Ultra-Low-Power Omnipolar Switch Hall Effect Sensor

1. Features

- Industry ultra-low power consumption
  - 1.2 μA with 3.0 V
- 1.65V to 5.5V operating range
- Push-Pull and Open-Drain output options
- -40°C to +85°C operating temperature range
- SOT23-3L and TO-92S package options

2. Applications

- Battery-critical position sensing
- Electricity meter tamper detection
- Cell Phone, laptop, or tablet case sensing
- E-locks, smoke detectors, appliances
- Medical devices, IoT systems
- Valve or solenoid position detection
- Contactless diagnostics or activation

3. Description

The SC206X family is an ultra-low-power Omnipolar switch Hall Effect Sensor, designed for the most compact and battery-sensitive systems. The device is offered in multiple magnetic thresholds, sampling rates, output drivers, and packages to accommodate various applications.

When the applied magnetics flux density exceeds the B_{OP} threshold, the device outputs a low voltage. The output stays low until the flux density decreases to less than BRP, and then the output either drives a high voltage or becomes high impedance, depending on the device version. By incorporating an internal oscillator, the device samples the magnetic field and updates the output at a rate of 20 Hz for the lowest current consumption. Omnipolar magnetic responses are available.

The device operates from a VDD range of 1.65 V to 5.5 V, and is packaged in a standard SOT23-3L, TO-92S.

