

3-Wire High Performance Programmable Switch Hall Effect Sensor

1. Features

- AEC-Q100 qualified
- ISO26262 ASIL-B SEooC
- Programmable 3-wire voltage mode interface
- Programmable parameters:
 - Unipolar or Omnipolar
 - Low power mode
 - Sensitivity range: -26mT to 26mT
 - Active Pole: North or South
 - Output: Direct or Inverted
- Less than 20uA average current in micro-Power Mode
- Wide voltage range: 3V to 40V
- Reverse battery protection: -28V
- Open-Drain output
- -Wide operating temperature range:
 - -40°C to 150°C
- Thermal shutdown protection
- 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
- Smart home and industry
- Brake Light switch

3. Description

The SC245X produced with BiCMOS technology, is a chopper-stabilized 3-wire Hall Effect Sensor that offers a magnetic sensing solution with superior sensitivity stability over temperature and integrated protection features.

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.

Each device includes on a single silicon chip a voltage regulator, Hall-voltage generator, small-signal amplifier, chopper stabilization, Schmitt trigger, and an output circuit.

An onboard regulator permits with supply voltages of 3V to 40V, which makes the device suitable for a wide range of industrial and automotive applications.

SC245X offers small 3-pin through-hole package TO-92S(UA) and 3-pin SOT23-3L(SO) package, environmental protection requirements.

