Unipolar Hall Effect Switches

FEATURES

- 3.8 to 40V supply voltage
- High transient voltage protection
- 40mA sinking capability
- 3-pin SIP, 3-pin SOT89 and SOT23-3 packages are available
- RoHs compliant

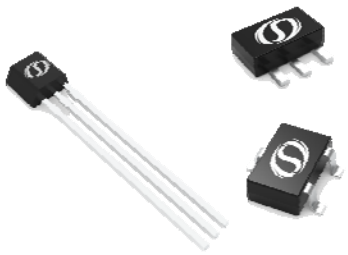
APPLICATIONS

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

DESCRIPTION

The SC113X Hall-Effect switch series is monolithic integrated circuits with tighter magnetic specifications, designed to operate continuously over extended temperatures to +150 ℃, and are more stable with both temperature and supply voltage changes. The negative compensation slope is optimized to match the negative temperature coefficient of low-cost magnets.

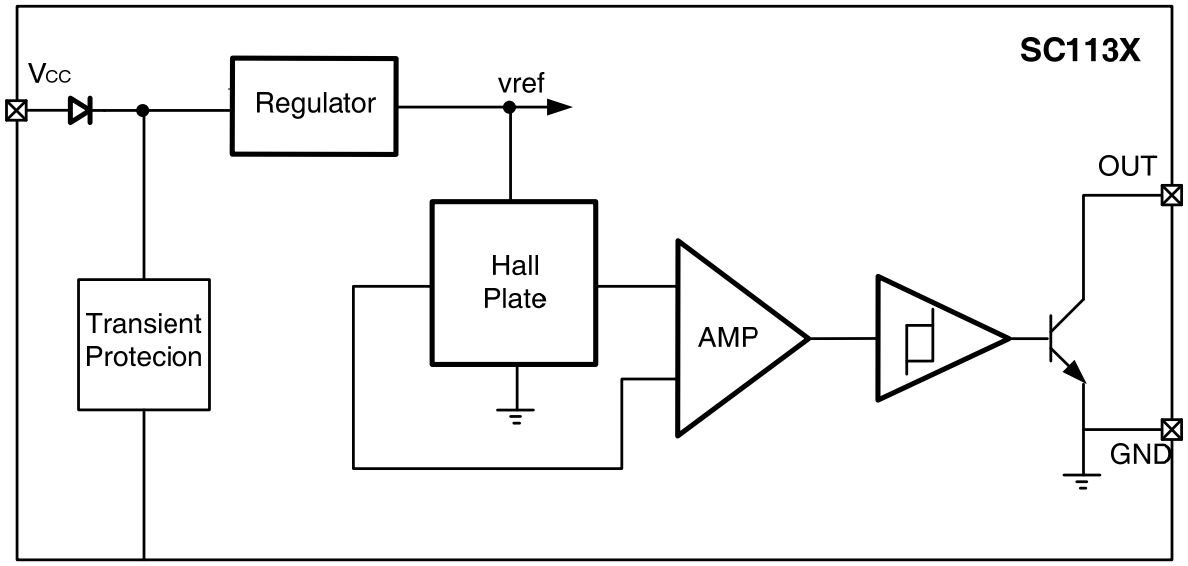
Each device includes a voltage regulator for operation with supply voltages of 3.8 to 40V volts, quadratic Hall-voltage generator, temperature compensation circuitry, small-signal amplifier, Schmitt trigger, and an open-collector output to sink up to 40mA.



CONTENTS

BLOCK DIAGRAM

The circuit includes Hall generator, amplifier and Schmitt-Trigger on one chip. The internal reference provides the supply voltage for the components. A magnetic field perpendicular to the chip surface induces a voltage at the Hall probe. This voltage is amplified and switches as a Schmitt-Trigger with open-collector output. A protection diode against reverse power supply is integrated.

