High Performance Digital-Latch Lateral Effect Sensor

1. Features

- Automotive AEC-Q100 Qualified
- IMC integration for lateral effect sensor ICs
- Automotive-grade ruggedness and fault tolerance
- Supports a wide voltage range
  - 2.8 to 40V
- Internal protection circuits enable 40V load dump compliance
- Output short circuit and overvoltage protection
- Operation from –55°C to 150°C ambient temperature
- High EMC immunity
- Symmetrical latch switch-points
- Choice of output polarity
- Open-drain output
- Solid-state reliability
- Small package
  - 3-pin SOT23-3L (SO)

2. Applications

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

3. Description

The SC249XM families of lateral effect latches are AEC-Q100 qualified for 40V automotive applications and compliant with ISO 26262:2011 ASIL A (pending confirmation). These sensors are temperature-stable and suited for operation over extended junction temperature ranges up to 150°C. The SC249XM families are available in several different magnetic sensitivities to offer flexible options for system design. They are available in active high and active low variants for ease of integration into electronic subsystems

The SC249XM features a planar lateral effect sensing element sensitive to magnetic flux parallel to the face of the IC package.

The devices include overvoltage protection for operating directly from an automobile battery, as well as protection from shorts to ground by limiting the output current until the short is removed. The device is especially suited for operation from unregulated supplies.

Not To Scale

Fig.1 Package Outline

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4. Terminal Configuration

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

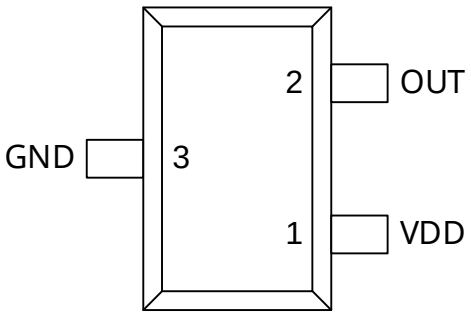


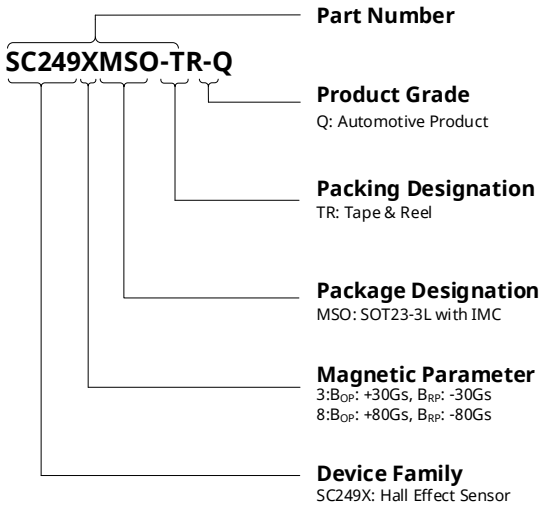
Fig. 2: Terminal Configuration

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

5. Ordering Information

Ordering Information	Mark	Option	Grade	B_{OP}(Gs)	B_{RP}(Gs)	Ambient, T_A(℃)	Package	Packing	Quantity
SC2493MSO-TR-Q	2493M		Q	30	-30	-55~150	SOT23-3L	TR	3000/reel
SC2498MSO-TR-Q	2498M		Q	80	-80	-55~150	SOT23-3L	TR	3000/reel

5.1. Ordering Information Format



6. Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted) (1)

Symbol	Parameter	Test Condition	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	44	mA
T_A	Operating ambient temperature		-55	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 PCB, with copper limited to solder pads	228 (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

over operating free-air temperature range (V_{DD} = 5.0V, unless otherwise noted)

