High Sensitive Digital-Bipolar Hall Effect Sensor

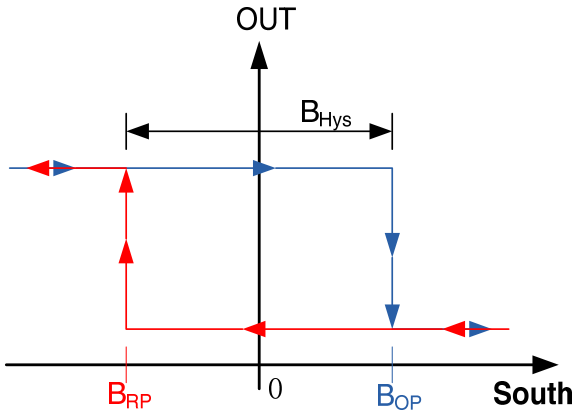
Features

- Ultra-high sensitivity
- High chopping frequency
- Supports a wide voltage range
  - 2.5 to 24V
  - Operation from unregulated supply
- Wide operating temperature range
- Solid-state reliability
- Small package
  - 3-pin SIP

Applications

- Power tools
- Flow meters
- Valve and solenoid status
- BLDC motors with sensors
- Proximity sensing
- Tachometers

Output state



Description

The U18 is a Hall-effect latch designed in mixed signal BiCMOS techology. The device integrates a voltage regulator, Hall sensor with dynamic offset cancellation system, Schmitt trigger and an open-drain output driver, all in a single package.

The low operating voltage and extended choice of temperature range make it suitable for use in automotive, industrial and consumer low voltage applications.

An onboard regulator permits with supply voltages of 2.5 to 24V which makes the device suitable for a wide range of industrial and atuomotive applications

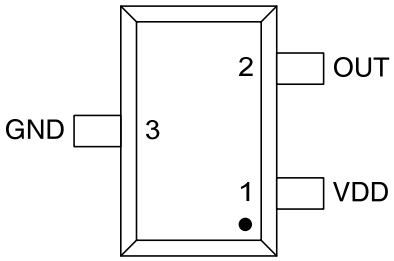
The device is available in a 3-pin SIP package (UA)..

Device Information

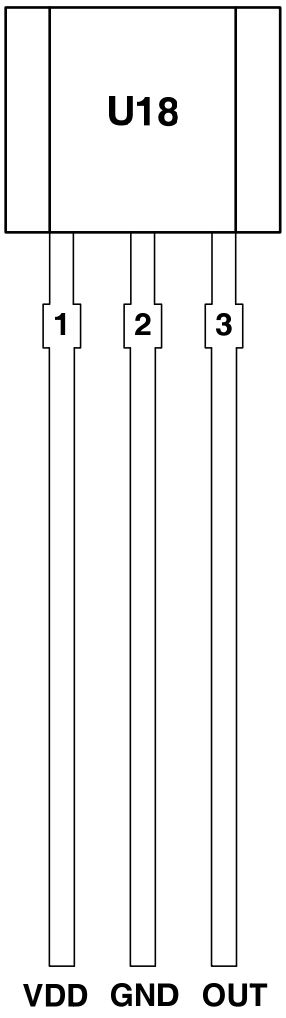
Part Number	Packing	Mounting	Ambient, T_A	B_{OP}(Typ.)	B_{RP}(Typ.)
U18	Bulk, 1000 pieces/bag	SIP3	-40℃ to 150℃	+1.5mT	-1.5mT

Terminal configuration and functions

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



3-Terminal SIP
UA Package
(Top View)



Not to scale

Terminal			Type	Description
Name	Number			
	UA	SO		
VDD	1	1	PWR	2.5 to 24 V power supply
GND	2	3	Ground	Ground terminal
OUT	3	2	Output	Open-drain output

Absolute Maximum Ratings

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

Parameter	Symbol	Min.	Max.	Units
Power supply voltage	V_{DD}	-0.5	28	V
Output terminal voltage	V_{OUT}	-0.5	28	V
Output terminal current sink	I_{SINK}	0	30	mA
Operating ambient temperature	T_A	-40	150	℃
Maximum junction temperature	T_J	-55	165	℃
Storage temperature	T_{STG}	-65	175	℃

(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.

