

High-voltage Programmable Micro-power Hall Effect Sensor

1. Features

- AEC-Q100 grade 0
- ISO26262 ASIL-B
- Wide voltage range: 3V to 40V
- Programmable parameters:
 - Unipolar or Omnipolar
 - micro power mode
 - Sensitivity range: -22mT to 22mT
 - Active Pole: North or South
 - Output: Direct or Inverted
- Less than 20uA average current in micro-Power Mode
- Open-Drain output
- CRC check protection
- Reverse battery protection: -28V
- Thermal shutdown protection
- Wide operating temperature range:
 - -40°C to 150°C
- High EMC/ESD immunity
- Small package:
 - 3-pin TO-92S (UA)
 - 3-pin SOT23-3L (SO)

2. Applications

- Shift lever position check
- E-Door Handle
- Detection of Car Door Lock Status
- Seat position detection
- Sunroof/Tailgate Opener
- Electronic Steering Column Lock
- Brake Light switch

3. Description

SC245X produced with BCD technology, it is a programmable micro-power mode automotive-grade Hall effect sensor. It is developed in accordance with the ISO 26262 standard and supports the ASIL B functional safety level. Programmable is a key attribute of the SC245X. Customer can select pre-programmed units, or program at end of line to realize the system optimization across a range spanning -22mT to +22mT.

SC245X is specifically designed according to the requirements of automotive applications, complies with the AEC-Q100 standard, supports operation with voltages ranging from 3V to 40V, and features -28V reverse voltage protection and over-temperature protection functions.

SC245X 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.



