Ultra-High Voltage Digital Latch Hall Effect Sensor

1. Features

- AEC-Q100 Certificated
- Ultra-high voltage stress endurance
  - up to 240V
- Wide supply operating range:
  - 4.0-120V
  - Operation from unregulated supply
- Wide operating temperature range:
  - -40~150℃
- Superior temperature stability
- High chopping frequency
- Robust EMC performance
- Small package：
  - SOT23-3L (SO)
  - TO-92S (UA)

2. Applications

- Automotive
- Valve and solenoid status
- BLDC motors with sensors
- Proximity sensing
- Tachometers

3. Description

The SC1919 family, produced with Ultra-High voltage BiCMOS technology, is a chopper-stabilized Hall Effect Sensor that offers a magnetic sensing solution with superior sensitivity stability over temperature and integrated protection features.

Superior high-temperature performance is made possible through dynamic offset cancellation, which reduces the residual offset voltage normally caused by device over molding, temperature dependencies, and thermal stress. Each device includes on a single silicon chip a high voltage regulator, Hall-voltage generator, small-signal amplifier, chopper stabilization, Schmitt trigger, and an open-drain output to sink up to 10mA.

An onboard regulator permits with supply voltages of 4.0V to 120V which makes the device suitable for a wide range of industrial and automotive applications.

The device is available in a 3-pin SIP package (UA) and SOT23-3L package (SO). It's lead (Pb) free, with 100% matte tin lead frame plating.

