Planar magnetic sensing Hall effect sensor

1. Features

- Automotive AEC-Q100 Qualified
- Planar magnetic sensing-effect ICs
- Supports a wide voltage range:
  - 2.8V to 40V
- Wide operating temperature range:
  - -40℃ to 150℃
- Current limited open drain output: 40mA
- Output short-circuits and overvoltage protection
- High EMC immunity
- Symmetrical latch switch-points
- Solid-state reliability
- Small package
  - 3-pin SOT23-3L (SO)

2. Applications

- Automotive and industrial safety systems
- Industrial motors/encoders
- Trunk/door/liftgate/wiper motors
- Electronic power steering (EPS)
- Transmission actuators
- Automotive seat/sunroof motors

3. Description

The SC2498T is a planar magnetic sensing Hall - effect latch designed with BCD process technology. It supports an operating voltage range from 2.8V to 40V. The device integrates a voltage regulator, a Hall sensor with a dynamic offset cancellation system, a Schmitt trigger, and an open - drain output driver in a single package. The SC2498T has passed the AEC-Q100 certification, is highly suitable for automotive applications, and complies with the ISO 26262:2011 ASIL A standard. This device has temperature stability and is suitable for operating within a working temperature range of -40°C to 150°C. It also has an overvoltage protection function and can operate directly powered by an automotive battery. Additionally, it can prevent ground short - circuits by limiting the output current until the short - circuit fault is eliminated. This device is particularly suitable for operating scenarios powered by unregulated power supplies.

The SC2498T adopts a 3 - pin SOT23 - 3L plastic package, and it is a 100% lead - free package with matte tin - plated pins.

SOT-23-3L

Fig.1 Package Outline

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4. Terminal Configuration

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

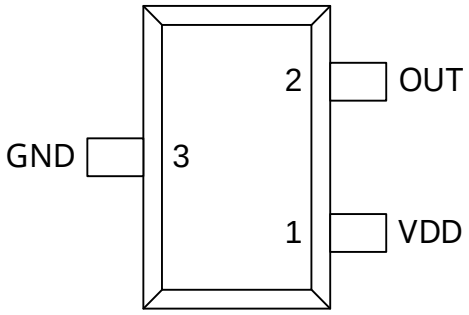


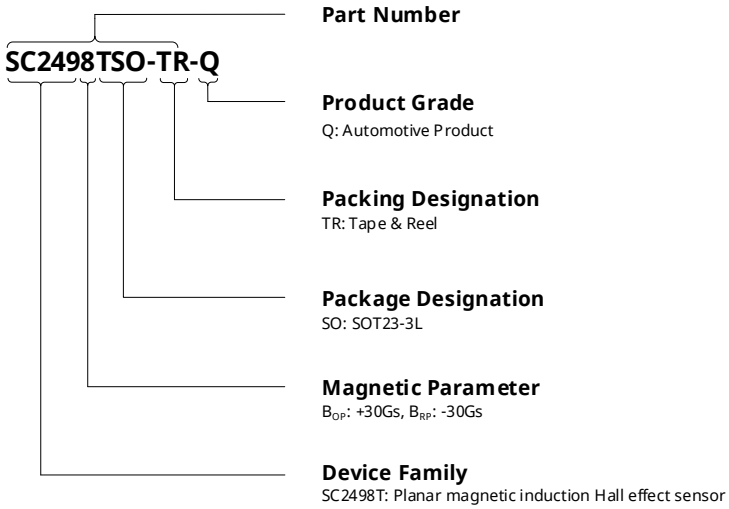
Fig. 2 Terminal Configuration

Terminal		Type	Description
Name	SO		
VDD	1	Power	2.8V to 40V power supply
GND	3	Ground	Ground terminal
OUT	2	Output	Open-drain output. The open drain requires a pull-up resistor

5. Ordering Information

Ordering Information	Mark	B_{OP}(Gs)	B_{RP}(Gs)	Ambient, (℃)	Package	Packing	Quantity
SC2498TSO-TR-Q	2498T	+30	-30	-40~150	SOT23-3L	Reel	3000/reel

Ordering Information Format



6. Absolute Maximum Ratings

Operating temperature range (unless otherwise specified) (1)