Fig.1 Package Outline

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4. Terminal Configuration

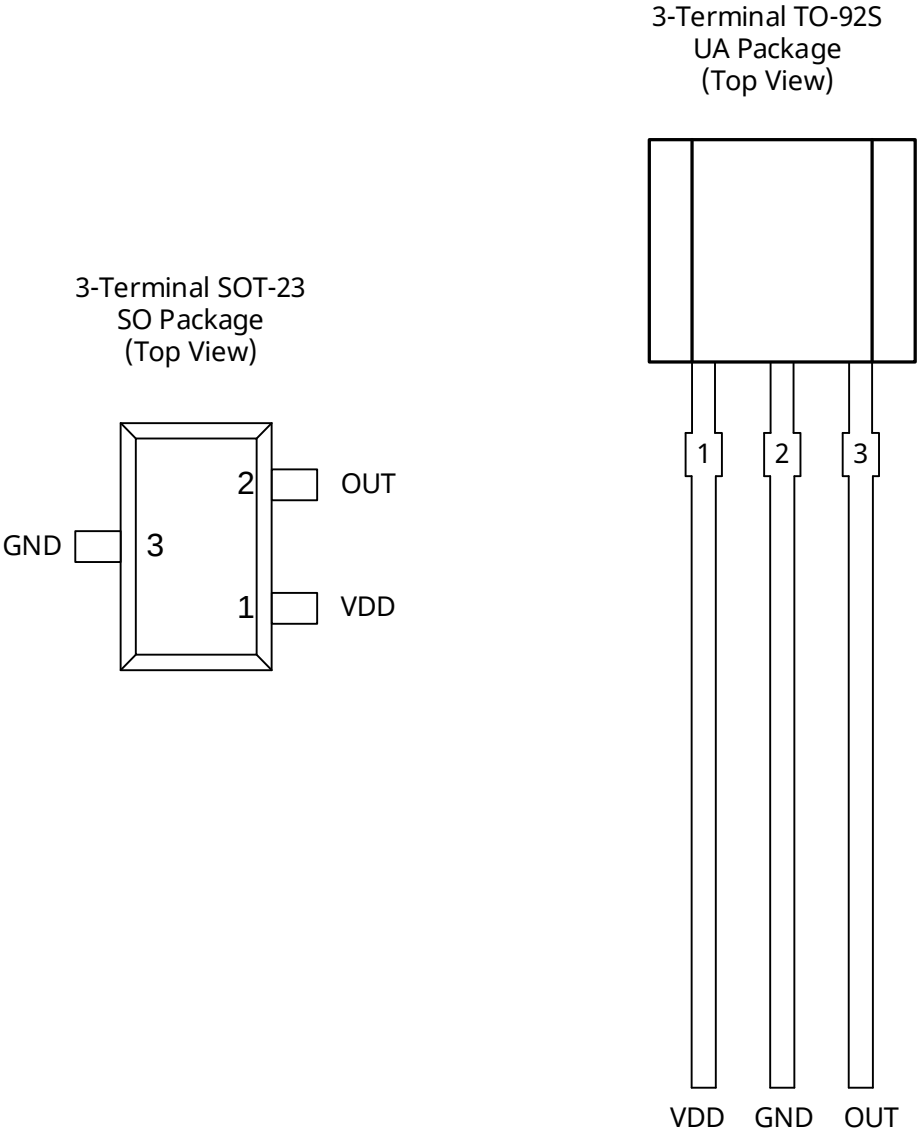


Fig.2 Pin Definition Diagram

Terminal			Type	Description
Name	UA	SO		
VDD	1	1	Power	3V to 40V power supply
GND	2	3	Ground	Ground terminal
OUT	3	2	Output	Open-Drain output

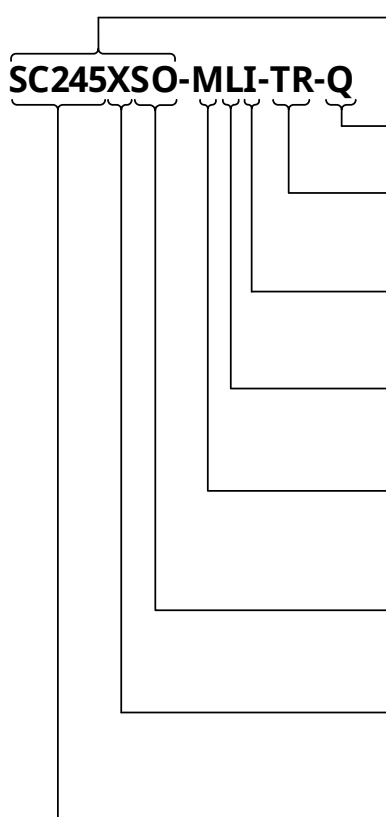
5. Ordering Information

Ordering Information	Marking	I _{DD} (mA)	B _{OP} (mT)	B _{RP} (mT)	Output	Package	Packing	Quantity
SC2450SO-TR-Q*	2450	3.3	2.5	1.5	Direct	SOT23-3L	Reel	3000/reel
SC2450SO-LI-TR-Q	2450	0.020	2.5	1.5	Inverted	SOT23-3L	Reel	3000/reel
SC2450UA-LI-BK-Q	2450	0.020	2.5	1.5	Inverted	TO-92S	Bulk	1000/bag
SC2450SO-M-TR-Q*	2450	3.3	±2.5	±1.5	Direct	SOT23-3L	Reel	3000/reel
SC2450UA-M-BK-Q	2450	3.3	±2.5	±1.5	Direct	TO-92S	Bulk	1000/bag
SC2450SO-ML-TR-Q*	2450	0.020	±2.5	±1.5	Inverted	SOT23-3L	Reel	3000/reel
SC2450UA-ML-BK-Q	2450	0.020	±2.5	±1.5	Inverted	TO-92S	Bulk	1000/bag
SC2450SO-MLI-TR-Q	2450	0.020	±2.5	±1.5	Inverted	SOT23-3L	Reel	3000/reel
SC2450UA-MLI-BK-Q	2450	0.020	±2.5	±1.5	Inverted	TO-92S	Bulk	1000/bag
SC2451SO-TR-Q	2451	3.3	10.0	8.5	Direct	SOT23-3L	Reel	3000/reel
SC2452SO-TR-Q	2452	3.3	18.0	13.0	Direct	SOT23-3L	Reel	3000/reel
SC2455SO-TR-Q	2455	3.3	22.0	17.0	Direct	SOT23-3L	Reel	3000/reel
SC2459SO-TR-Q*	2459	PROG	PROG	PROG	PROG	SOT23-3L	Reel	3000/reel
SC2459UA-BK-Q	2459	PROG	PROG	PROG	PROG	TO-92S	Bulk	1000/bag

Note :