Electrical Characteristics

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
V_{DD}	Operating voltage(1)	$T_J < T_{J(Max.)}$	2.5	--	24	V
I_{DD}	Operating supply current	V_{DD}=2.5 to 24 V, T_A=25℃	0.8	1.3	2.0	mA
		V_{DD}=2.5 to 24 V, T_A=125℃	0.9	1.4	2.1	mA
t_{on}	Power-on time		--	35	50	μS
I_{QL}	Off-state leakage current	Output Hi-Z	--	--	3	μA
$R_{DS(on)}$	FET on-resistance	V_{DD}=5V, I_O=10mA, T_A=25℃	--	20	--	Ω
		V_{DD}=5V, I_O=10mA, T_A=125℃	--	30	--	Ω
t_d	Output delay time	B=B_{RP} to B_{OP}	--	15	25	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

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

Magnetic Characteristics

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

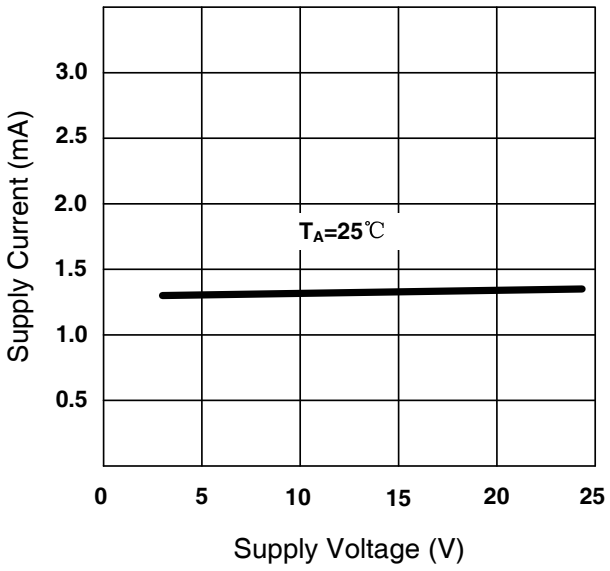
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
f_{BW}	Bandwidth		20	--	--	kHz
B_{OP}	Operated point	T_A=25℃	--	+1.5	+3.0	mT
B_{RP}	Release point		-3.0	-1.5	--	mT
B_{HYS}	Hysteresis		--	3.0	--	mT

1mT=10Gs

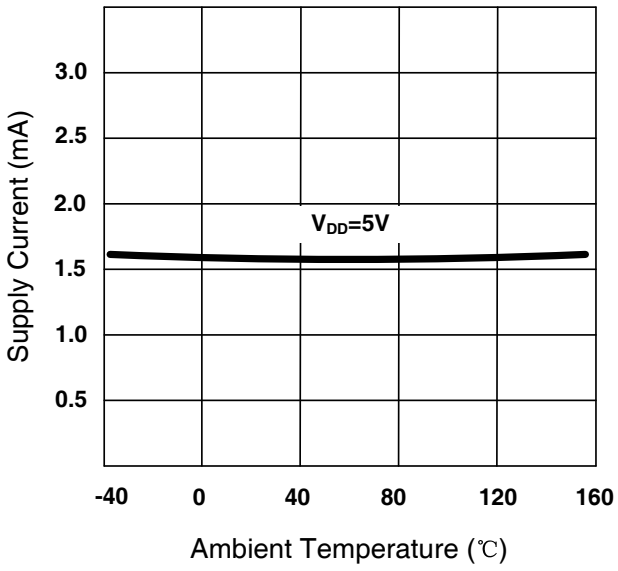
Magnetic flux density, B, is indicated as a negative value for North-polarity magnetic fields, and as a positive value for South-polarity magnetic fields.