Fig.1: Package Outline

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4. Terminal Configuration

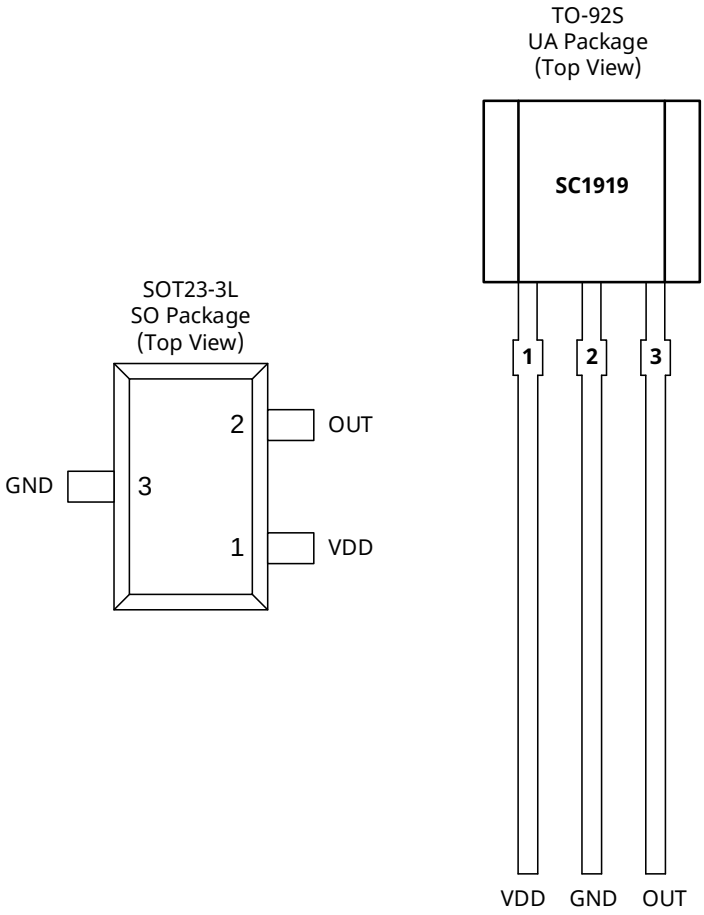


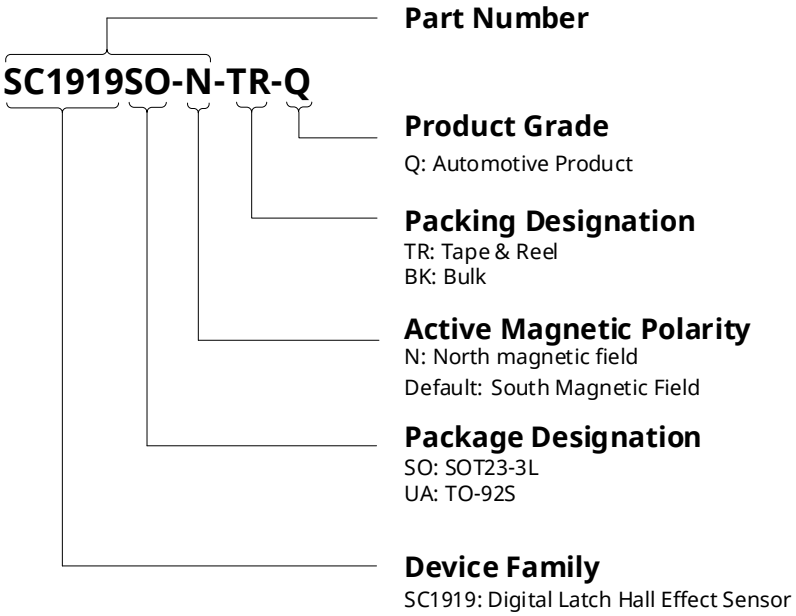
Fig.2: Pin Description

Terminal			Type	Description
Name	UA	SO		
VDD	1	1	POWER	4.0V ~ 120V power supply
GND	2	3	Ground	Ground
OUT	3	2	Output	Open-drain output required a pull-up resistor

5. Ordering Information

Order Information	Mark	Class	B_{OP}(Gs)	B_{RP}(Gs)	Ambient, T_A(℃)	Package	Packing	Quantity
SC1919SO-N-TR-Q	919H	Q	-70	70	-40~150	SOT23-3L	TR	3000/reel
SC1919UA-BK-Q	919H	Q	70	-70	-40~150	TO-92S	BK	1000/bag

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		-0.5	240	V
V_{OUT}	Output terminal voltage	For 5 Min. @1.0K pull-up resistor	-0.5	240	V
I_{SINK}	Output terminal current sink		-	10	mA
T_A	Operating ambient temperature		-40	150	℃
T_J	Junction temperature		-55	165	℃
T_{STG}	Storage temperature		-65	175	℃

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}	HBM	Refer to AEC-Q100-002E HBM standard, R=1.5kΩ, C=100pF	-2	2	kV
V_{ESD_CDM}	CDM	Refer to AEC-Q100-011C CDM standard	-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)	˚C/W
	UA Package thermal resistance	Single-layer PCB, with copper limited to solder pads	166(1)	˚C/W

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

9. Operating Characteristics

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

Symbol	Parameter	Test Conditions	Min.	Typ.(1)	Max.	Units
Electrical Characteristics						
V_{DD}	Operating voltage (2)	$T_J < T_{J(Max.)}$	4.0	-	120	V
$I_{DD(off)}$	Off state, operating supply current	V_{DD}=4.0 to 24V, T_A=25℃	0.8	1.52	2.0	mA
$I_{DD(on)}$	On state, operating supply current	V_{DD}=4.0 to 24V, T_A=25℃	0.8	1.52	2.0	mA
		V_{DD}=48V, T_A=25℃	-	1.63	-	mA
I_{QL}	Off-state leakage current	Output Hi-Z	-	-	1	μA
$R_{DS\ (on)}$	FET on-resistance	V_{DD}=5V, I_O=10mA, T_A=25℃	-	40	-	Ω
		V_{DD}=5V, I_O=10mA, T_A=125℃	-	70	-	Ω
t_{on}	Power-on time	V_{DD}≥5.0V	-	35	50	μs
t_d	Output delay time	B_{RP} to B_{OP}	-	3	5	μs
t_r	Output rise time (10% to 90%)	R1=1Kohm, Co=50pF	-	-	0.5	μs
t_f	Output fall time (90% to 10%)	R1=1Kohm, Co=50pF	-	-	0.2	μs
Magnetic Characteristics						
f_{BW}	Bandwidth		20	-	-	kHz
SC1919						
B_{OP}	Operated point	T_A=-40~125℃	+4.0	+7.0	+10.0	mT(3)
B_{RP}	Release point		-10.0	-7.0	-4.0	mT
B_{HYS}	Hysteresis	B_{OP} - B_{RP}	8.0	14.0	20.0	mT
B_O	Magnetic offset	B_O=(B_{OP}+B_{RP})/2	-3.0	0	+3.0	mT