*Main product model of our company

Ordering Information Format



Part Number

Product Grade

Q: Automotive Product

Packing Designation

TR: Tape & Reel

BK: Bulk

Output

Blank: Normal Output

I: Inverted Output

Power Mode

Blank: Normal Power

L: Micro Power

Switch Mode

Blank: Unipolar

B: Bipolar

M: Omnipolar

Package Designation

SO: SOT23-3L

UA: TO-92S

Magnetic Parameter

0-8: fixed B_{OP}/B_{RP}

9: Programmable

Device Family

SC245X: High-voltage programmable low-power Hall effect sensor

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	60	V
V _{OUT}	Output terminal voltage	For 5 Min. @1.2K pull-up resistor	-0.5	60	V
I _{SINK}	Output terminal current sink	-	0	40	mA
T _A	Operating ambient temperature	-	-40	150	°C
T _J	Maximum junction temperature	-	-40	165	°C
T _{STG}	Storage temperature	-	-65	175	°C

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	-8	+8	kV
V _{ESD_CDM}	CDM	According to: standard AEC-Q100-011 CDM	-1	+1	kV

8. Thermal Characteristics

Symbol	Parameter	Test Conditions	Rating	Units
R _{θja}	UA Package thermal resistance	Single-layer PCB, with copper limited to solder pads	200 ⁽¹⁾	°C/W
R _{θja}	SO Package thermal resistance	Single-layer PCB, with copper limited to solder pads	300 ⁽¹⁾	°C/W

Note:

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

9. Operating Characteristics

9.1. Electrical Characteristics

Symbol	Parameter	Test Conditions	Min.	Typ. ⁽¹⁾	Max.	Units
V_{DD}	Operating voltage	$T_J < T_{J(Max.)}$	3.0	5.0	40	V
$UVLO_H$	Under Voltage Lockout High	$B > B_{OP}$, V_{DD} Rising From 2V	-	2.8	-	V
$UVLO_L$	Under Voltage Lockout Low	$B > B_{OP}$, V_{DD} Decreasing From 3V	-	1.9	-	V
$UVLO_{HYS}$	Under Voltage Hysteresis	$UVLO_H - UVLO_L$	-	500	-	mV
I_{DD}	Supply Current (Normal Power)	$V_{DD}=3$ to 40 V, $T_A=25^\circ\text{C}$	2.8	3.3	3.8	mA
I_{DD} (Micro Power)	Average current consumption (Micro Power)	$V_{DD}=3.0$ to 40V, $T_A=25^\circ\text{C}$	-	15	30	μA
		$V_{DD}=3.0$ to 40V, $T_A=150^\circ\text{C}$	-	30	50	μA
t_{ON}	Power on time	$V_{DD}=5.0\text{V}$	-	170	300	μs
t_d	Output delay time	$B=B_{RP}$ to B_{OP}	--	15	25	μs
T_{UPD}	Output Update Period	Normal Power Mode		40	45	μs
t_{ACTIVE}	Active time	Micro Power Mode	-	100	200	μs
T_{OP}	Operating (Output Update) Period	Micro Power Mode	-	50	-	ms
T_R	Output rise time (10% to 90%)	$R1=1\text{Kohm}$, $C_o=50\text{pF}$	-	0.3	1	μs
T_F	Output fall time (90% to 10%)	$R1=1\text{Kohm}$, $C_o=50\text{pF}$	-	0.2	1	μs
OTP	Over Temperature Protection	Temperature increasing	-	187	-	$^\circ\text{C}$
OTP_{HYS}	Over Temperature Hysteresis		-	12	-	$^\circ\text{C}$
I_{OLKG}	Output Leakage Current		-	0.1	10	μA
I_O	Output Current	Normal Power Mode	-	40	65	mA
V_{OL}	Low Output Voltage	Normal Power Mode, $I_O=20\text{mA}$	-	0.13	0.4	V
		Micro Power Mode, $I_O=10\text{mA}$	-	0.15	0.5	V