Fig1: Left-TO92S; Right-SOT23-3L

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4. Terminal Configuration

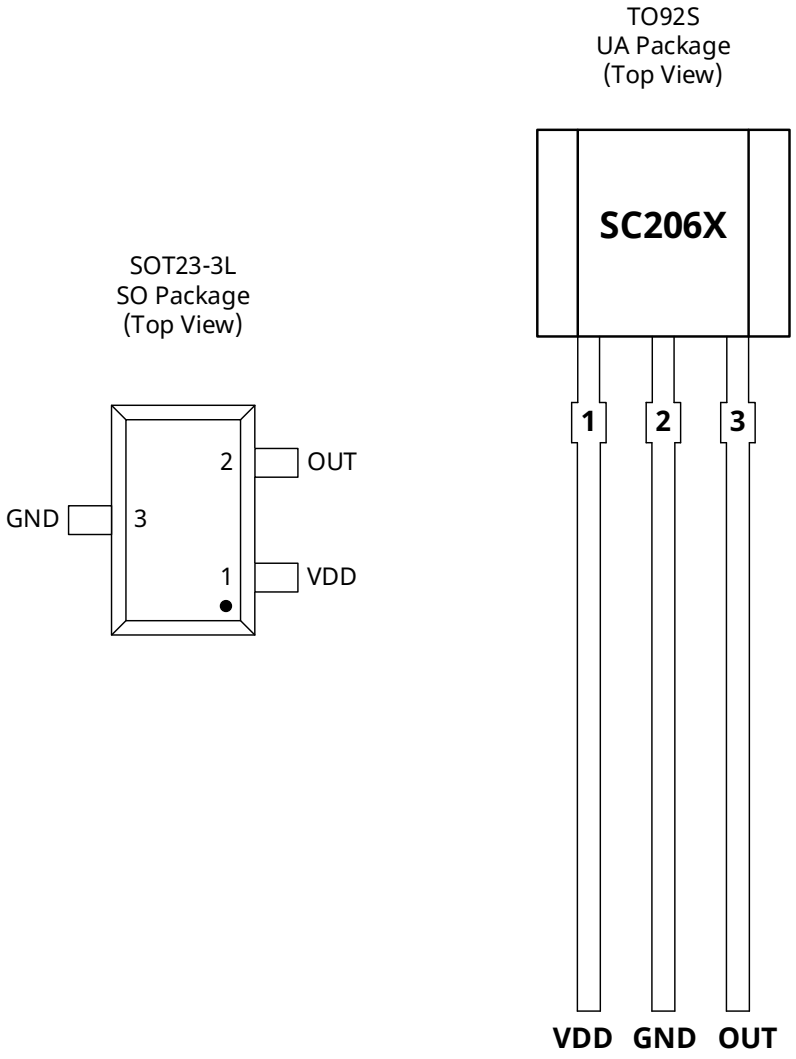


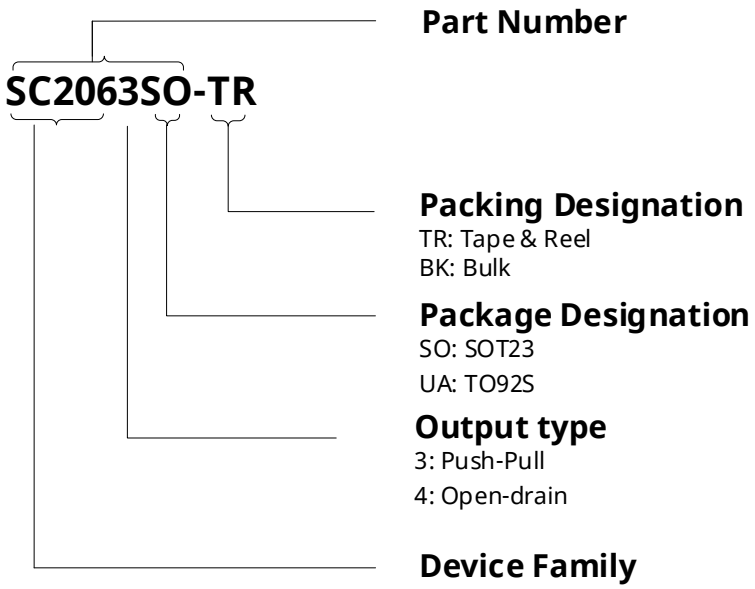
Fig2: Pin definition diagram

Terminal			Type	Description
Name	Number			
	UA	SO		
VDD	1	1	PWR	1.65V to 5.5V power supply
GND	2	3	Ground	Ground terminal
OUT	3	2	Output	Push-Pull or Open-drain output. The open drain requires a pull-up resistor to supply.

5. Ordering Information

Ordering Information	Marking	Options	Ambient, (℃)	Package	Packing	Quantity
SC2063SO-TR	2063	Push-Pull	-40~85	SOT23-3L	Reel	3000Pcs
SC2063UA-BK	2063	Push-Pull	-40~85	TO-92S	Bulk	1000Pcs
SC2064SO-TR	2064	Open-drain	-40~85	SOT23-3L	Reel	3000Pcs
SC2064UA-BK	2064	Open-drain	-40~85	TO-92S	Bulk	1000Pcs

Ordering Information Format



6. Absolute Maximum Ratings

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

Symbol	Parameter	Test Conditions	Min.	Max.	Units
V_{DD}	Power supply voltage	-	-0.3	6	V
V_{OUT}	Output terminal voltage	-	-0.3	6	V
I_{SINK}	Output terminal current sink	-	0	5	mA
T_A	Operating ambient temperature	-	0	85	℃
T_J	Maximum junction temperature	-	-55	125	℃
T_{STG}	Storage temperature	-	-65	125	℃

Note：

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	standard ANSI/ESDA/JEDEC JS-001	-6	+6	KV
	CDM	standard ANSI/ESDA/JEDEC JS-002	-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	166	℃/W
$R_{\theta ja}$	SO Package thermal resistance	Single-layer PCB, with copper limited to solder pads	228	℃/W