Symbol	Parameter	Test Condition	Min.	Max.	Units
V_{DD}	Power supply voltage	Resistance ≥ 200Ω, no more than 5 minutes	-28	60	V
V_{OUT}	Output terminal voltage	1.2 kΩ pull up resistor, not exceed 5 min	-0.5	60	V
I_{SINK}	Output terminal current sink		0	40	mA
T_A	Operating ambient temperature		-40	150	℃
T_J	Maximum junction temperature		-55	165	℃
T_{STG}	Storage temperature		-65	175	℃

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 Condition	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	-750	+750	V

8. Thermal Characteristics

Symbol	Parameter	Test Conditions	Rating	Units
$R_{\theta JA}$	SO Package thermal resistance	Single-layer PCBS, JEDEC 1s0p are defined in JESD 51-3	300 (1)	℃/W

Note:

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

9. Operating Characteristics

9.1. Electrical Characteristics

Within the operating temperature range, V_{DD} = 5V (unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.(1)	Max.	Units
V_{DD}	Operating voltage (2)	$T_J < T_{J(Max.)}$	2.8	5.0	40	V
I_{DD}	Operating supply current	V_{DD}=2.8 to 40 V, T_A=25℃	3.5	4.1	7	mA
$UVLO_H$	Under Voltage Lockout High	B>BOP+2.0mT, VDD Rising From 2.5V	-	2.7	-	V
$UVLO_L$	Under Voltage Lockout Low	B>BOP+2.0mT, VDD Decreasing From 3.0V	-	2.5	-	V
$UVLO_{HYS}$	Under Voltage Hysteresis	$UVLO_H$- $UVLO_L$	-	0.2	-	V
t_{on}	Power-on time	VDD≥5V	-	25	40	μs
I_{QL}	Off-state leakage current	Output Hi-Z	-	-	3	μA
V_{SAT}	Output saturation voltage	IO=20mA	-	0.14	0.40	V
OCP	Over current protection	Output on VPULL-UP<30V	30	50	70	mA
t_d	Output delay time	B=BRP to BOP	-	15	25	μs
t_r	Output rise time(10% to 90%)	R1=1Kohm, Co=50pF	-	0.2	1	μs
t_f	Output fall time(90% to 10%)	R1=1Kohm, Co=50pF	-	0.1	1	μs

Note:

(1) Typical values are defined at TA = +25°C and V_{DD} = 5V

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

9.2. Magnetic Characteristics

Within the operating temperature range, VDD = 5.0V (unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
f_{BW}	BW		20	-	-	kHz
SC2498TSO +3.0(1) /-3.0 mT(2)						
B_{OP}	Operating point	T_A=25℃	+1.5	+3.0	+4.5	mT
B_{RP}	Release point		-4.5	-3.0	-1.5	mT
B_{HYS}	Hysteresis		3.0	6.0	9.0	mT
B_{HYS}	Magnetic offset	$B_O=(B_{OP}+B_{RP})/2$	-1.5	0	+1.5	mT

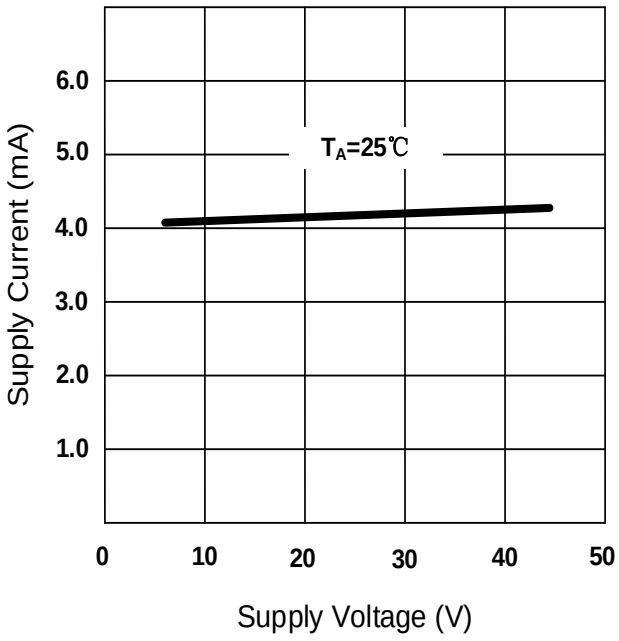
Note:

(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

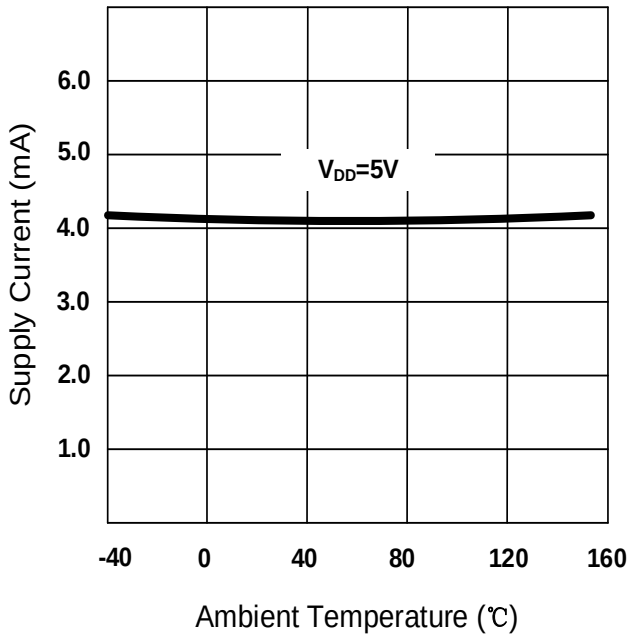
(1) 1mT=10Gs

10. Typical Characteristics

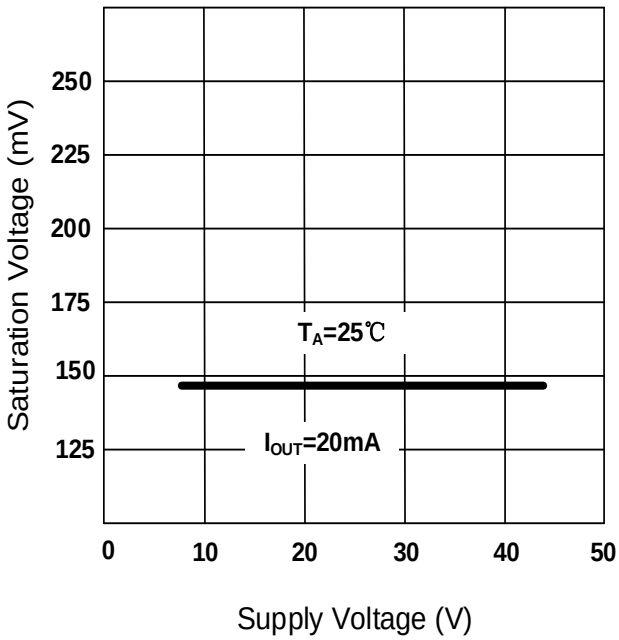
I_{DD} vs V_{DD}



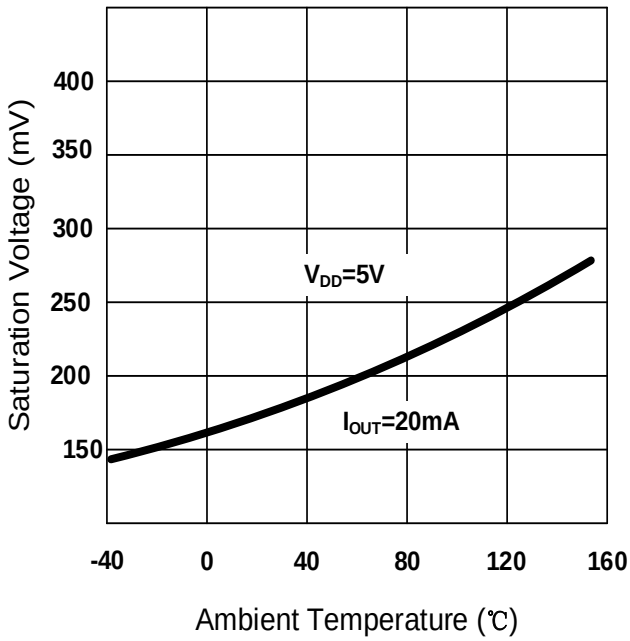
I_{DD} vs T_A



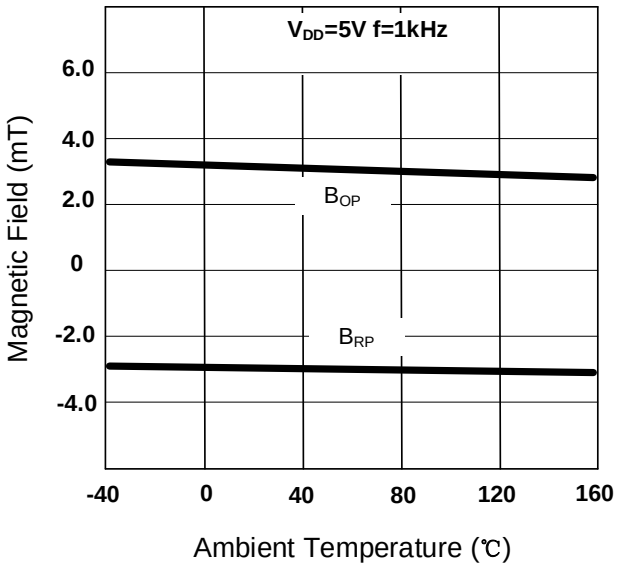
$V_{Q(sat)}$ vs V_{DD}



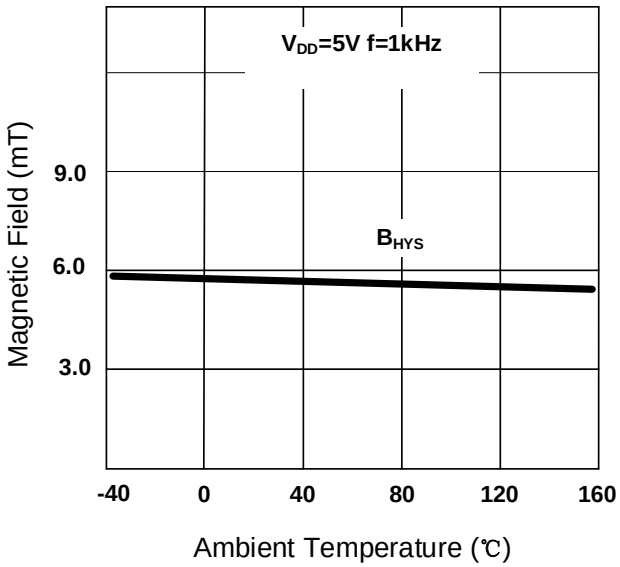
$V_{Q(sat)}$ vs T_A



B_{OP} and B_{RP} vs T_A



B_{HYS} vs T_A



11. Block Diagram

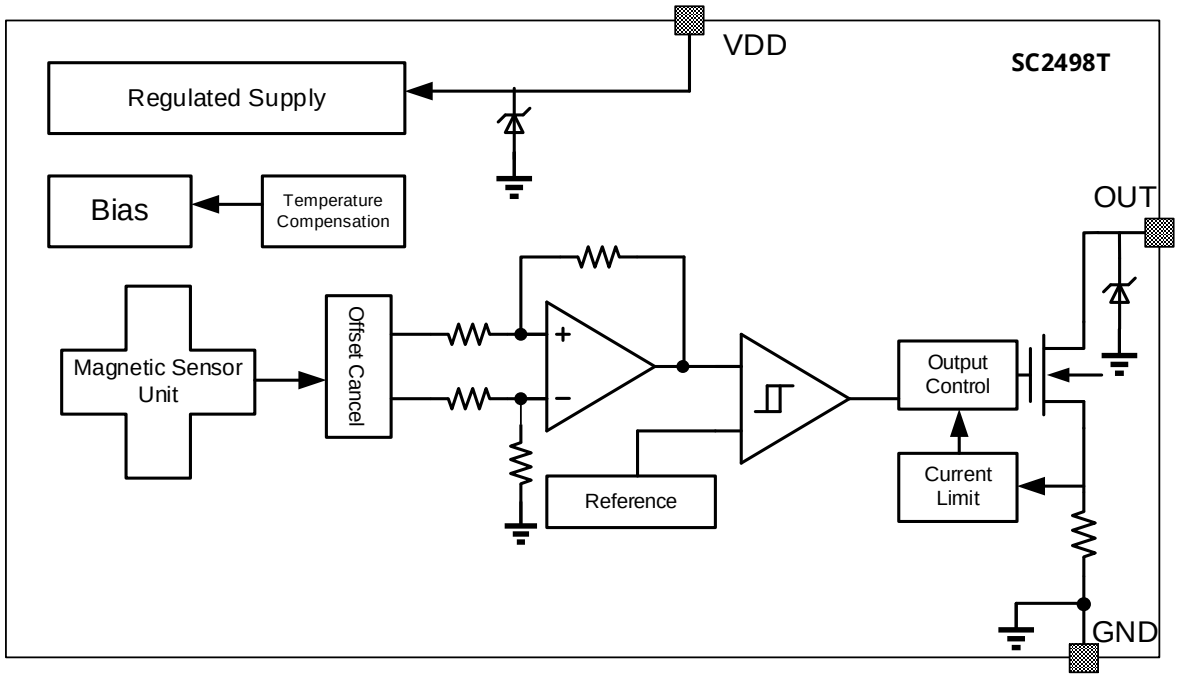


Fig. 3 Function Block Diagram

12. Function Description