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
SC2450 ±2.5 ⁽¹⁾ /±1.5mT ⁽²⁾						
B _{OP}	Operating point	T _A =25°C	±1.5	±2.5	±3.5	mT
B _{RP}	Release point		±1.0	±1.5	±3.0	mT
B _{HYS}	Hysteresis		±0.5	±1.0	±1.5	mT
SC2451 ±10.0/±8.5mT						
B _{OP}	Operating point	T _A =25°C	±8.0	±10.0	±12.0	mT
B _{RP}	Release point		±6.5	±8.5	±10.5	mT
B _{HYS}	Hysteresis		±0.5	±1.5	±2.5	mT
SC2452 ±18.0/±13.0mT						
B _{OP}	Operating point	T _A =25°C	±16.0	±18.0	±20.0	mT
B _{RP}	Release point		±11.0	±13.0	±15.0	mT
B _{HYS}	Hysteresis		±3.0	±5.0	±7.0	mT
SC2455 +22.0/+17.0mT						
B _{OP}	Operating point	T _A =25°C	±19.0	±22.0	±25.0	mT
B _{RP}	Release point		±14.0	±17.0	±20.0	mT
B _{HYS}	Hysteresis		±3.0	±5.0	±7.0	mT
SC2459 normal power mode programmable unipolar switch						
B _{OP}	Operating point	T _A =25°C	-22.0	-	22.0	mT
B _{HYS}	Hysteresis		0.5	-	10.0	mT
B _{OP(STEP)} ⁽³⁾	Average Magnetic Step Size		0.3	0.5	0.7	mT
B _{HYS(STEP)} ⁽⁴⁾	Average Hysteresis Step Size		0.3	0.5	0.7	mT
B _{OP(INT)}	Initial Operation Point		6.0	8.2	10.0	mT
B _{HYS(INT)}	Initial Hysteresis		1.0	2.0	3.5	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) $1mT = 10Gs$

(3) $B_{OP(STEP)}$ is a calculated average from the cumulative programmed bits

(4) $B_{HYS(STEP)}$ is a calculated average from the cumulative programmed bits

9.3. Program Related Specification

$V_{DD} = 12.0V$, $T_A = -40^{\circ}C$ to $150^{\circ}C$ (unless otherwise noted)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
BOPSEL	Operation Point Magnitude Programming		-	6	-	BIT
HYSSEL	Magnitude Hysteresis Programming		-	6	-	BIT
MAG_POL	Magnetic Polarity Selection	The default value is 0.	-	1	-	BIT
OMNI	Unipolar/Omnipolar/Latch Selection	The default value is 0.	-	1	-	BIT
LTH	Unipolar/Omnipolar/Latch Selection	The default value is 0.	-	1	-	BIT
OUT_POL	Output Polarity Selection	The default value is 0.	-	1	-	BIT
LPSEL	Micro Power Mode Selection	The default value is 1.	-	1	-	BIT

