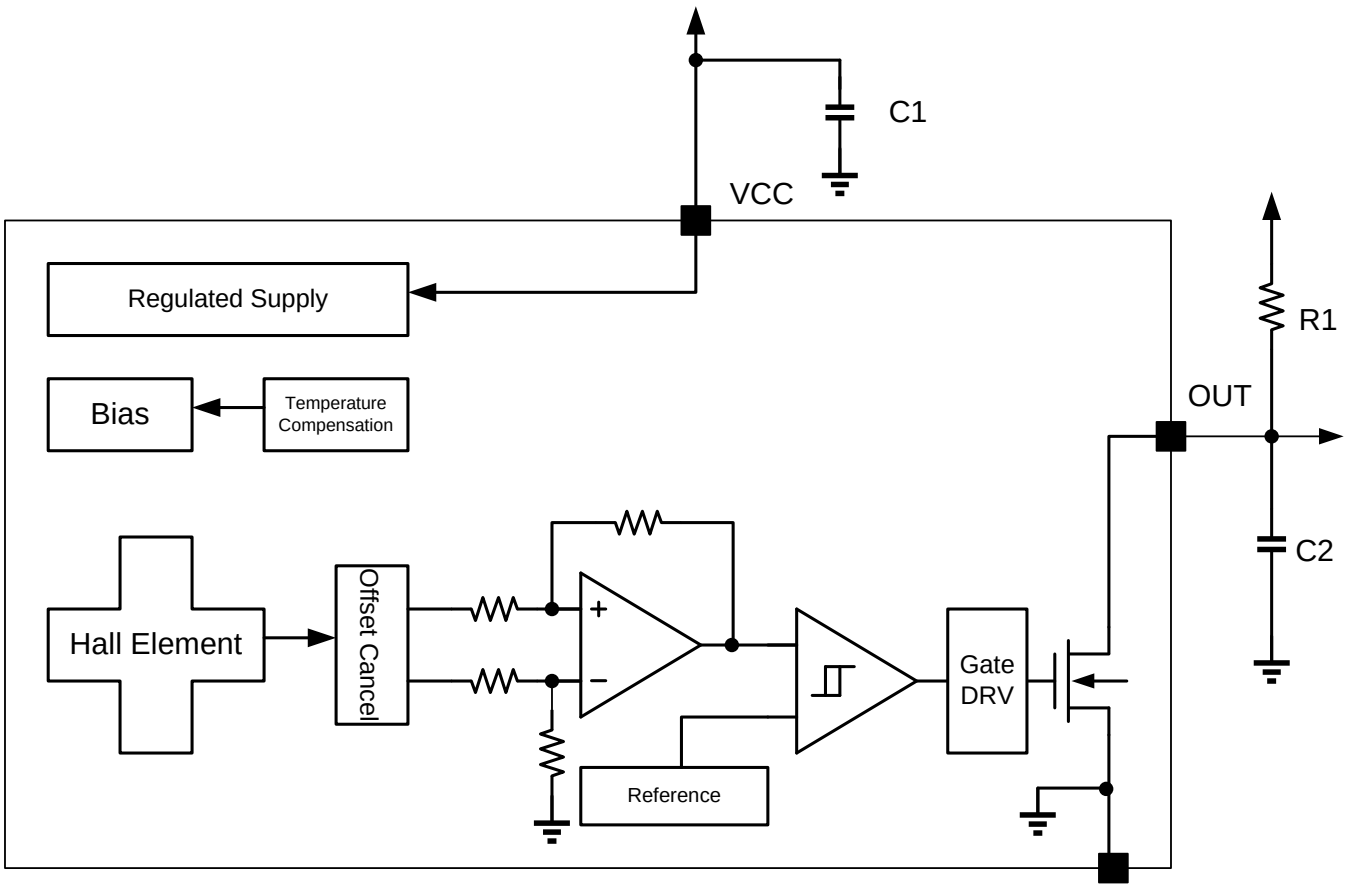
Function Description Overview

The 244X 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 device does not operate when -28 to 2.2V is applied to the VDD terminal (with respect to the GND terminal). In addtion, the device can withstand voltages up to 40V for transient durations.