Characteristic Data

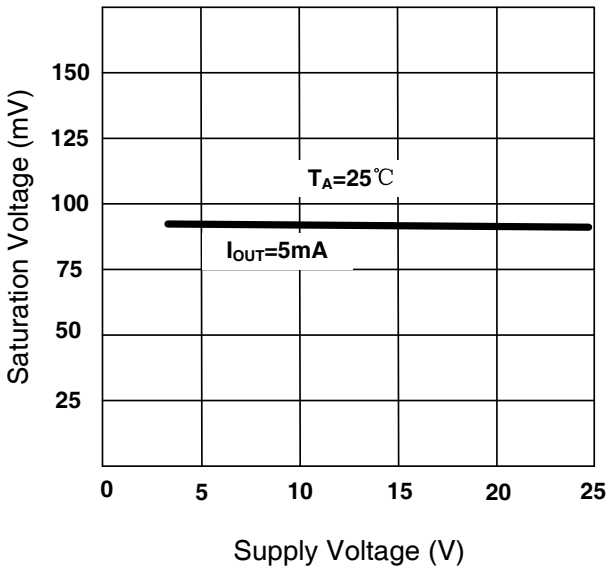
I_{DD} vs V_{DD}



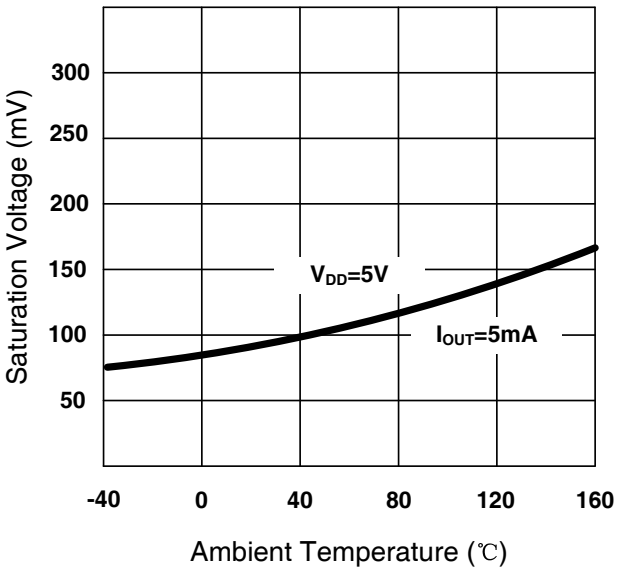
I_{DD} vs T_A



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

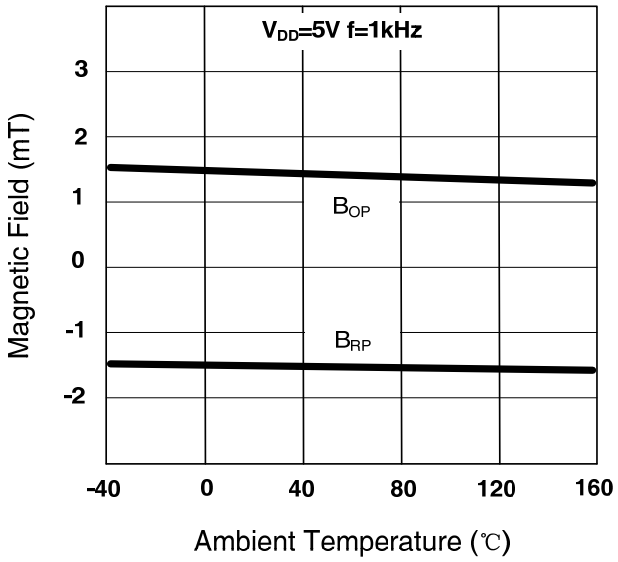


$V_{Q(sat)}$ vs T_A

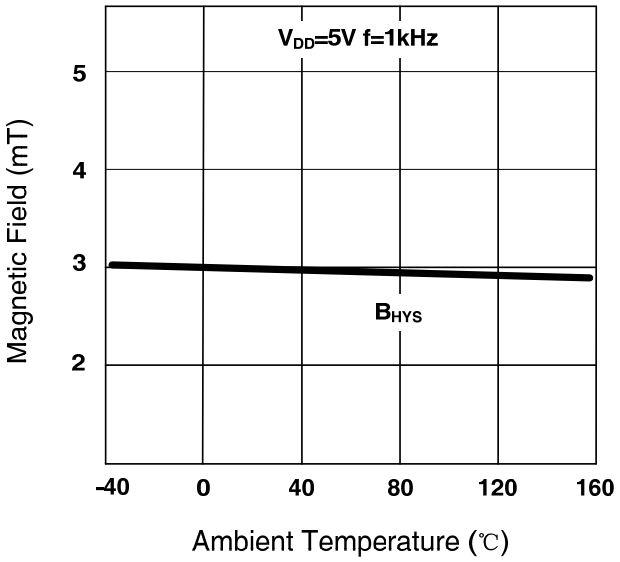


Characteristic Data (Continued)