10. Block Diagram

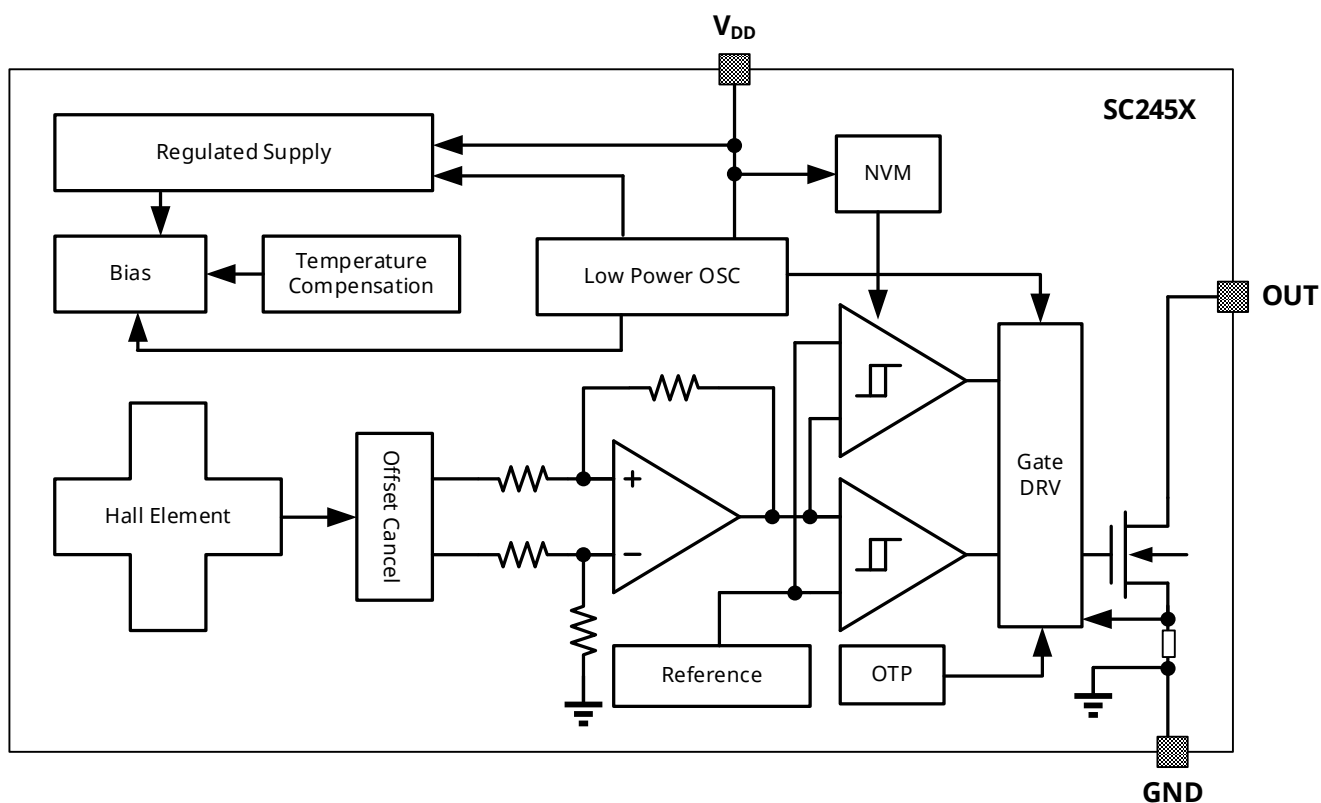


Fig. 3 Functional block diagram

11. Function Description

The SC245X device is a magnetic sensor with a digital output that indicates when the magnetic flux density threshold has been crossed. Programming can be performed at the end of the line to optimize the sensor on a per unit or per module basis. The user can select the magnetic operating points across a range spanning -22mT to 22mT, the magnitude hysteresis across a range spanning 0.5mT to 10mT, and whether the device responds to north or south magnetic fields (unipolar switch) or both (omnipolar switch), and output polarity (direct or inverted). Additionally, the Hall switch can be programmed to enter a micropower mode as required.

The output of SC245X switches low (turns on) when a magnetic field (South or North polarity) perpendicular to the Hall element exceeds the operate point threshold, B_{OP} . After turn-on, the output is capable of sinking 40mA 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.

11.1. Field Direction Definition

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

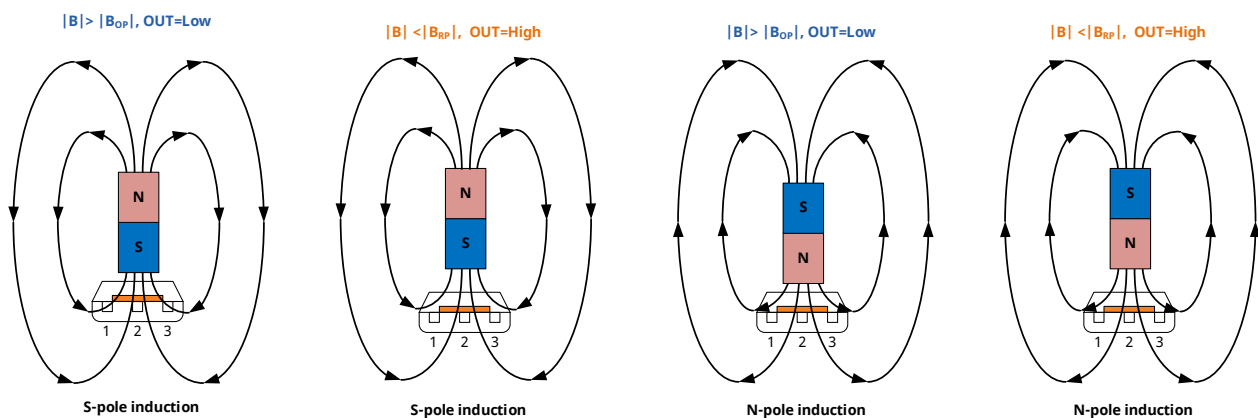


Fig.4 Field Direction Definition diagram

11.2. Transfer Function

“Omnipolar” magnetic characteristics, it means the device reacts to both North and South magnetic pole. The purpose is to detect the presence of any magnetic field applied on the device.