9. Operating Characteristics

9.1. Electrical Characteristics

over operating free-air temperature range (V_{DD} = 1.8V, unless otherwise noted)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
Operating Characteristics						
V_{DD}	Operating voltage	$T_J < T_{J(Max.)}$	1.65	3.0	5.5	V
tV_{DD}slope	tV_{DD}slope = 0→0.9*VDD	V_{DD}=1.65V to 5.5V	-	-	100	μs
$I_{DD\ (Average)}$	Average current consumption	V_{DD}=1.8V	-	1.0	1.7	μA
		V_{DD}=3V	-	1.2	1.9	μA
		V_{DD}=5V	-	1.6	2.6	μA
$I_{DD\ (peak)}$	Peak current consumption	V_{DD}=1.65V to 5.5V	1.1	1.4	1.8	mA
t_{ACTIVE}	Active time	V_{DD}=1.65V to 5.5V	25	40	55	μs
t_{ON}	Power on time	V_{DD}=1.65V to 5.5V	-	40	55	μs
f_S	Frequency of magnetic sampling	V_{DD}=1.65V to 5.5V	10	20	30	Hz
t_S	Period of magnetic sampling	V_{DD}=1.65V to 5.5V	33	50	100	ms
Push Pull Output Characteristics						
V_{OH}	High-level output voltage	I_{OUT} = –1 mA	V_{DD}-0.35V	V_{DD}-0.1V	-	V
V_{OL}	Low-level output voltage	I_{OUT} = 1 mA	-	0.1	0.3	V
Open Drain Output Characteristics						
I_{LINK}	Output leakage current	V_{DD} = 5.5 V, OUT = 5.5 V	-	-	100	nA
V_{OL}	Low-level output voltage	I_{OUT} = 1 mA	-	0.1	0.3	V

9.2. Magnetic Characteristics

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
B_{OP}	Operated point	T_A=25℃	±1.5	±3.0	±4.5	mT(1)
B_{RP}	Release point		±1.0	±2.0	±3.0	mT
B_{HYS}	Hysteresis		±0.1	±1.0	±1.5	mT

Note：

(1)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.