The SC2498T is a planar magnetic sensing Hall - effect sensor integrated circuit with an open - drain output. The open - drain output is an N - channel metal - oxide - semiconductor (NMOS) transistor that responds to the magnetic field. For the SC2498T, the direction of the applied magnetic field is parallel to the marked side. These devices are packaged in a small outline (SO) package, which is a 3 - pin surface - mount configuration.

12.1. Field Direction Definition

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

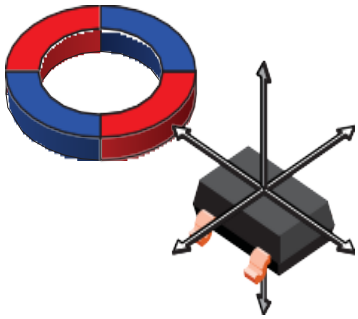


Fig. 4: Magnetic Field Direction Definition

12.2. 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}.

SOT23-3L package as an example, 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.

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

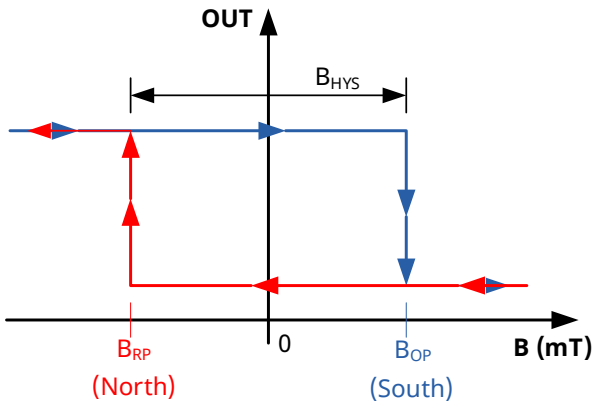


Fig. 5 Magnetic Transfer Function

13. Typical Application

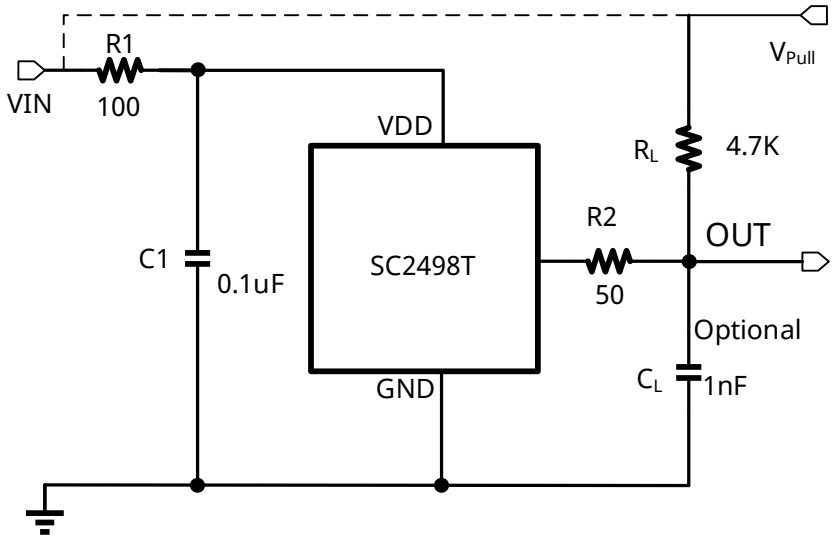


Fig. 6 Typical Application Circuit

The SC2498T 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 that C1 capacitor be connected to the ground in parallel near the VDD power end of the chip, with a typical value of 0.1μF. At the same time in the external optional series resistor R1 and output capacitance CL used for enhanced protection circuit, its typical values for 100Ω and 1nF.