B_{OP} and B_{RP} vs T_A



B_{HYS} vs T_A



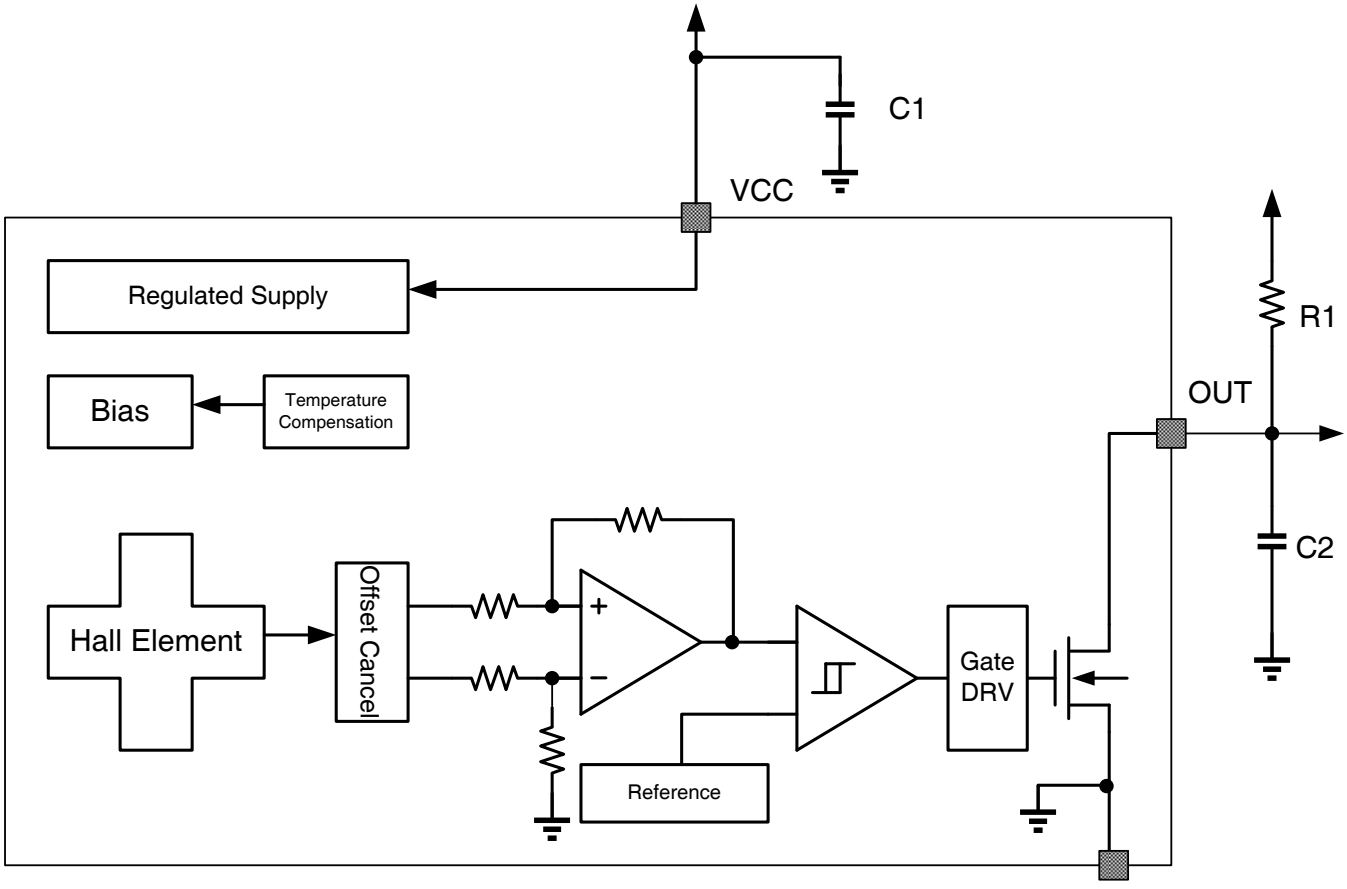
Function Description Overview

The U18 device is a chopper-stabilized Hall sensor with a digital latched output for magnetic sensing applications. The device can be powered with a supply voltage between 2.5 and 24V. The device does not operate when -0.5 to 2.2V is applied to the VDD terminal (with respect to the GND terminal). In addtion, the device can withstand voltages up to 40V for transient durations.