Not To Scale



Fig.1 Package Outline

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4. Terminal Configuration

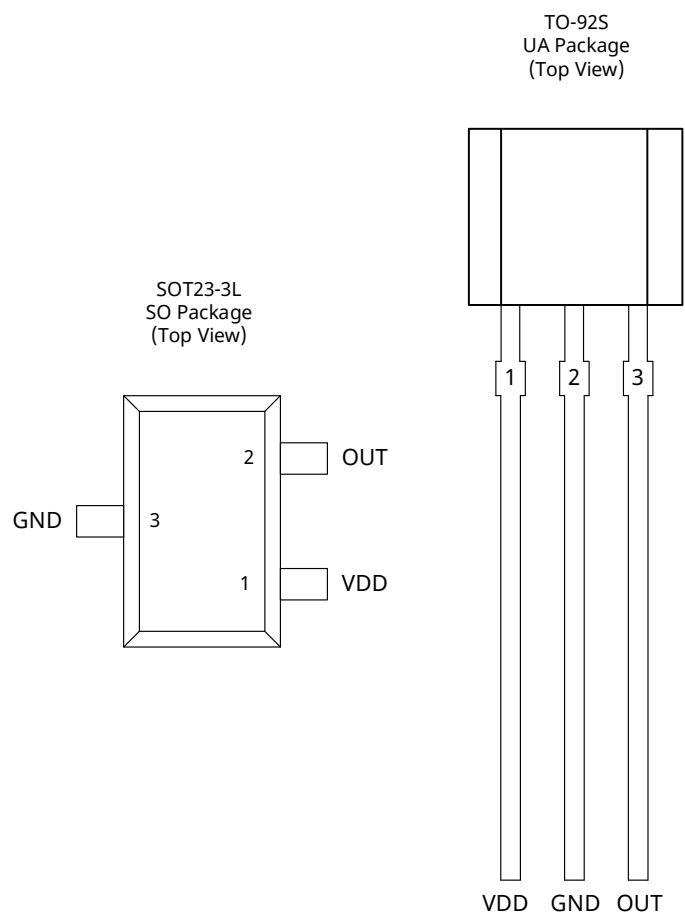


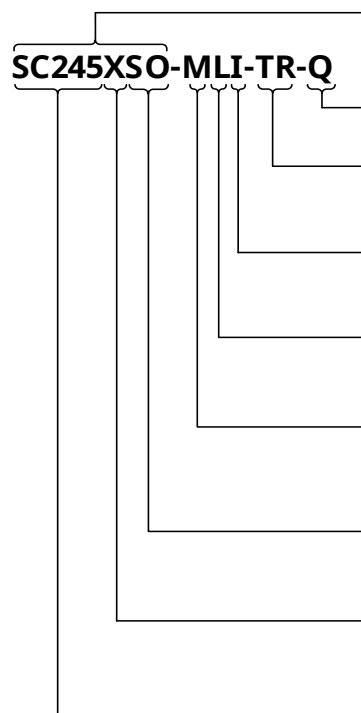
Fig.2 Pin Definition Diagram

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	B _{OP} (Gs)	B _{RP} (Gs)	Ambient, T _A (°C)	Package	Packing	Quantity
SC2450SO-TR-Q	2450	+25	+15	-40~150	SOT23-3L	Reel	3000/reel
SC2450SO-LI-TR-Q	2450	+25	+15	-40~150	SOT23-3L	Reel	3000/reel
SC2450UA-LI-BK-Q	2450	+25	+15	-40~150	TO-92S	Bulk	1000/bag
SC2450SO-M-TR-Q	2450	±25	±15	-40~150	SOT23-3L	Reel	3000/reel
SC2450UA-M-BK-Q	2450	±25	±15	-40~150	TO-92S	Bulk	1000/bag
SC2450SO-ML-TR-Q	2450	±25	±15	-40~150	SOT23-3L	Reel	3000/reel
SC2450UA-ML-BK-Q	2450	±25	±15	-40~150	TO-92S	Bulk	1000/bag
SC2450SO-MLI-TR-Q	2450	±25	±15	-40~150	SOT23-3L	Reel	3000/reel
SC2450UA-MLI-BK-Q	2450	±25	±15	-40~150	TO-92S	Bulk	1000/bag
SC2451SO-TR-Q	2451	+100	+85	-40~150	SOT23-3L	Reel	3000/reel
SC2452SO-TR-Q	2452	+180	+130	-40~150	SOT23-3L	Reel	3000/reel
SC2455SO-TR-Q	2455	+255	+200	-40~150	SOT23-3L	Reel	3000/reel
SC2459SO-TR-Q	2459	Programmable	Programmable	-40~150	SOT23-3L	Reel	3000/reel
SC2459UA-BK-Q	2459	Programmable	Programmable	-40~150	TO-92S	Bulk	1000/bag
SC2459SO-M-TR-Q	2459	Programmable	Programmable	-40~150	SOT23-3L	Reel	3000/reel
SC2459UA-M-BK-Q	2459	Programmable	Programmable	-40~150	TO-92S	Bulk	1000/bag
SC2459SO-L-TR-Q	2459	Programmable	Programmable	-40~150	SOT23-3L	Reel	3000/reel
SC2459UA-L-BK-Q	2459	Programmable	Programmable	-40~150	TO-92S	Bulk	1000/bag

Ordering Information Format



Part Number

Product Grade

Q: Automotive Product

Packing Designation

TR: Tape & Reel

BK: Bulk

Output

-: Normal Output

I: Inverted Output

Power Mode

-: Normal Power

L: Micro Power

Switch Mode

-: 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: Programmable Hall Effect Sensor 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	-	-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

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	$T_J < T_{J(Max.)}$	3.0	5.0	40	V
$UVLO_H$	Under Voltage Lockout High	$B > BOP$, V_{DD} Rising From 2V	-	2.8	-	V
$UVLO_L$	Under Voltage Lockout Low	$B > BOP$, 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, $T_A=25^{\circ}C$	2.8	3.3	3.8	mA
I_{DD} (Micro Power)	Average current consumption(Micro Power)	$V_{DD}=3.0$ to 40V, $T_A=25^{\circ}C$	-	15	30	μA
		$V_{DD}=3.0$ to 40V, $T_A=150^{\circ}C$	-	30	50	μA
t_{ON}	Power on time	$V_{DD}= 5.0V$	-	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%)	$R1=1Kohm$, $Co=50pF$	-	0.3	1	μs
T_F	Output fall time(90% to 10%)	$R1=1Kohm$, $Co=50pF$	-	0.2	1	μs
OTP	Over Temperature Protection	Temperature increasing	-	187	-	$^{\circ}C$
OTP_{HYS}	Over Temperature Hysteresis		-	12	-	$^{\circ}C$
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, $I_O=20mA$		0.13	0.4	V
		Micro Power Mode, $I_O=10mA$		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		±5.0	±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 ±25.5/±20.0mT						
B _{OP}	Operating point	T _A =25°C	±23.5	±25.5	±27.5	mT
B _{RP}	Release point		±18.0	±20.0	±22.0	mT
B _{HYS}	Hysteresis		±3.5	±5.5	±7.5	mT
SC2459 normal power mode programmable unipolar switch						
B _{OP}	Operating point	T _A =25°C	-26.0	-	+26.0	mT
B _{RP}	Release point		-25.5	-	+25.5	mT
B _{HYS}	Hysteresis		0.5	-	10.0	mT
B _{OP(STEP)} ⁽²⁾	Average Magnetic Step Size		0.3	0.5	0.7	mT
B _{HYS(STEP)} ⁽³⁾	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