Note:

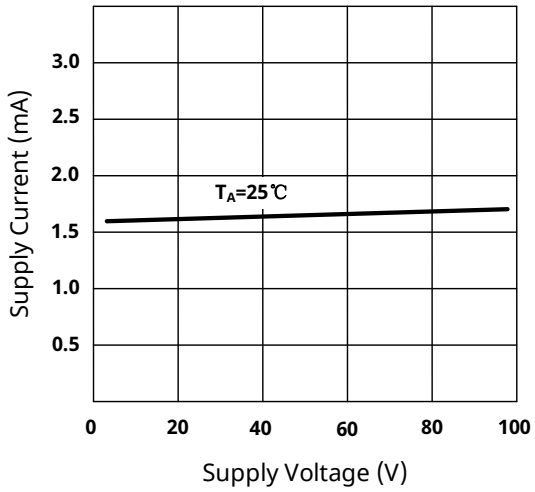
(1) Typical values are defined at T_A = 25°C and V_{DD} = 5.0V

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

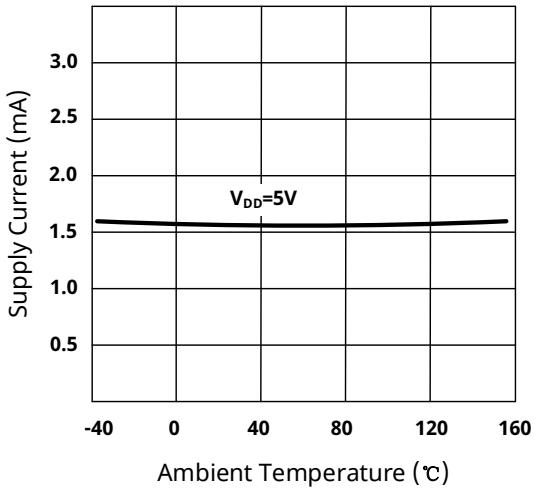
(3) 1mT=10Gs

10. Typical Characteristics

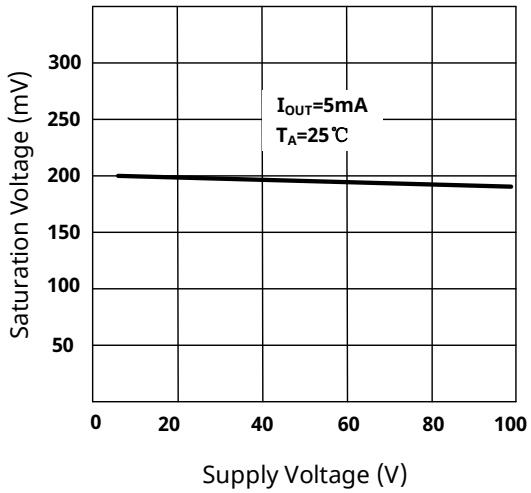
I_{DD} vs V_{DD}



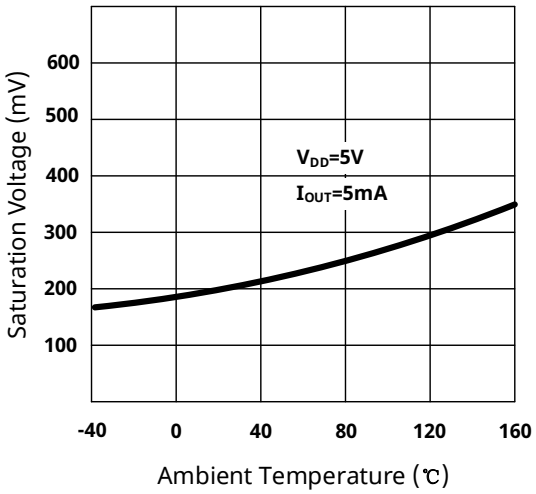
I_{DD} vs T_A



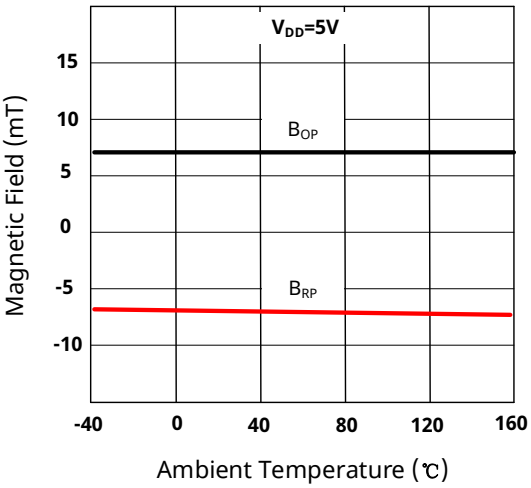
$V_{Q(sat)}$ vs V_{DD}



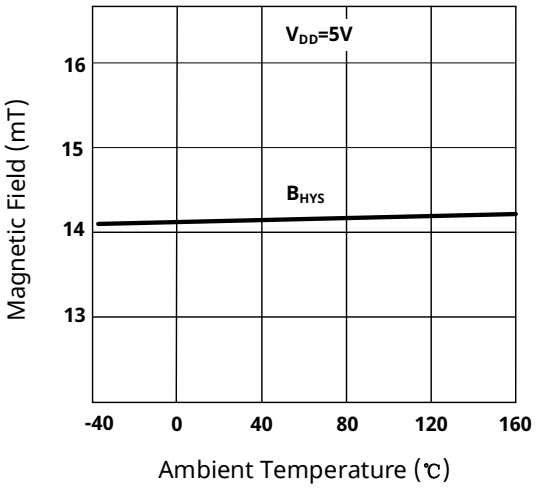
$V_{Q(sat)}$ vs T_A



SC1919
B_{OP} and B_{RP} vs T_A



SC1919
B_{HYS} vs T_A



11. Block Diagram