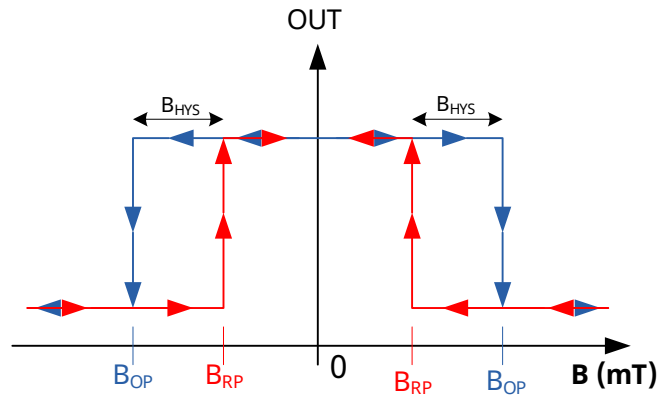


Fig.5 Omnipolar Transfer Function diagram

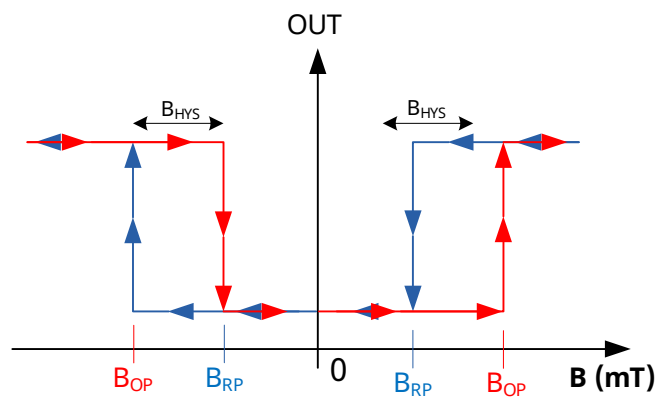


Fig.6 Omnipolar and Unipolar Inverted output Transfer Function diagram

“Unipolar” magnetic characteristics, it means the device only reacts to North or South magnetic pole.