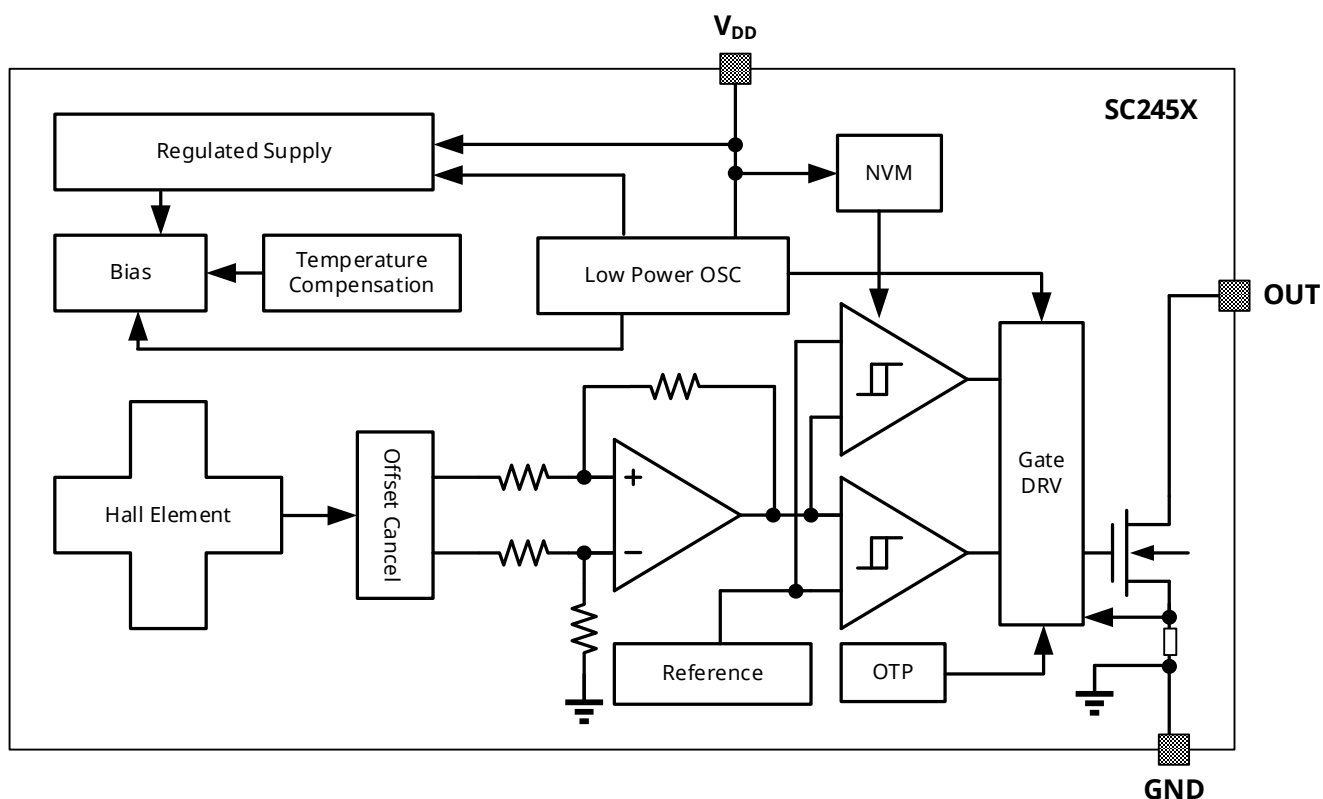


Fig. 3 Functional block diagram

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. The device integrates a Hall Effect element, analog signal conditioning, and a low-frequency oscillator that enables ultra-low average power consumption. Operating from a 3 to 40V supply voltage, the device periodically measures magnetic flux density, updates the output, and enters a low-power sleep state.

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.