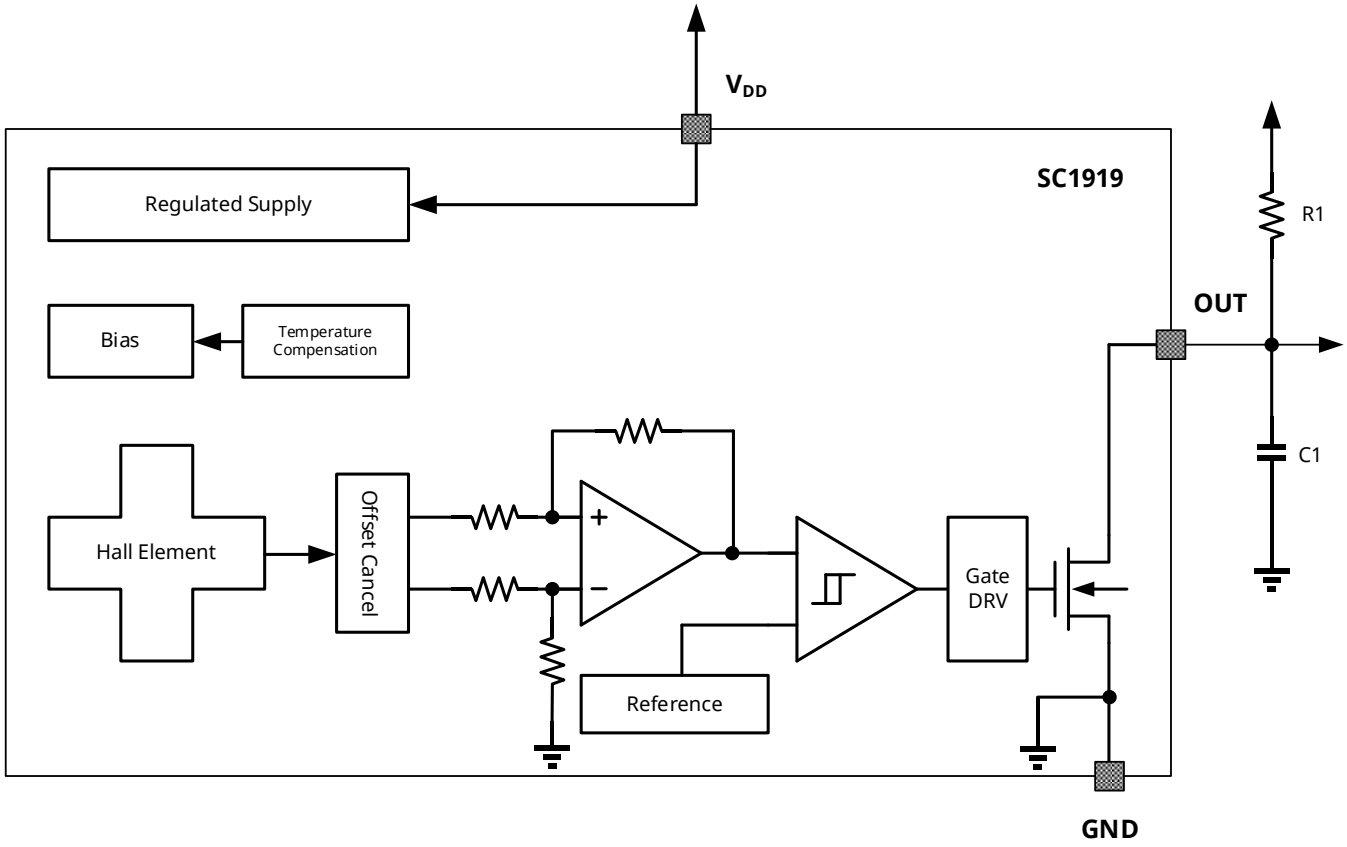


Fig.3: Block Diagram

12. Function Description

The SC1919 device is a chopper-stabilized Hall sensor with a digital latched output for magnetic sensing applications. The device can work with a supply voltage between 4.0V and 120V. In addition, the device can withstand voltages up to 240V for transient surge.

The output of SC1919 switches low (turns on) when a magnetic field (South polarity) perpendicular to the Hall element exceeds the operate point threshold, B_{OP}. After turn-on, the output is capable of sinking 10mA 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.