Symbol	Parameter	Test Conditions	Min.	Typ.(2)	Max.	Units
V_{DD}	Operating voltage (1)	$T_J < T_{J(Max.)}$	2.8	5	40	V
I_{DD}	Operating supply current	V_{DD}=3 to 24 V, T_A=25℃	3.5	4.1	7	mA
t_{on}	Power-on time		-	25	40	μs
I_{QL}	Off-state leakage current	Output Hi-Z	-	-	3	μA
V_{sat}	Output saturation voltage	V_{DD}=5V,IO=20mA	-	140	400	mV
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
OCP	Over current protection	Output on VPULL-UP<30V	45	65	80	mA
$V_{Z(SLY)}$	Supply Zener Clamp Voltage	IDD=IDD(max)+3mA	40	-	-	V
$V_{Z(OUT)}$	Output Zener Clamp Voltage	Output Hi-Z,IOUT=1.5mA	40	-	-	V

Note:

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

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

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
f_{BW}	BW		20	-	-	kHz
SC2493MSO +3.0 /-3.0 mT						
B_{OP}	Operating point	T_A=-40℃ to 160℃	1.5	3.0(2)	4.5	mT(1)
B_{RP}	Release point		-4.5	-3.0(2)	-1.5	mT
B_{HYS}	Hysteresis		3.0	6.0	9.0	mT
SC2498MSO +8.0 /-8.0 mT						
B_{OP}	Operating point	T_A=-40℃ to 160℃	5.5	8.0	10.5	mT
B_{RP}	Release point		-10.5	-8.0	-5.5	mT
B_{HYS}	Hysteresis		11	16	21	mT

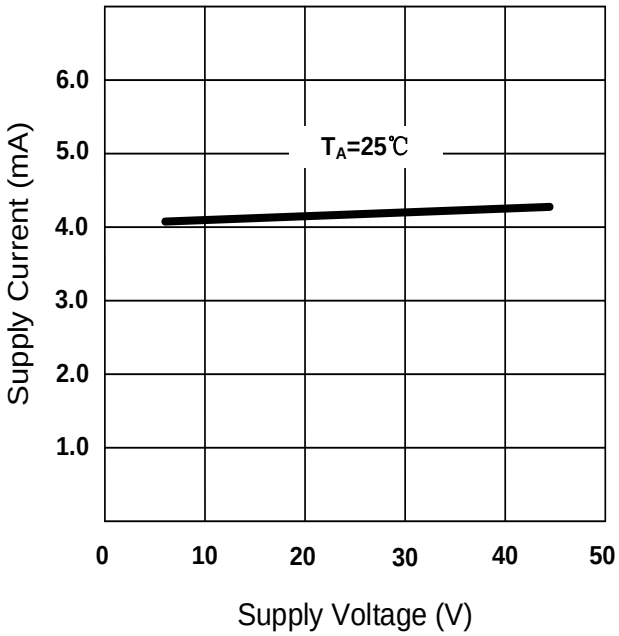
Note:

(1) 1mT=10Gs

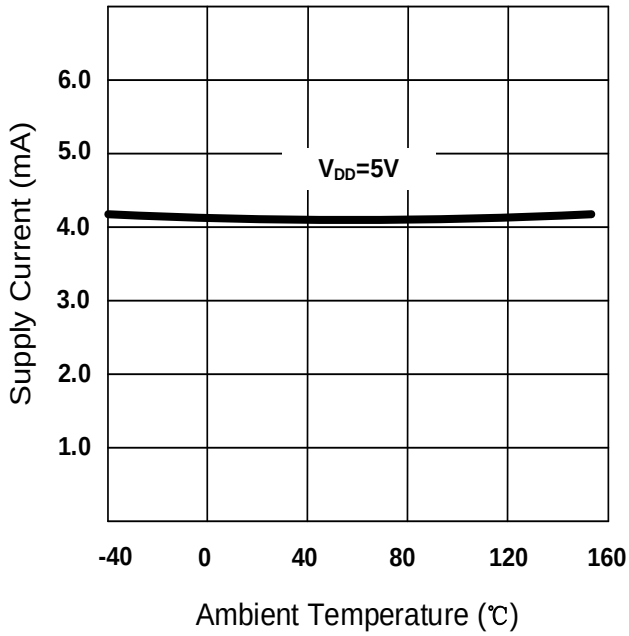
(2) Magnetic flux density, B, is indicated as a negative value for North-polarity magnetic fields, and as a positive value for South-polarity magnetic fields.