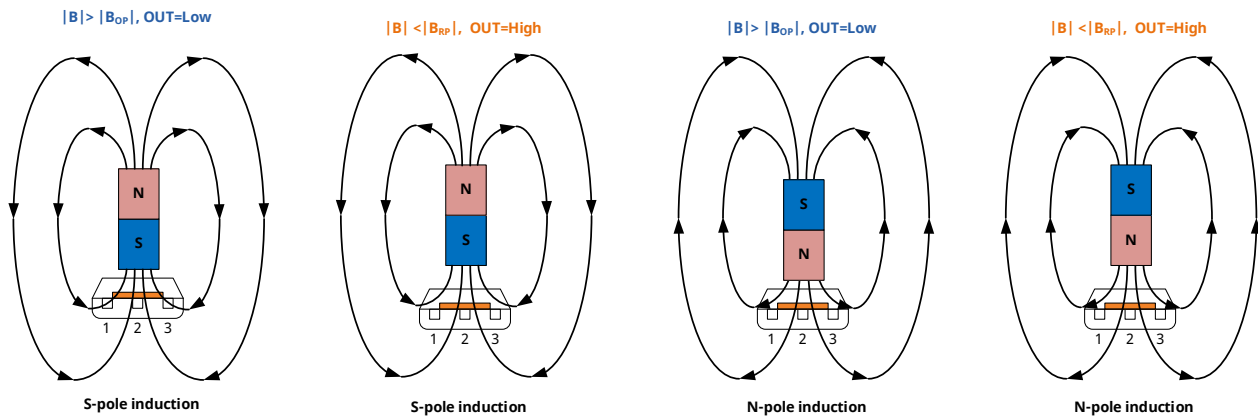


Fig.4 Field Direction Definition diagram

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.