The output of U18 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 20mA 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.

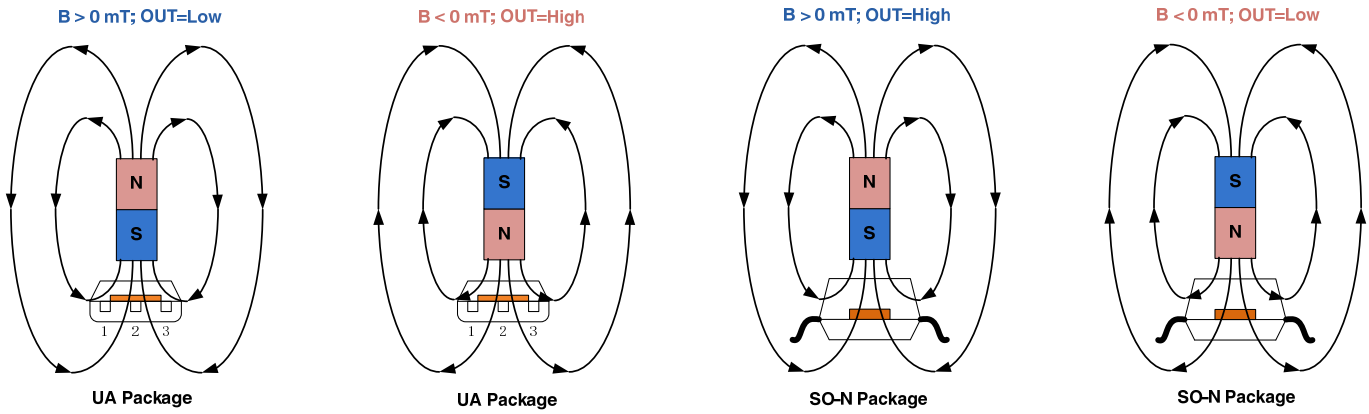
An external output pull-up resistor is required on the OUT terminal. The OUT terminal can be pulled up to V_{DD} or to a different voltage supply. This allows for easier interfacing with controller circuits.