The output of 244X switches low (turns on) when a magnet ic 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.

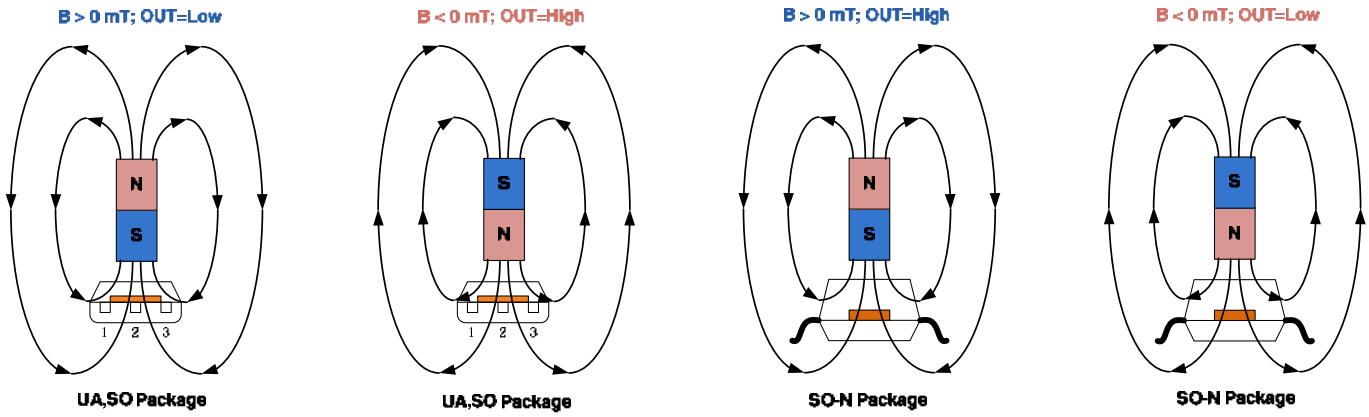
An external output pull-up resistor is required on the OUT terminal. The OUT terminal can be pulled up to V_{DD} or to a different voltage supply. This allows for easier interfacing with controller circuits.

Functional Block Diagram



Field Direction Definition

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



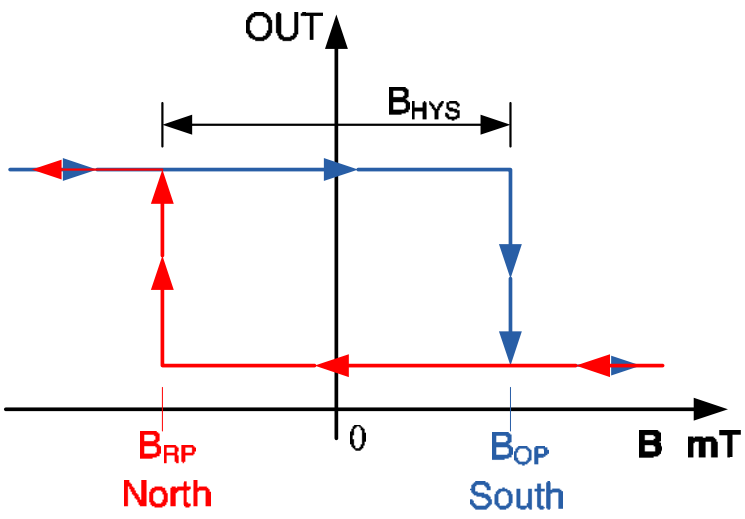
Transfer Function

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.