An external output pull-up resistor is required on the OUT terminal. The OUT terminal can be pulled up to V_{DD} or to a different voltage supply. This allows for easier interfacing with controller circuits.

12.1. Field Direction Definition

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

Take TO-92S package (UA) as example:

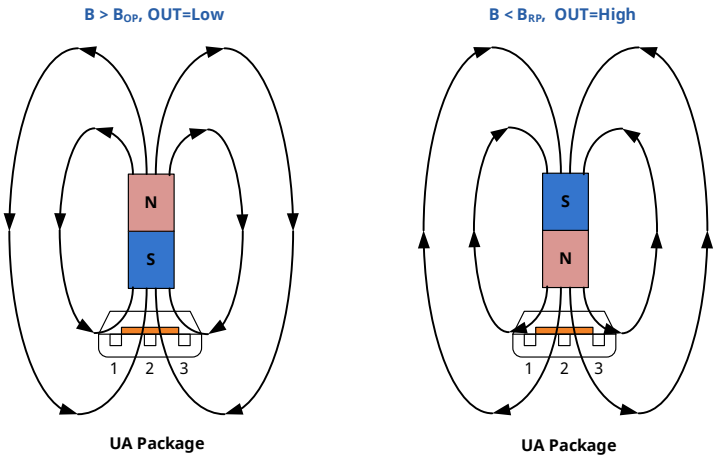


Fig.4: Switch Points versus Magnetic Signal

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}. 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.