Functional Block Diagram



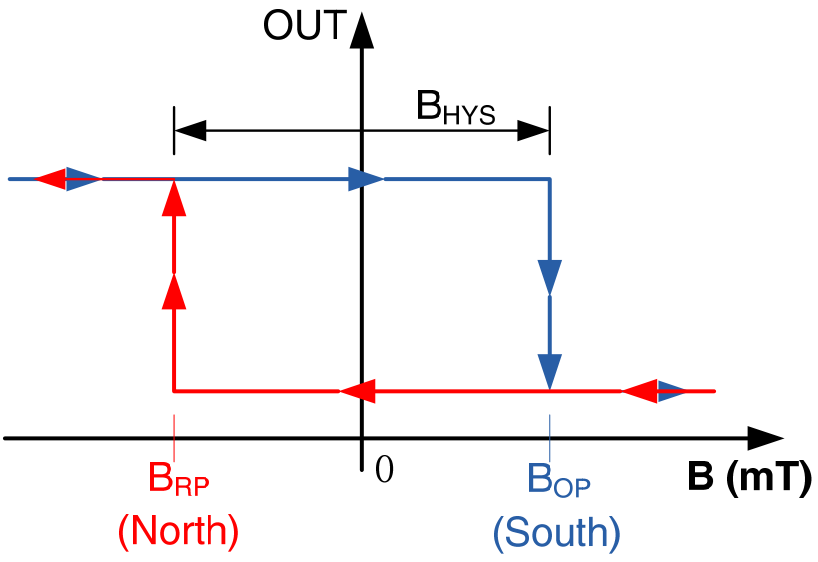
Field Direction Definition

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

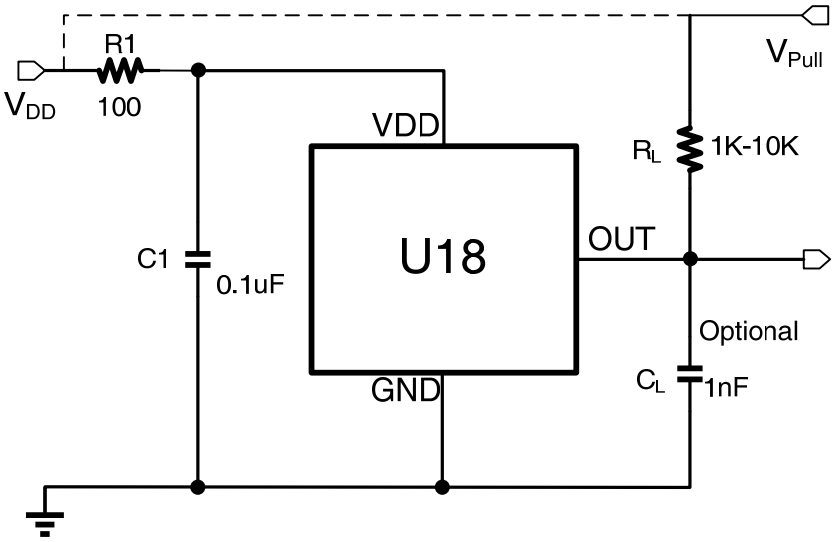


Transfer Function

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.



Typical Application



The U18 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. R1 is for improved CI performance, and could be 100 or 200 Ω typically.

The U18 device output stage uses an open-drain NMOS, and it is rated to sink up to 20mA of current. For proper operation, calculate the value of the pull-up resistor R_L is required. The size of R_L 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 vaule for C_L based on the system bandwidth specifications as:

$$2 \times f\,(Hz) = \frac{1}{2\pi \times R \times \mathrm{C}}$$

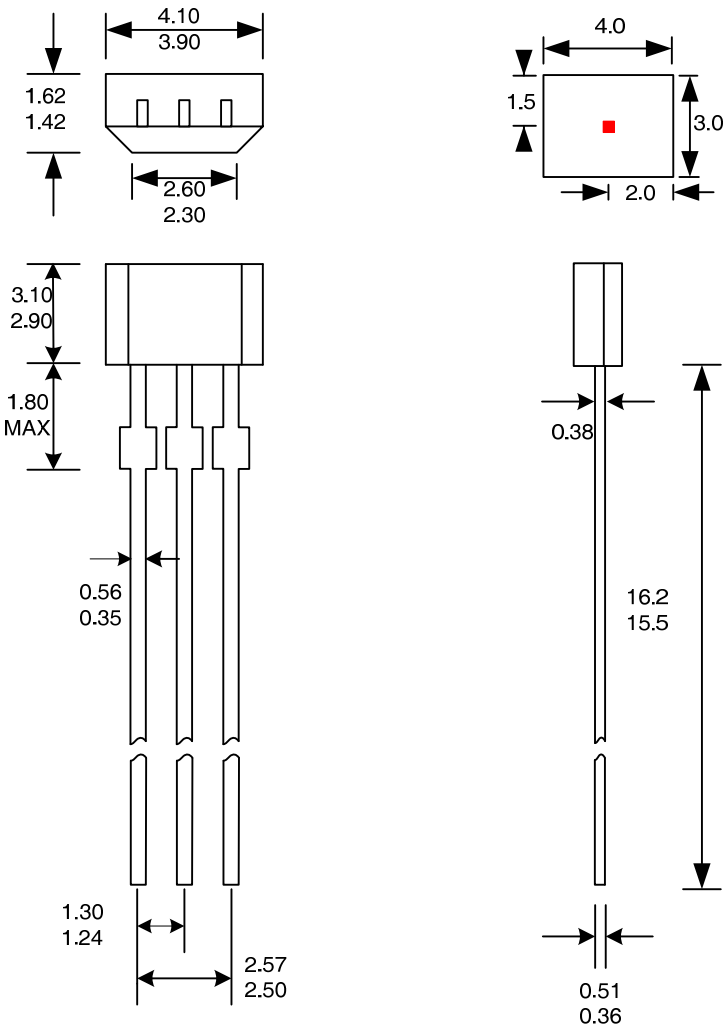
Most applications do not require this C_L filtering capacitor.