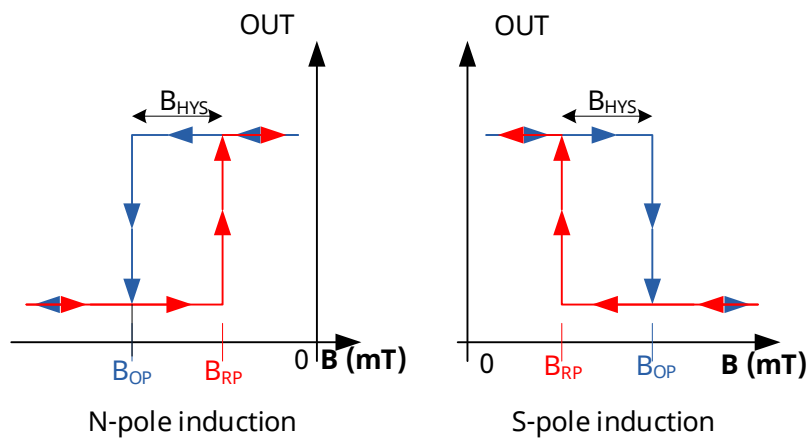


Fig.7 Unipolar Transfer Function diagram

12. Typical Application

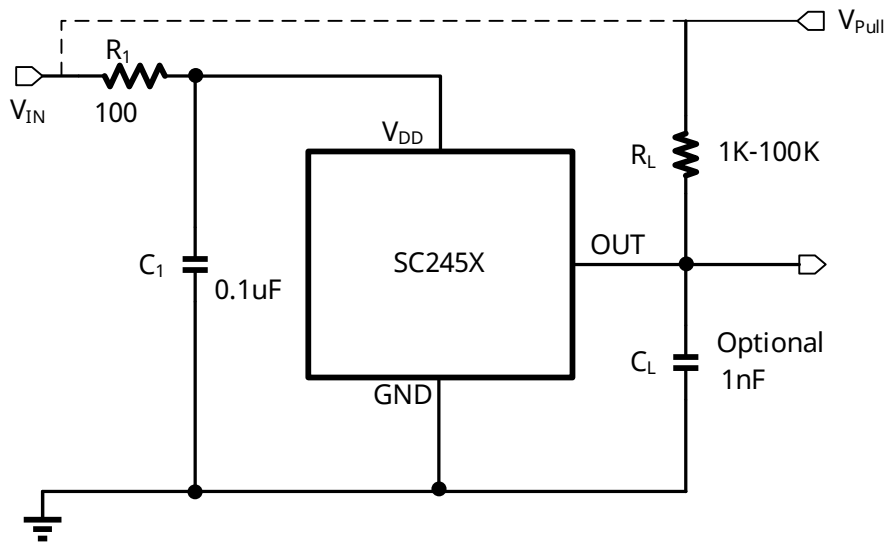


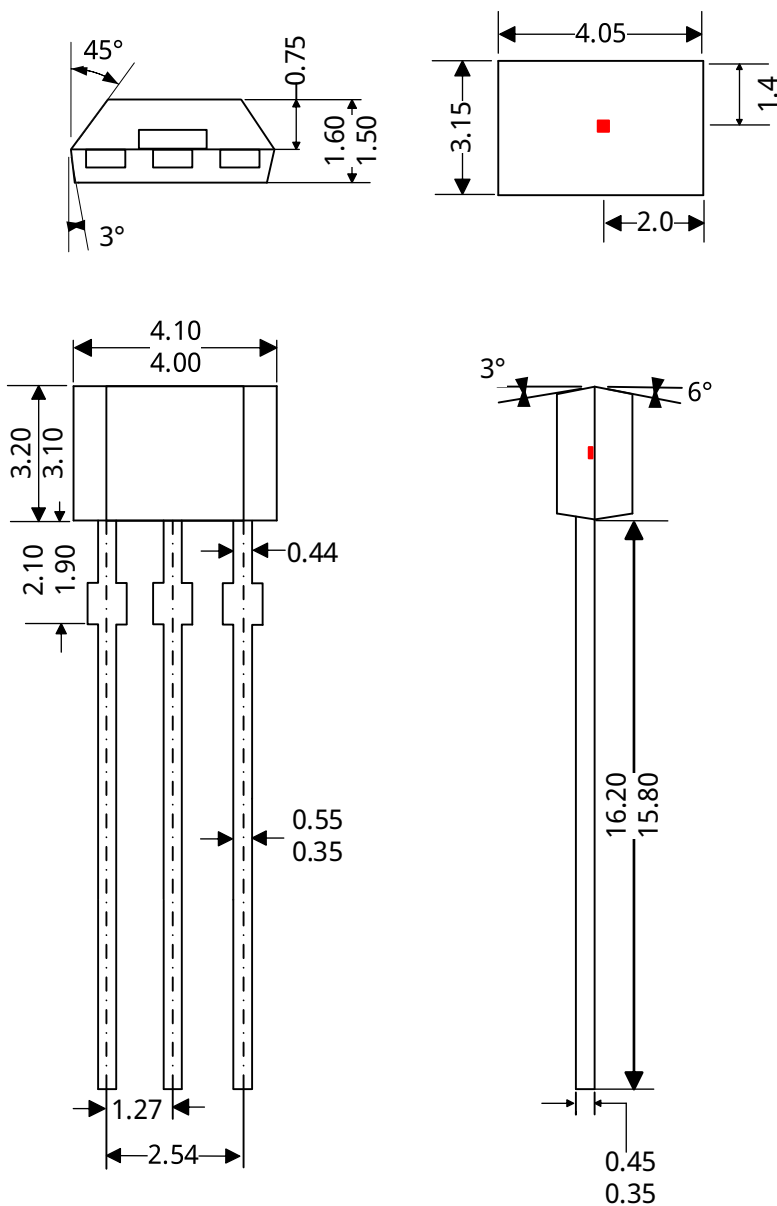
Fig.8 SC245X Typical Application Circuit

The SC245X contains an on-chip voltage regulator can reduce ripple and noise in the power output. 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 that C_1 capacitor be connected to the ground in parallel near the V_{DD} power end of the chip, with a typical value of 0.1uF. R_1 recommends a 100Ω current limiting resistor, packaged in SMD larger than 0805 form. R_L selects appropriate pull-up resistors based on actual application requirements. C_L is an optional output capacitor for increase system EMC ability.