10. Typical Characteristics

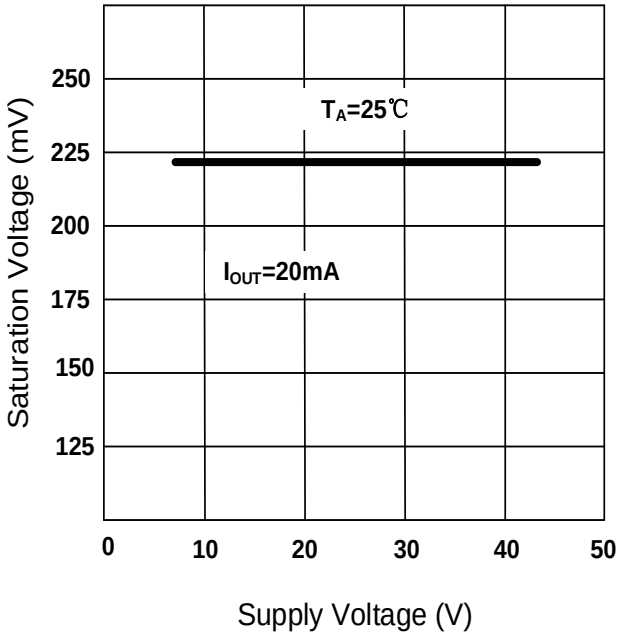
I_{DD} vs V_{DD}



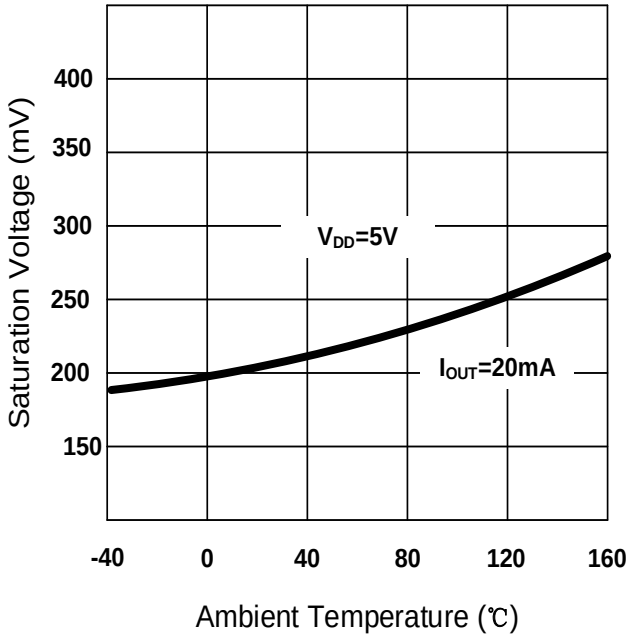
I_{DD} vs T_A



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

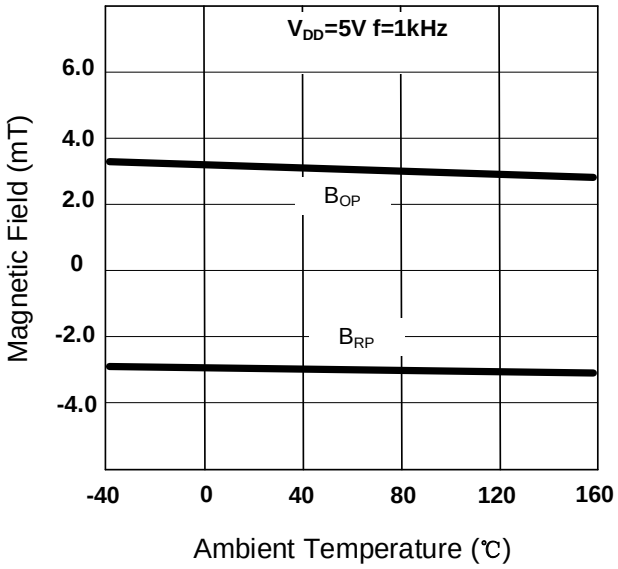


$V_{Q(sat)}$ vs T_A

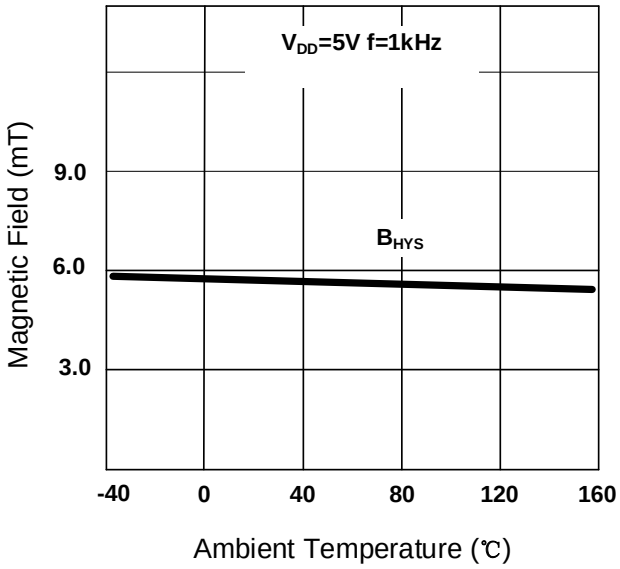


10.1 Typical Characteristics(Continued)

B_{OP} and B_{RP} vs T_A



B_{HYS} vs T_A



11. Block Diagram

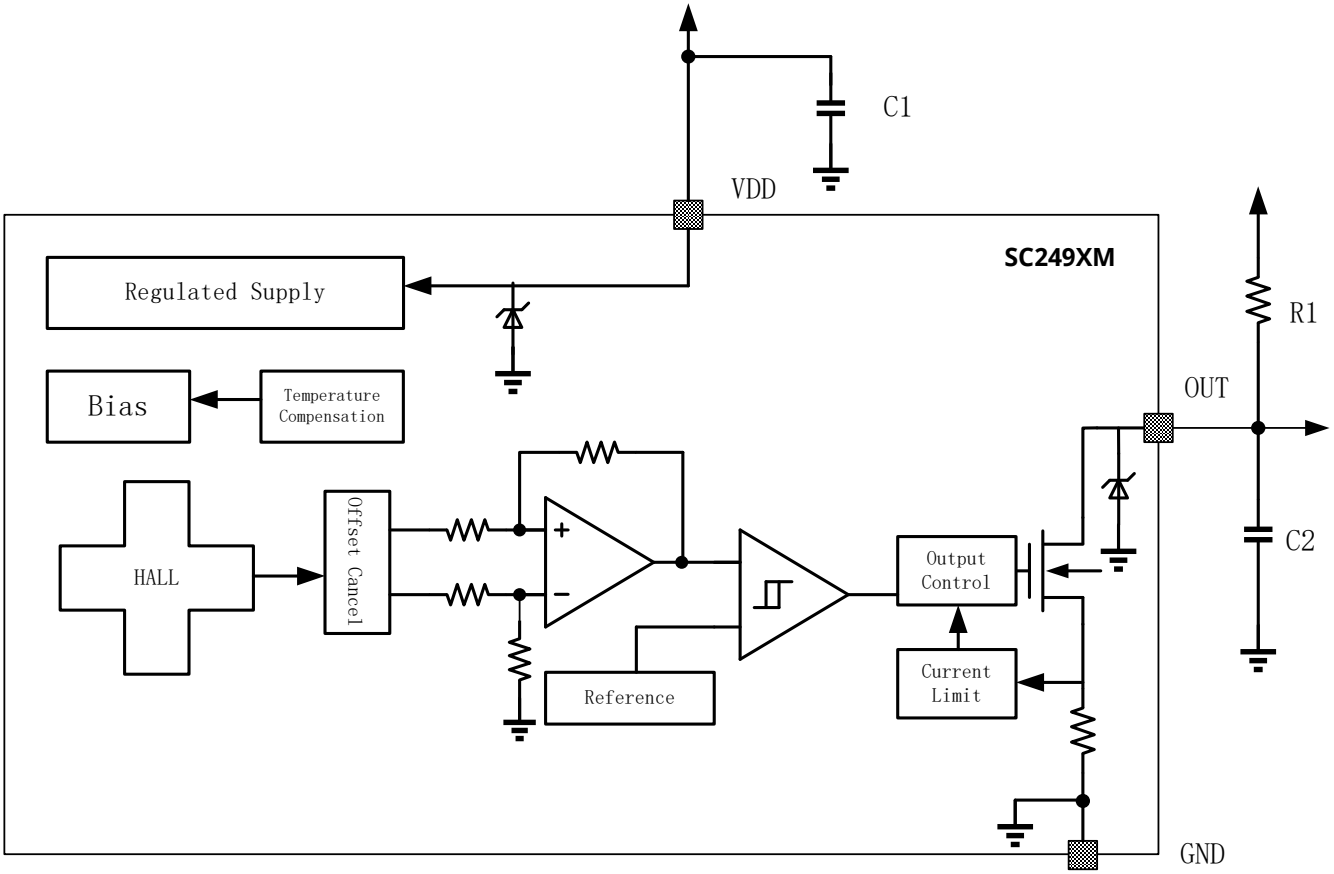


Fig. 3: Function Block Diagram

12. Function Description