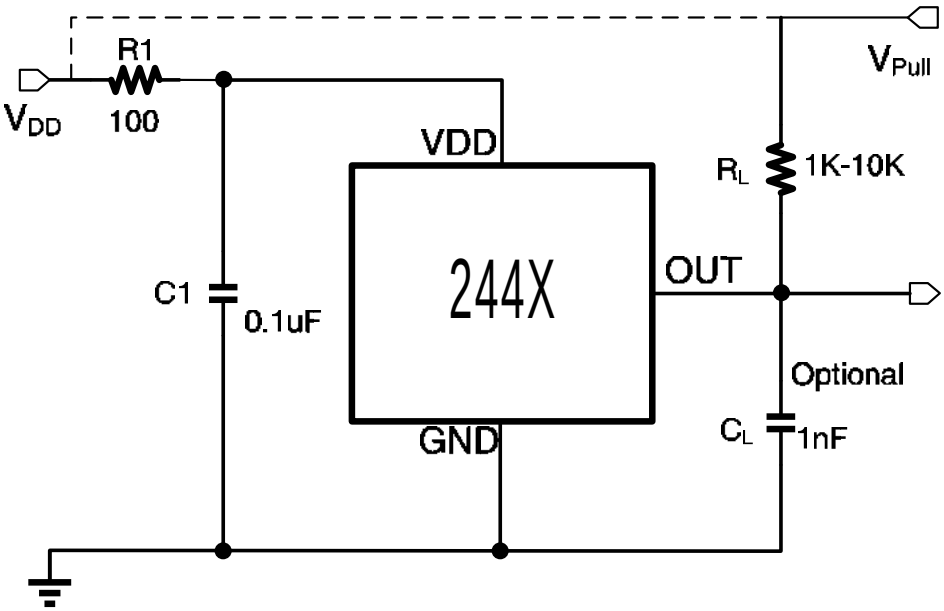
B_{OP}—magnetic threshold for activation of the device output, turning in ON (low) state

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

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



Typical Application



The 244X 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. R1 is for improved CI performance, and could be 100 or 200 Ω typically.

The 244X 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 vaule for C_L based on the system bandwidth specifications as:

$$2 \times f\,(Hz) = \frac{1}{2\pi \times R \times \mathrm{C}}$$

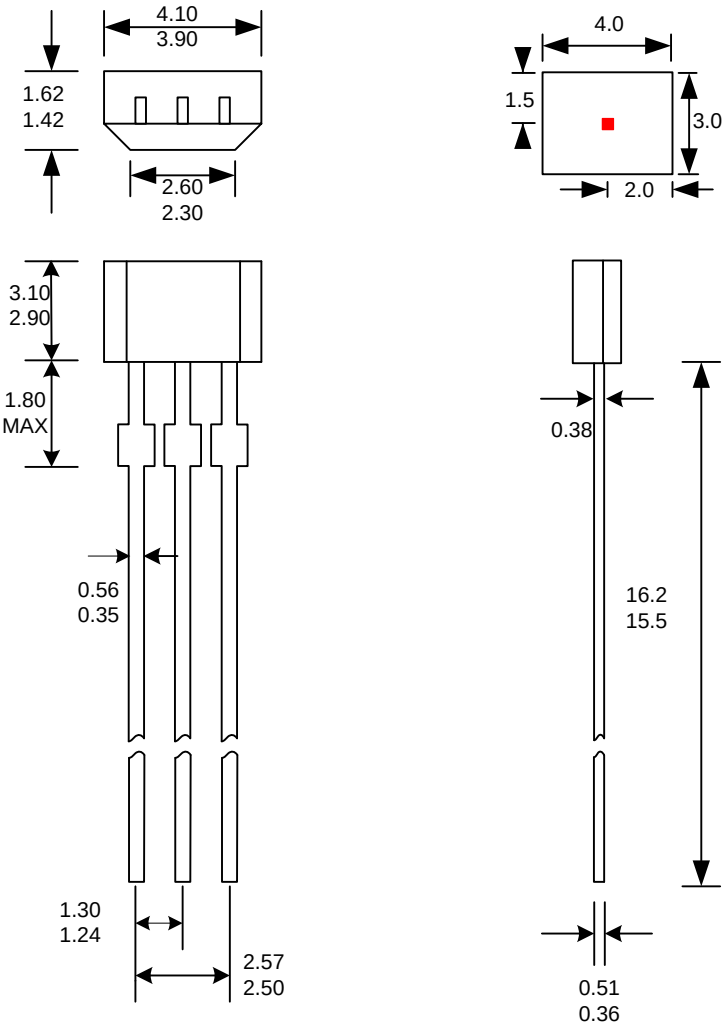
Most applications do not require this C_L filtering capacitor.

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.