13. Package Information UA

3-Terminal
UA Package

Unit: mm



Notes:

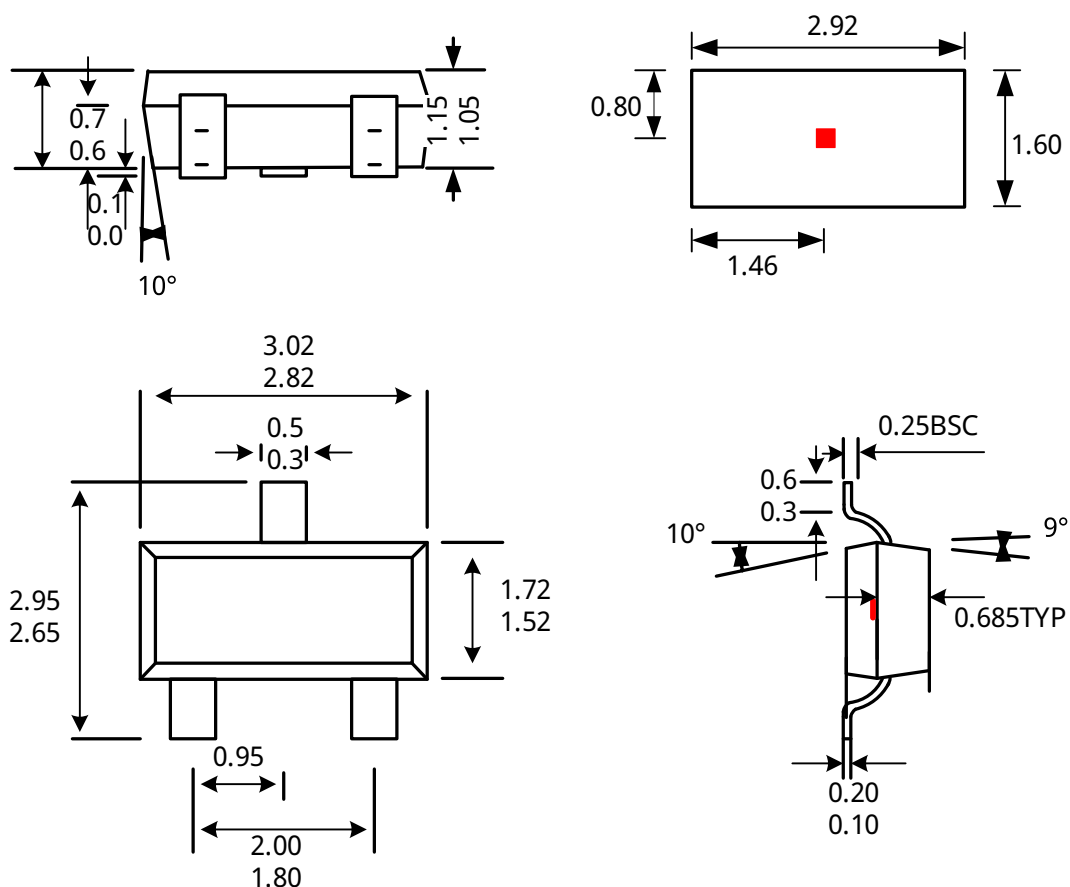
- (1) Exact body and lead configuration at vendor's option within limits shown.
- (2) Height does not include mold gate flash.

Where no tolerance is specified, dimension is nominal.

14. Package Information SO

3-Terminal
SO Package

Unit: 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. Revision History

Revision	Date	Description
Rev.E0.1	2023-03-10	Preliminary Datasheet
Rev.A1.0	2025-07-14	Official version release