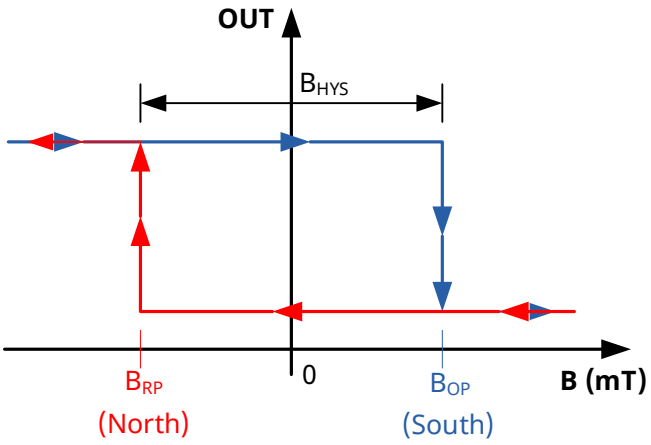


Fig.5: Magnetic Transfer Function

13. Typical Application

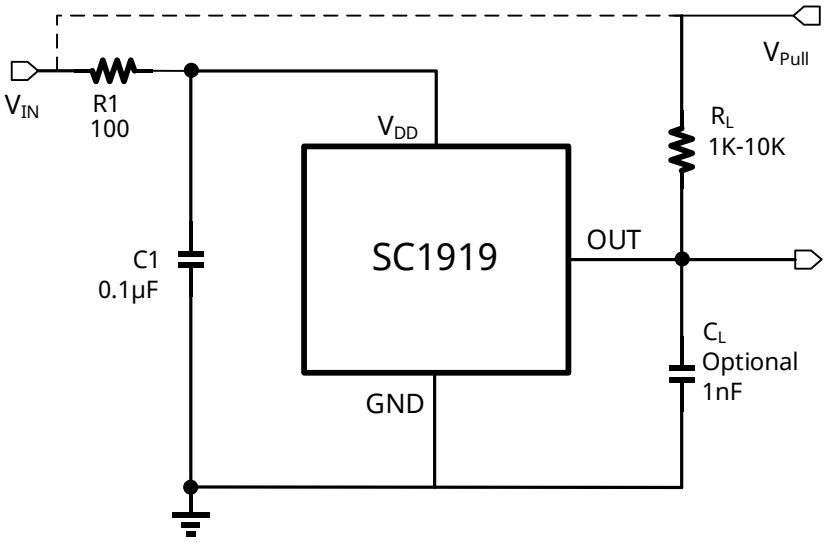


Fig.6: Typical Application Circuit

The SC1919 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 to move C1 capacitors to the ground near the chip V_{DD} power supply, with a typical value of 0.1μF. At the same time in the external optional series resistor R1 their typical values for 100Ω. The output capacitor C_L is used as the output filter, typically 1nF.

Select a value for C_L based on the system bandwidth specifications as:

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

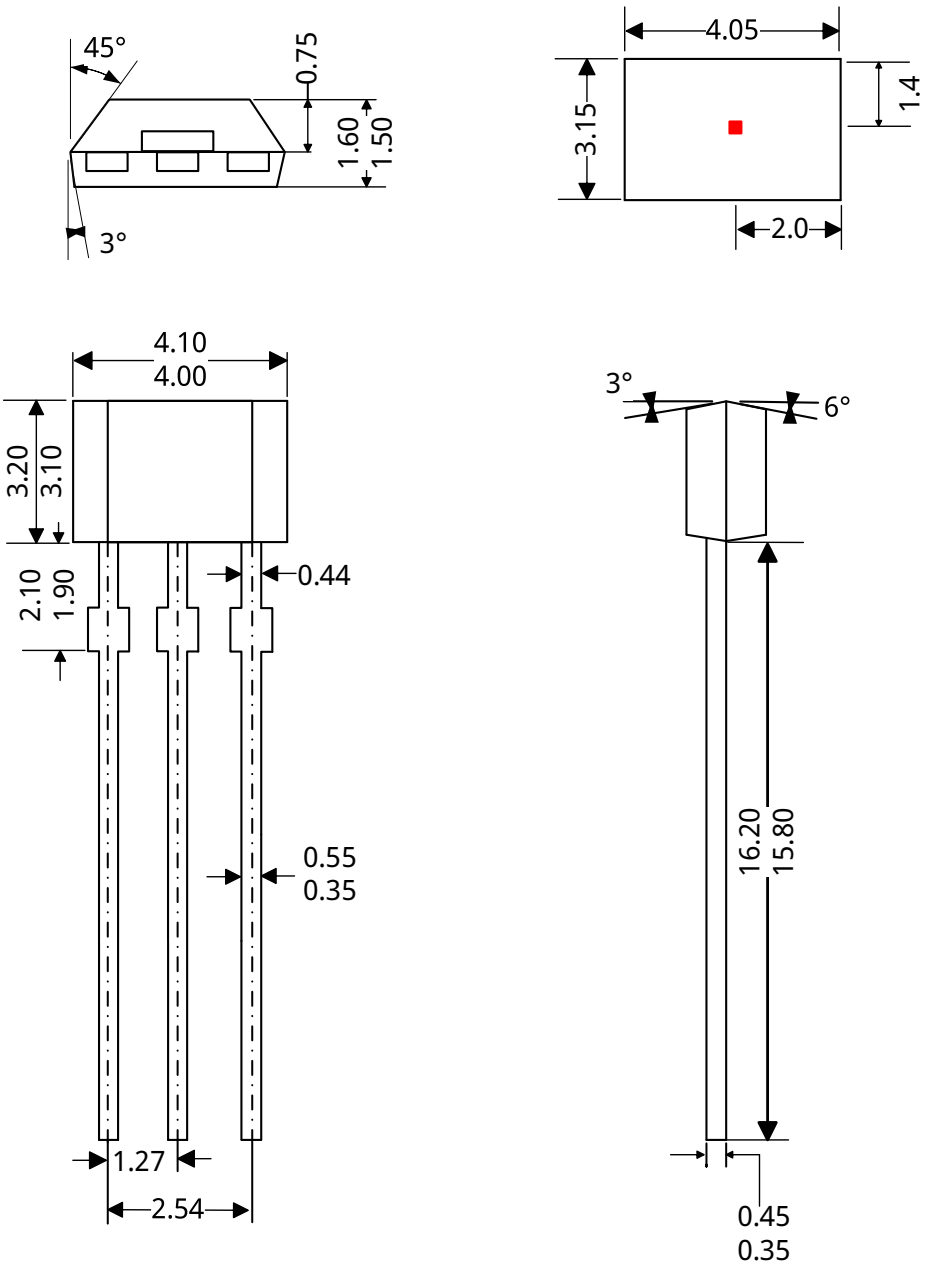
The output stage of the SC1919 device is a drain open-circuit NMOS, which provides a load capacity of 10mA. Adjust the pull-up resistor R_L to make it work properly. The R_L provides a high level for the leak-opening output. In general, less current is better, but faster transient response and bandwidth are required, with a smaller resistor RL for faster switching.

V_{PULL} is not restricted to V_{DD}, and could connect to other voltage reference. The allowable voltage range of this terminal is specified in the Absolute Maximum Ratings.