10. Block Diagram

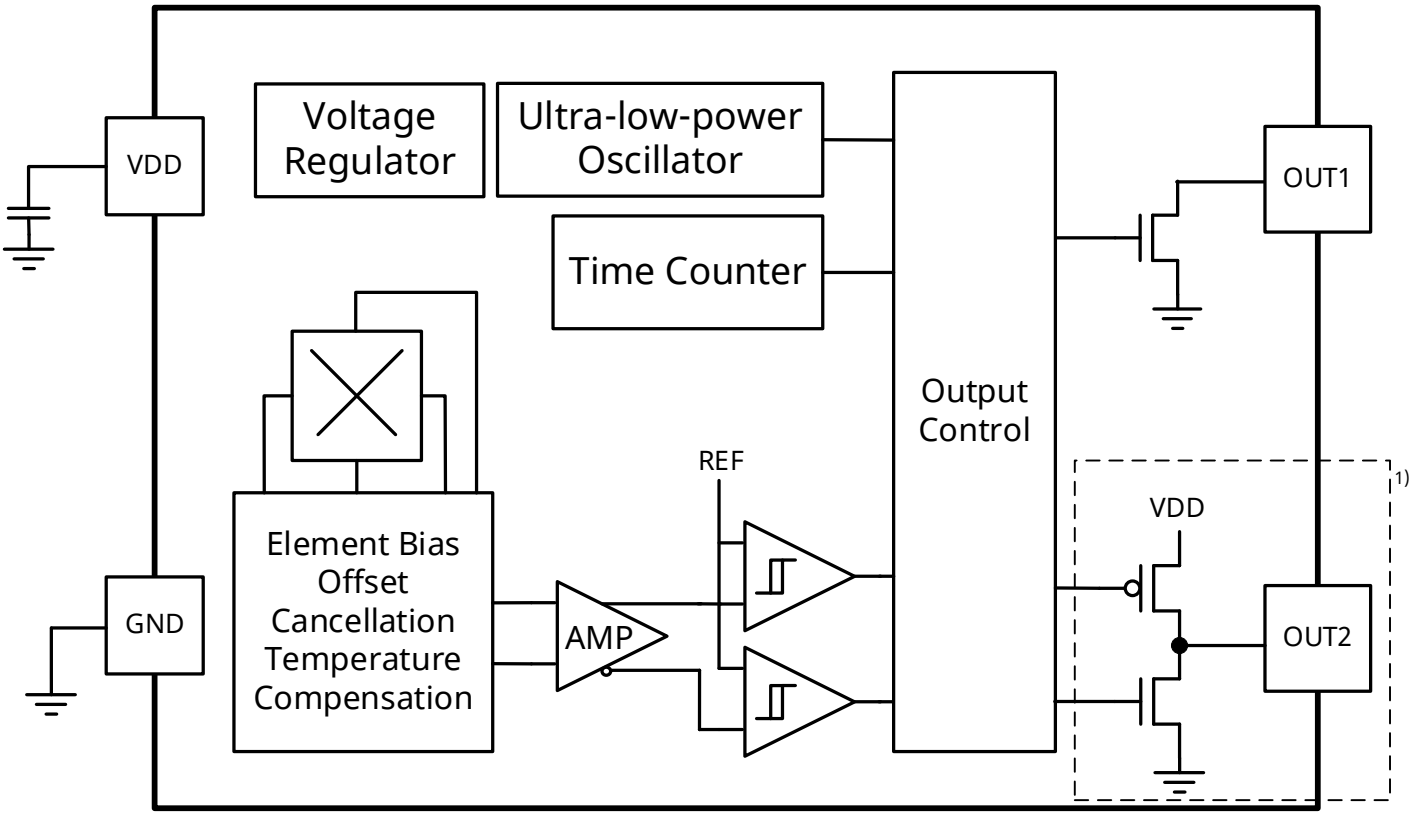


Fig3: Functional block diagram

11. Function Description

The SC206X 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. By operating from a 1.65V to 5.5V supply, the device periodically measures magnetic flux density, updates the output, and enters a low-power sleep state.

The output of SC206X 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 5mA and the output voltage is VQ (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 a South Pole near the marked side of the package.

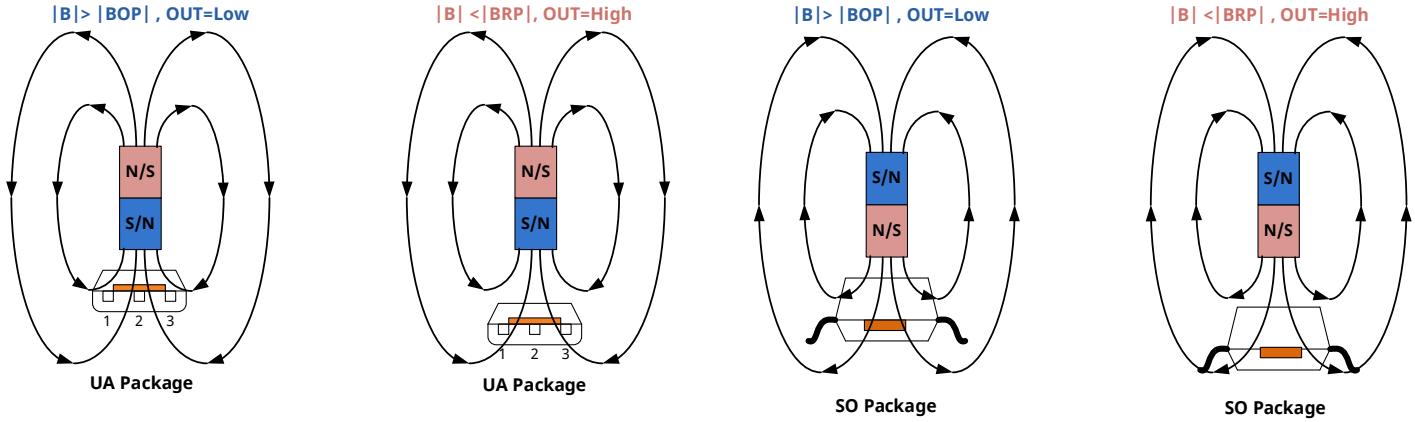


Fig4: Field Direction Definition diagram

11.2. Transfer Function

The SC206X exhibits “Omni polar” 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. This mode of operation simplifies customer production processes by avoiding the need to detect the Hall sensor pole active on the magnet used in the application. Therefore, the “Omni polar” magnetic behavior helps customers by removing the need of magnet pole detection system during production phase.