The SC2498T device output stage uses an open-drain NMOS, and it is rated to sink up to 40mA of current. For proper operation, calculate the value of the pull-up resistor RL is required. The size of RL 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 value for CL based on the system bandwidth specifications as:

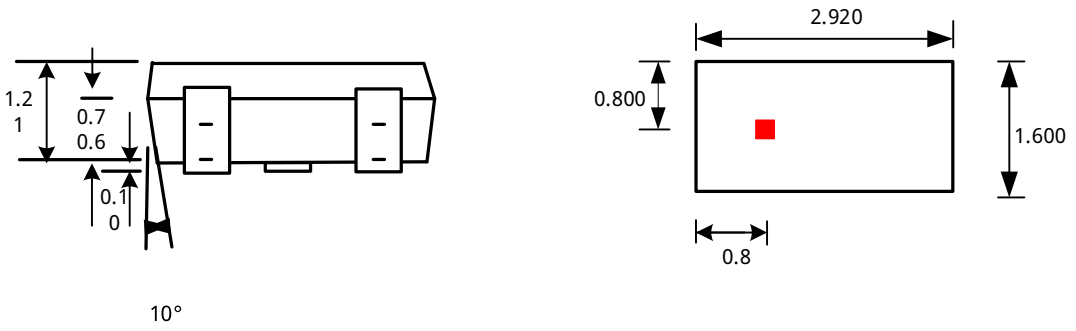
$$C_L < \frac{1}{2\pi \times R_L \times 2 \times f_{BW}(Hz)}$$

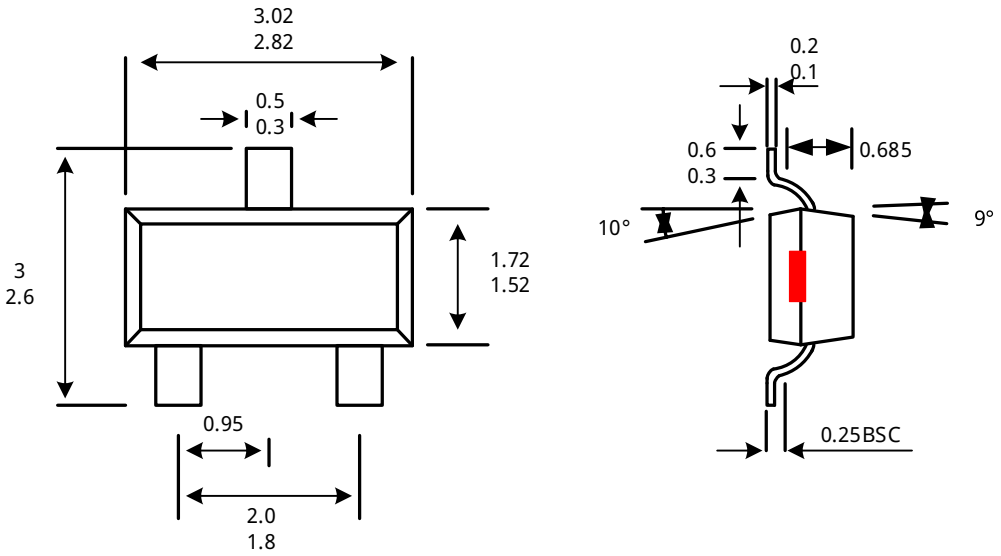
VPULL is not restricted to VDD, and could be connected to other voltage reference. The allowable voltage range of this terminal is specified in the Absolute Maximum Ratings.

14. Package Information SO

3-Terminal
SO Package

Uint:mm





Notes:
(1)Exact body and lead configuration at vendor's option within limits shown.
(2)Height does not include mold gate flash.
(3)The red mark is Hale element.

Where no tolerance is specified, dimension is nominal.

15. Revision History

Revision	Date	Description
Rev.E0.1	2023-06-10	Preliminary datasheet
Rev.E0.2	2023-07-17	Unified format
Rev.E0.3	2023-08-21	Revised some description
Rev.A1.0	2023-08-24	Upgrade Version
Rev.A1.1	2024-06-11	Update Sensor Position
Rev.A1.2	2025-07-05	Release with updated format