The SC249XM are integrated lateral effect sensor ICs with an open-drain output. The open-drain out- put is an NMOS transistor that actuates in response to a magnetic field. The direction of the applied magnetic field is parallel with the branded face for the SC249XM; The devices are offered in the SO package, 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.

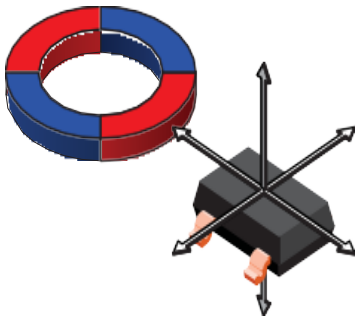


Fig. 4: Magnetic Field Direction Definition

12.2. Transfer Function

Powering-on the device in the hysteresis region, less than BOP 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.

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

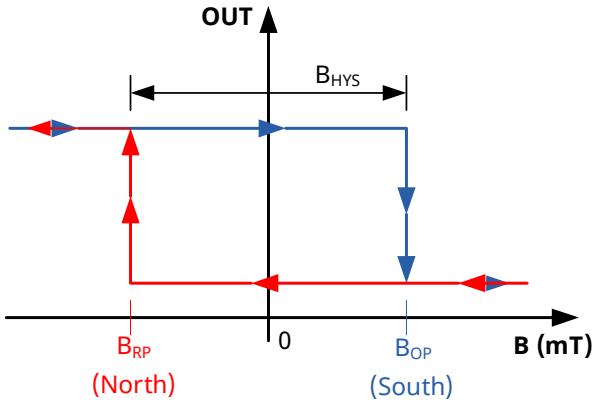


Fig. 5: Magnetic Transfer Function

13. Typical Application

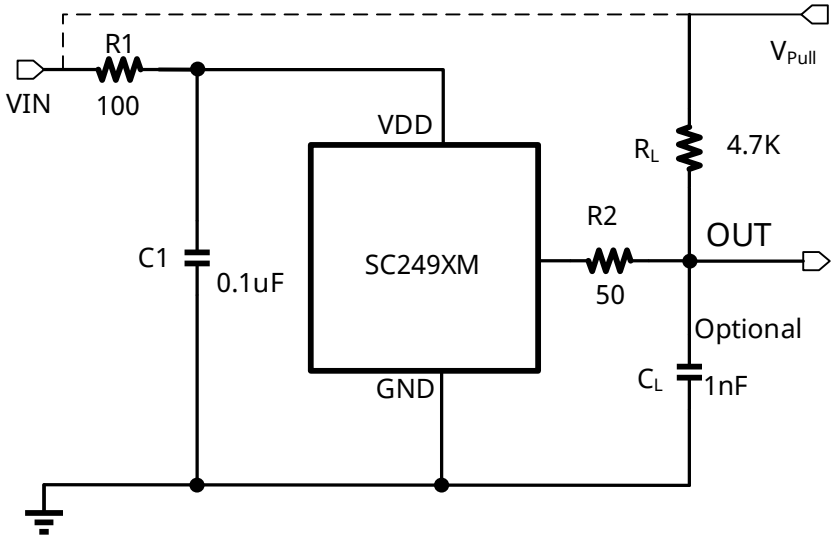


Fig. 6: Typical Application Circuit

The SC249XM 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 SC249XM device output stage uses an open-drain NMOS, and it is rated to sink up to 30mA 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:

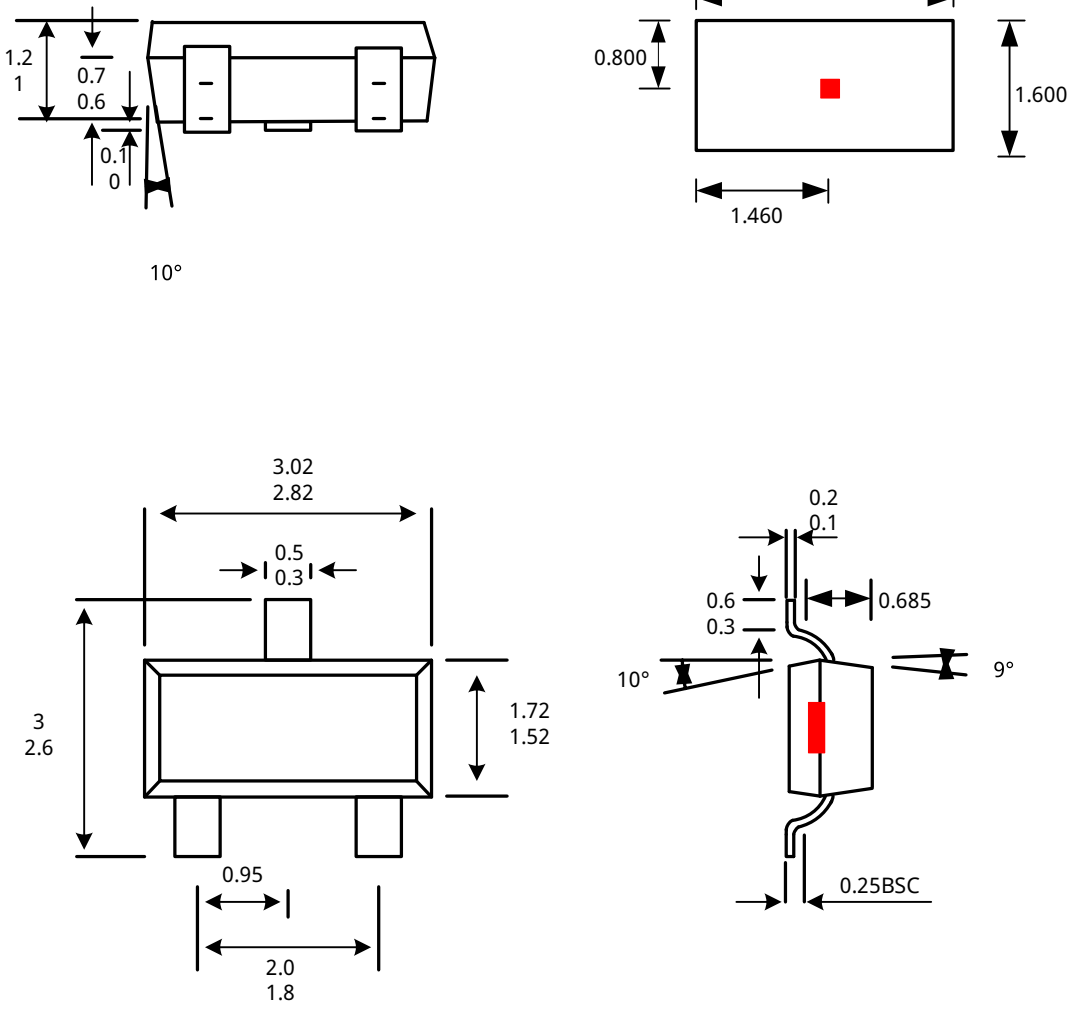
$$C_L < \frac{1}{2\pi \times R_L \times 2 \times f_{BW}(Hz)}$$

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

Dimension: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 VA1.0	2025-04-25	The final revision of old datasheet