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.

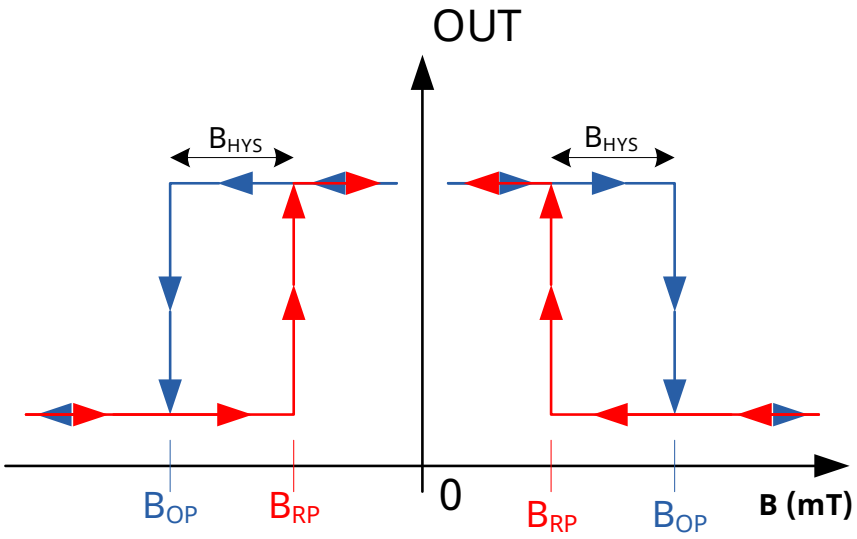


Fig5: Transfer Function diagram

12. Typical Application

Push Pull Output