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

Mechanical Dimensions

3-Terminal
UA Package

Dimension:mm



Notes:

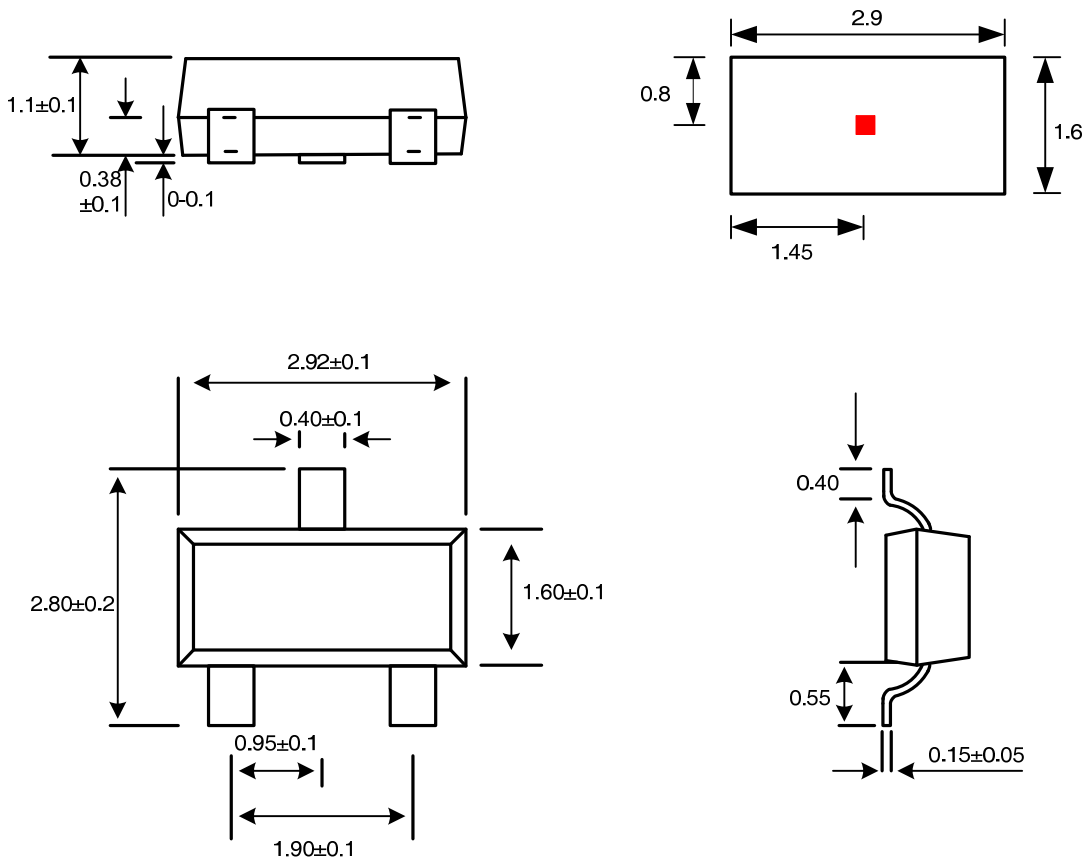
1. *Exact body and lead configuration at vendor's option within limits shown.*
2. *Height does not include mold gate flash.*

Where no tolerance is specified, dimension is nominal.

Mechanical Dimensions

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.