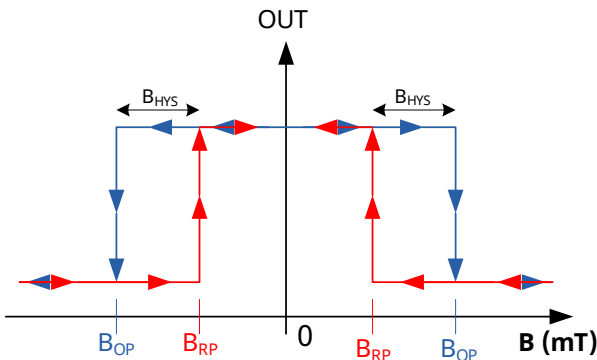


Fig.5 Omnipolar Transfer Function diagram

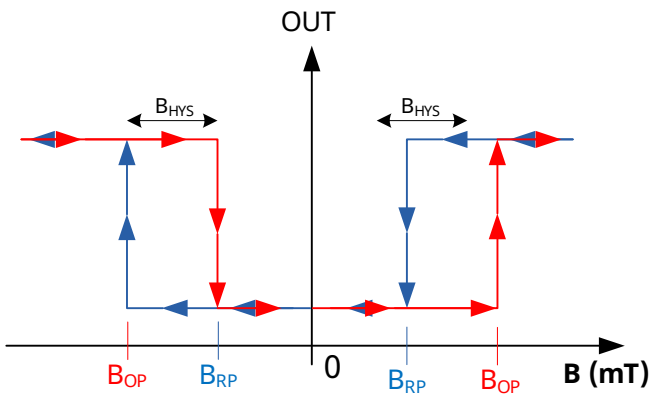


Fig.6 Omnipolar and Unipolar Inverted output Transfer Function diagram

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

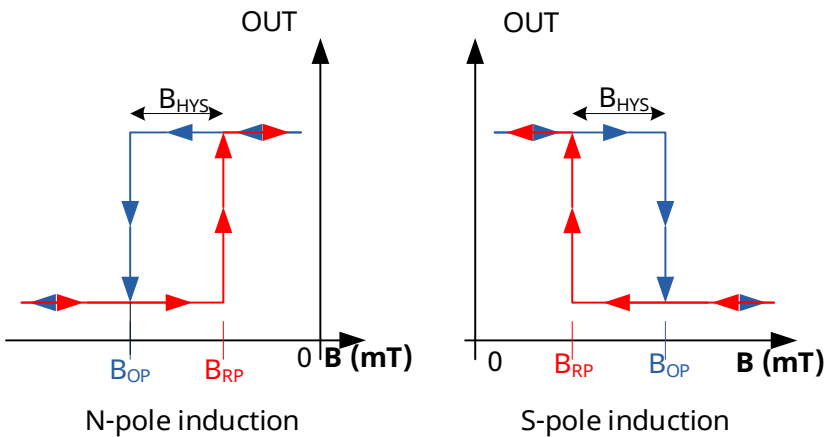


Fig.7 Unipolar Transfer Function diagram

12. Typical Application

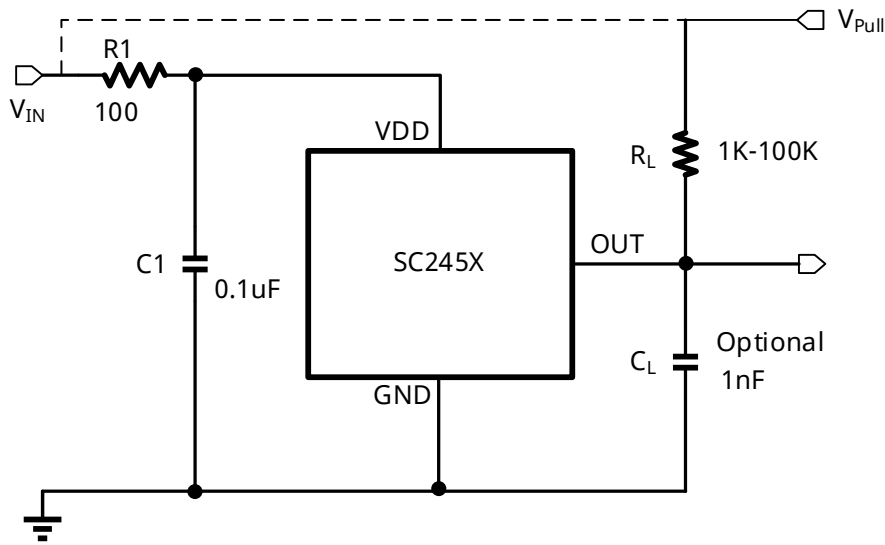


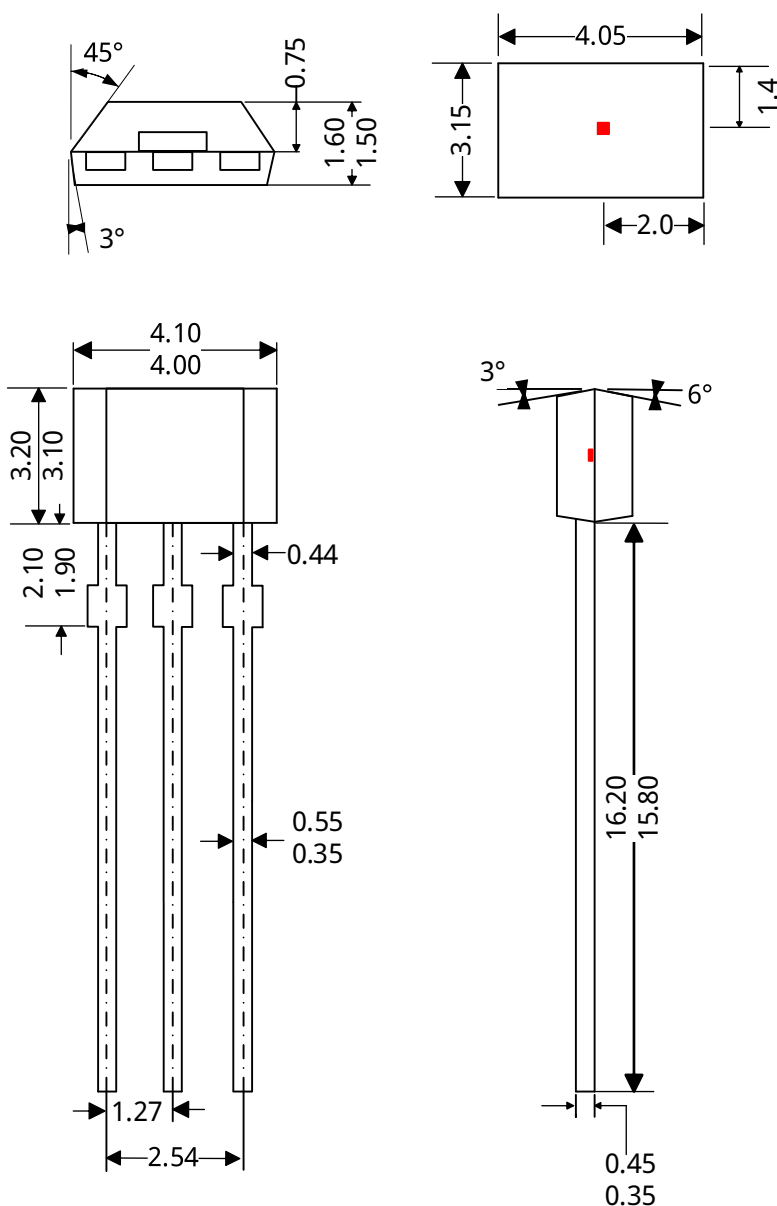
Fig.8 SC245X Typical Application Circuit