Mechanical Dimensions

3-Terminal
UA Package

Dimension:mm



Notes:

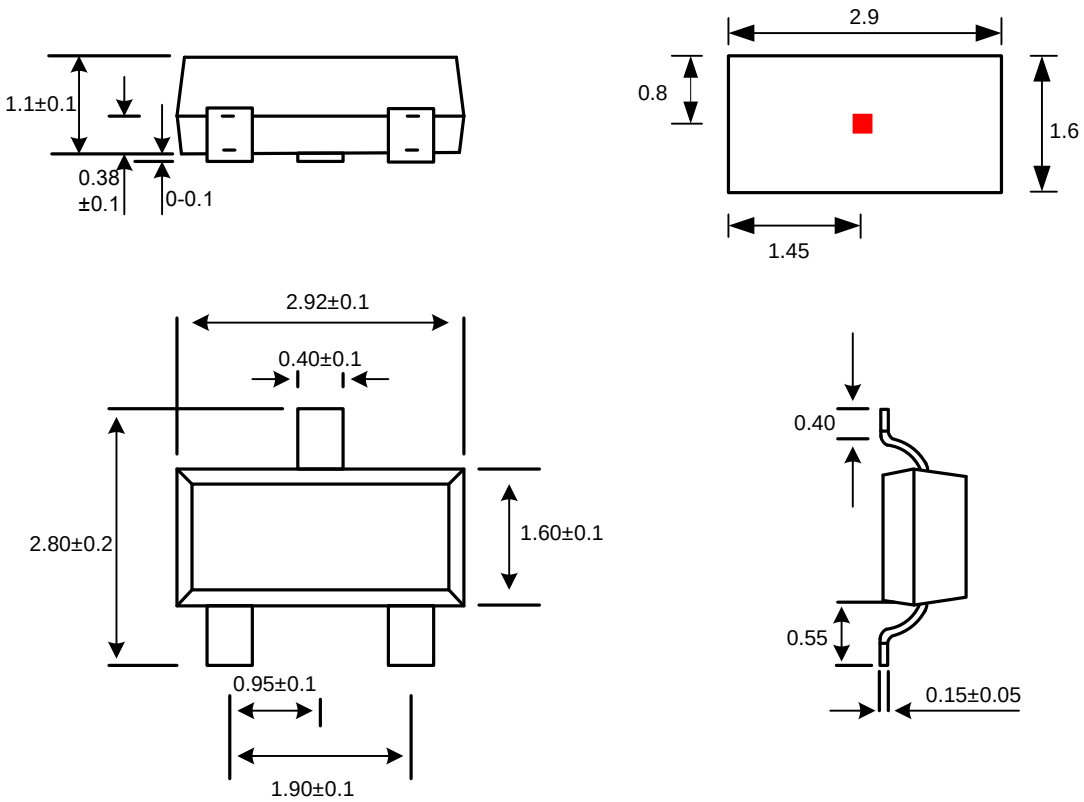
1. *Exact body and lead configuration at vendor's option within limits shown.*
2. *Height does not include mold gate flash.*

Where no tolerance is specified, dimension is nominal.

Package Designator “SO”

3-Terminal
SO Package

Dimension:mm



注 意 事 项

1.霍尔是敏感器件，在使用过程以及存储过程中请注意采取静电防护措施。

2.霍尔在安装过程中应尽量避免对霍尔本体施加机械应力，如管脚需要弯曲请在距引线根部3ＭＭ以外操作。

3.建议焊接温度:电烙铁焊接，建议温度350℃，最长5秒。
波峰焊:建议最高温度260℃，最长3秒　　红外回流焊:建议最高245℃，最长10秒

4.不建议超越数据表中的参数使用，虽然极限参数下霍尔会正常工作，但是长时间外于极限条件下可能会造成霍尔可靠性降低以及损坏或者实际产品的损坏，为了保障霍尔的正常工作和产品的安全性稳定性，请在数据表许可范围内使用。

5.如将本产品应用干医疗、军事、航天等可靠性要求极高的行业产品中，请预先告知评估。如发生潜在或者直接风险（人身伤害或产品损坏)海尔希科技不承担任何责任。

6.海尔希科技致力于为客户提供更优秀的产品，保留产品及其规格书的更改权，规格书如果有更改，恕不另行通知。