14. Package Information TO-92S "UA"

3-Terminal
UA Package

Dimension:mm



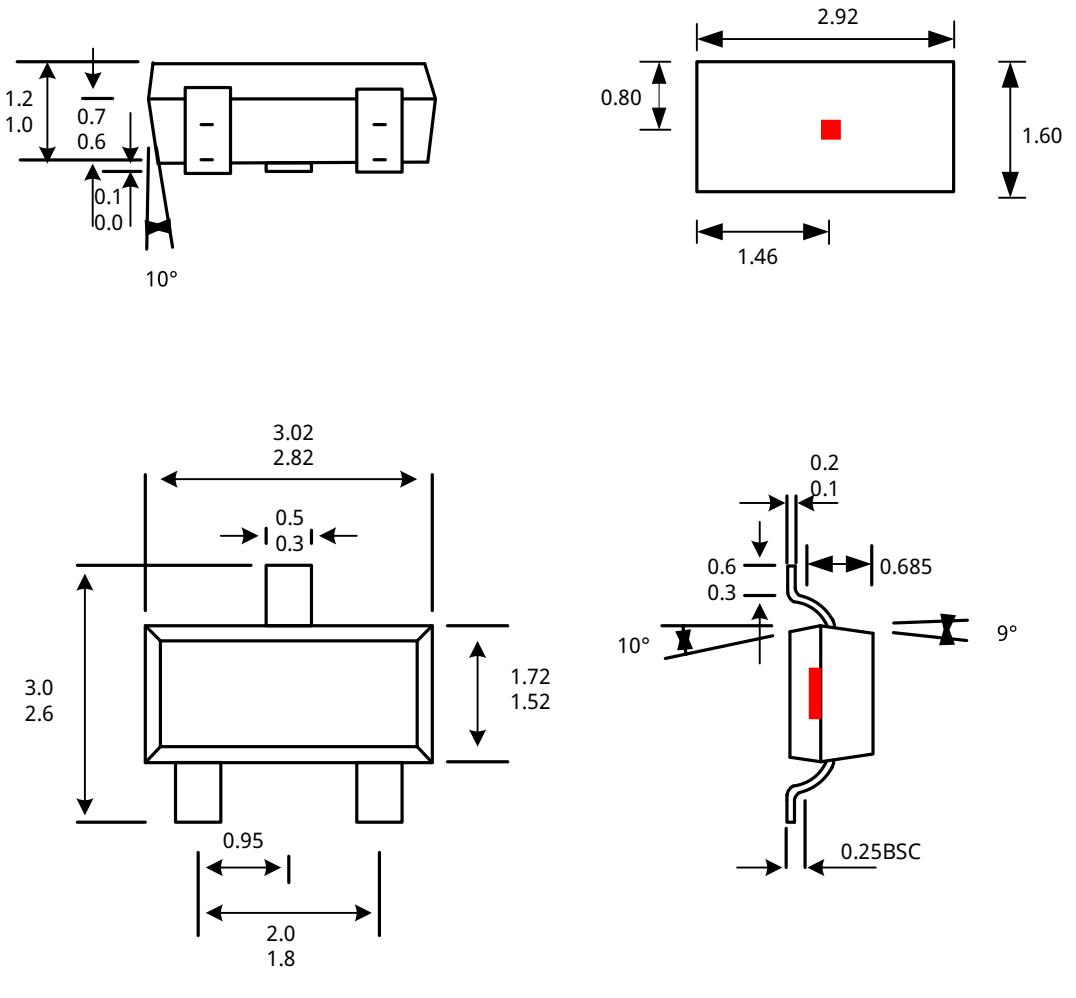
Notes:
1. Exact body and lead configuration at vendor's option within limits shown.
2. Height does not include mold gate flash.

Where no tolerance is specified, dimension is nominal.

15. Package Information SOT23-3L “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.

16. Revision History

Revision	Date	Description
Rev0.1	2017-03-22	Preliminary datasheet
Rev2.3	2018-05-06	Release formal product datasheet
Rev A.1.0	2020-11-19	Update ordering information
Rev A.1.1	2025-03-16	Add SOT23-3 package information