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:

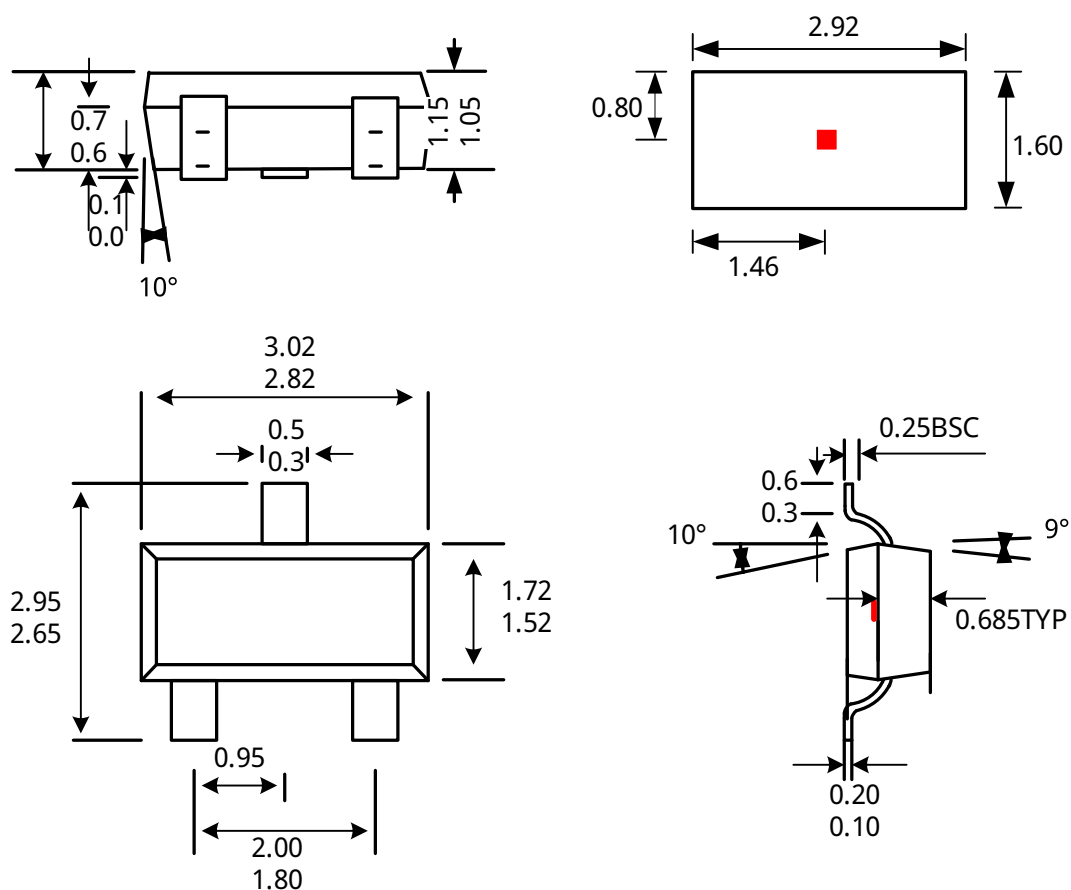
- (1) Exact body and lead configuration at vendor's option within limits shown.
- (2) Height does not include mold gate flash.

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