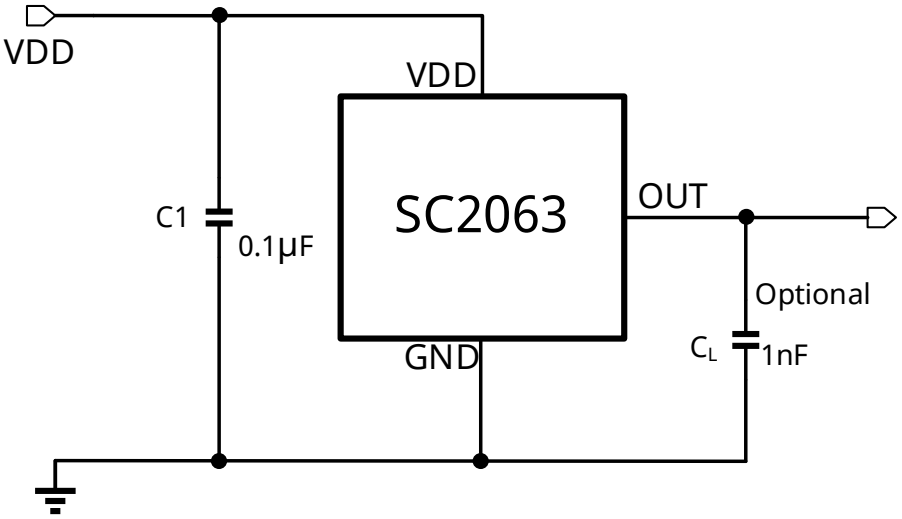


Fig6: SC2063 Typical Application diagram

Open Drain Output

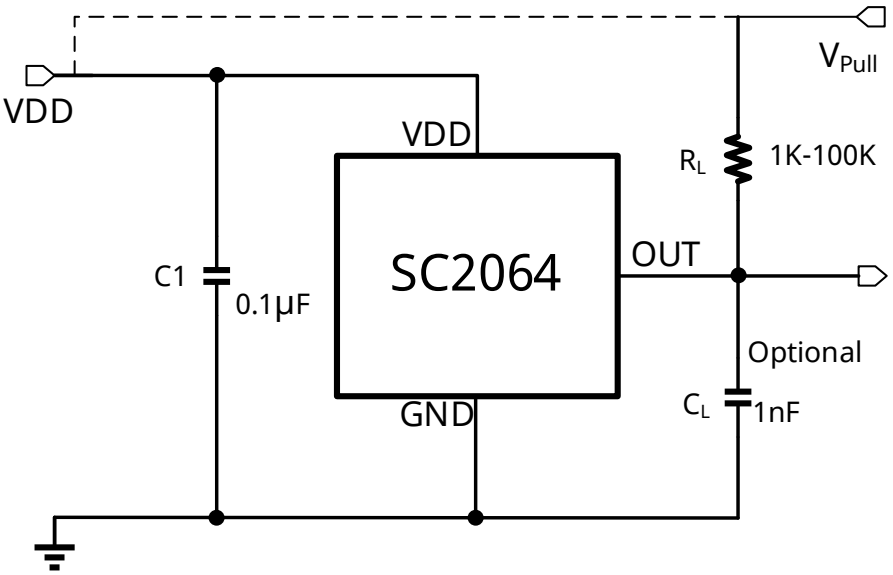
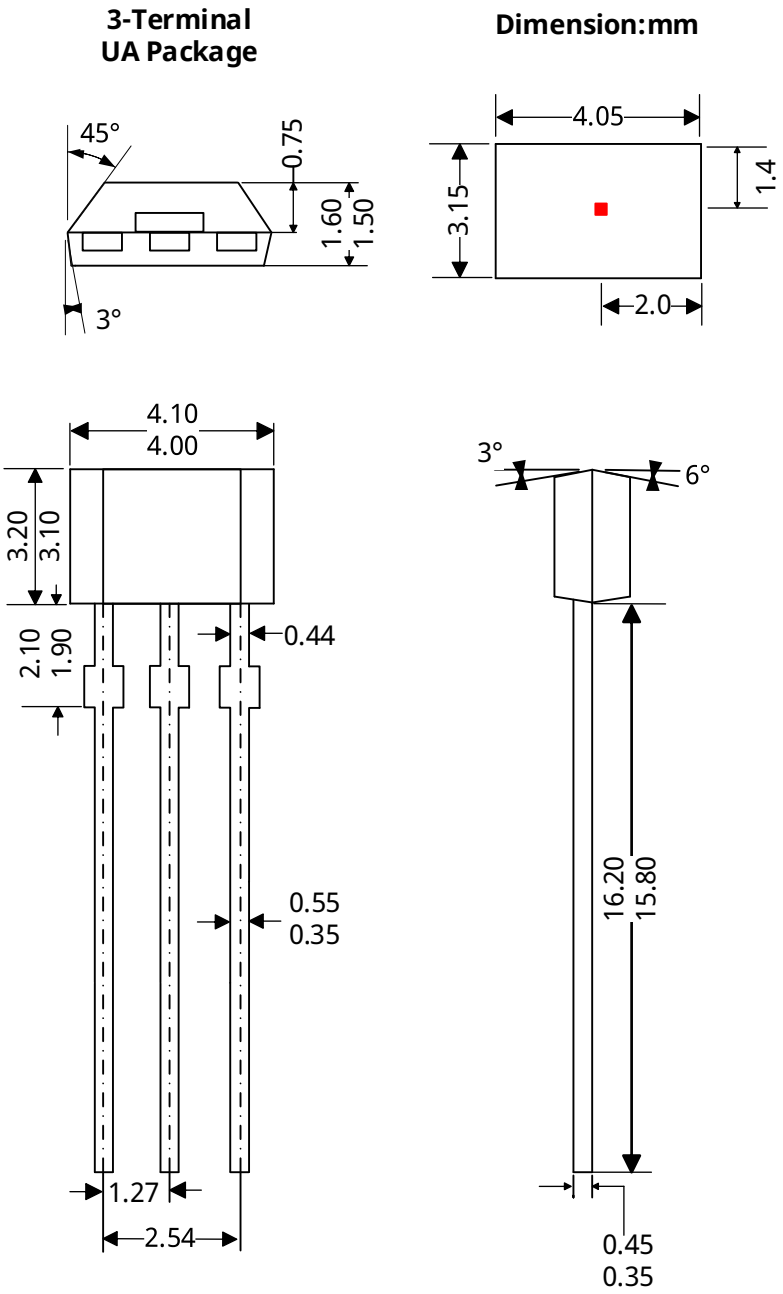


Fig7: SC2064 Typical Application diagram

13. Package Information "UA"



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

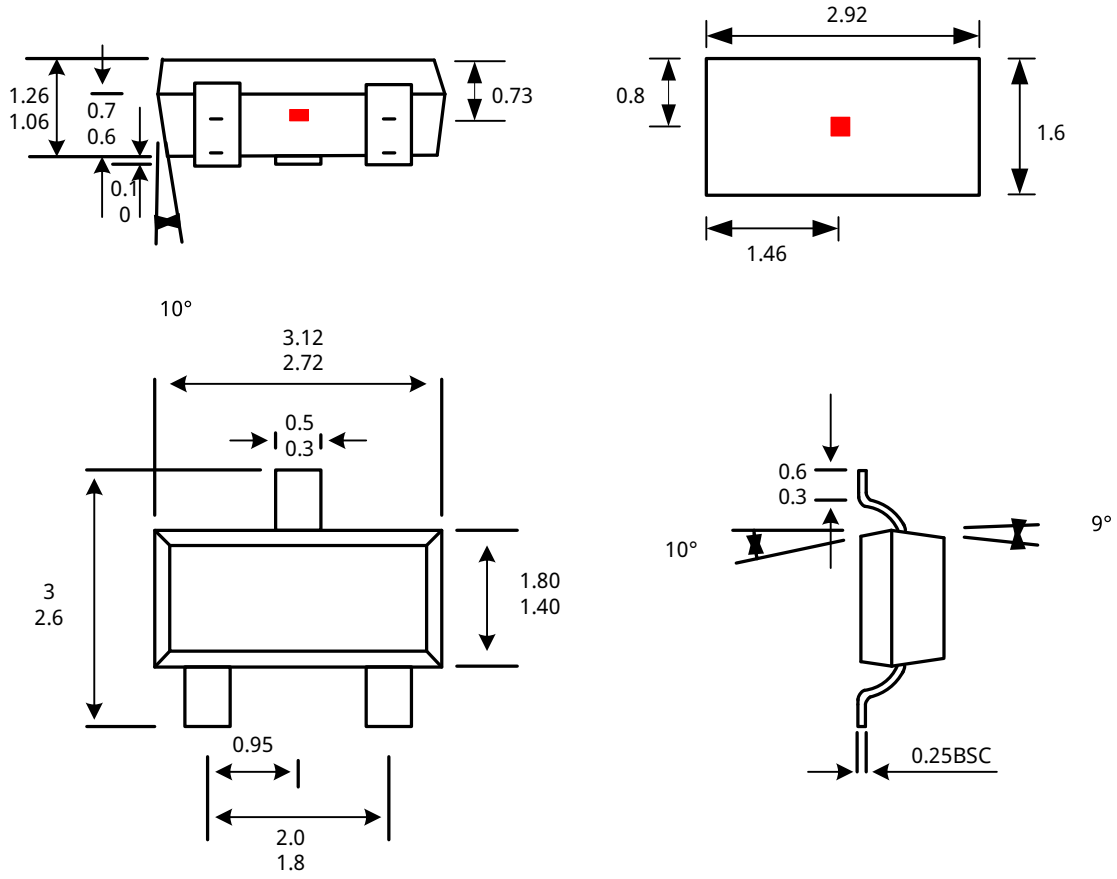
Where no tolerance is specified, dimension is nominal.

Fig8: Package Information "UA" diagram

14.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.

Fig9: Package Information “SO” diagram

15.Revision History

Revision	Date	Description
Rev0.1	2022-03-18	Preliminary Datasheet
Rev1.0	2022-05-28	Release datasheet
Rev1.1	2024-05-11	Add SC2062 Part Number
Rev1.2	2024-11-29	Modify ordering information