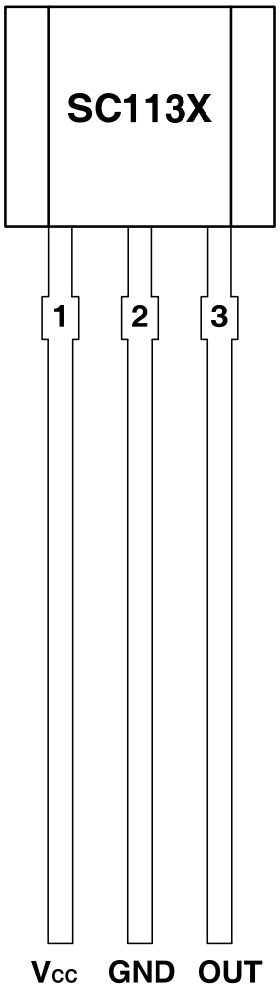


ORDERING INFORMATION

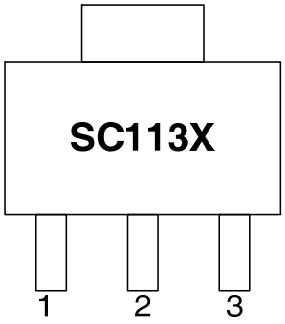
Part Number	Packing	Mounting	Ambient, T_A	B_{OP}(TYP.)	B_{rp}(TYP.)
SC1133UA	Bulk,1000 pieces/Bag	SIP3	-40℃ to 150℃	+8.0mT	+5.5mT
SC1133SO-N	Reel,3000 pieces/Reel	SOT-23		-8.0mT	-5.5mT
SC1134UA	Bulk,1000 pieces/Bag	SIP3	-40℃ to 150℃	+12.0mT	+9.5mT
SC1134BU	Reel,1000 pieces/Reel	SOT89			
SC1134SO-N	Reel,3000 pieces/Reel	SOT23-3		-12.0mT	-9.5mT
SC1138UA	Bulk,1000 pieces/ Bag	SIP3	-40℃ to 150℃	+25.0mT	+20.0mT
SC1138SO-N	Reel,3000 pieces/Reel	SOT-23		-25.0mT	-20.0mT

TERMINAL DESCRIPTION

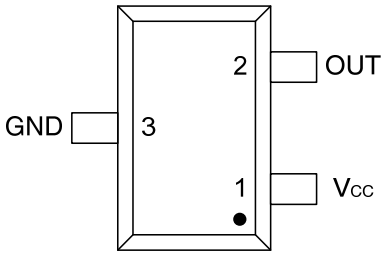
3-Terminal SIP
UA Package
(Top View)



3-Terminal SOT89
BU Package
(Top View)



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



Terminal			Type	Description
Name	Number			
	UA/BU	SO		
VCC	1	1	PWR	3.8V ~ 40 V power supply
GND	2	3	Ground	Ground terminal
OUT	3	2	Output	Open-drain output. The open drain requires a pull-up resistor

Absolute Maximum Ratings

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

Parameter	Symbol	Min.	Max.	Units
Power supply voltage	V_{CC}	-40(2)	60	V
Output terminal voltage	V_{OUT}	-0.5	60	V
Output terminal current sink	I_{SINK}	0	50	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.

(2) Ensured by design.

ESD PROTECTION

Human Body Model (HBM) tests according to: standard AEC-Q100-002.

Parameter	Symbol	Limit Values		Units
		Min.	Max.	
ESD-Protection	V_{ESD}	-2	2	KV

OPERATING CHARACTERISTICS

over operating free-air temperature range (V_{CC} =5V, unless otherwise noted)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
V_{CC}	Operating voltage (1)	$T_J < T_{J\,(Max.)}$	3.8	--	40	V
V_{CCR}	Reverse supply voltage	T_A=25℃	-40	--	--	V
I_{CC}	Operating supply current	V_{CC}=3.8 to 40 V	--	4.0	10	mA
I_{QL}	Off-state leakage current	Output Hi-Z	--	--	1	μA
V_{SAT}	Output saturation voltage	I_Q=20mA, T_A=25℃	--	--	300	mV
t_r	Output rise time	R1=1Kohm Co=20pF	--	--	1.5	μS
t_f	Output fall time	R1=1Kohm Co=20pF	--	--	1.5	μS
Magnetic Characteristics						
f_{BW}	Bandwidth		--	--	100	kHz
SC1133 +8.0/+5.5mT						
B_{OP}	Operated point	T_A=25℃	5.5	8.0	11.5	mT(2)
B_{RP}	Release point		1.5	5.5	10.0	mT
B_{HYS}	Hysteresis	B_{OP} - B_{RP}	--	2.5	--	mT
SC1134 +12.0/+9.5mT						
B_{OP}	Operated point	T_A=25℃	9.5	12.0	16.5	mT
B_{RP}	Release point		5.5	9.5	14.0	mT
B_{HYS}	Hysteresis	B_{OP} - B_{RP}	--	2.5	--	mT
SC1138 +25.0/+20.0mT						
B_{OP}	Operated point	T_A=25℃	20.5	25	29.5	mT
B_{RP}	Release point		14.5	20.0	25.5	mT
B_{HYS}	Hysteresis	B_{OP} - B_{RP}	--	5.0	--	mT

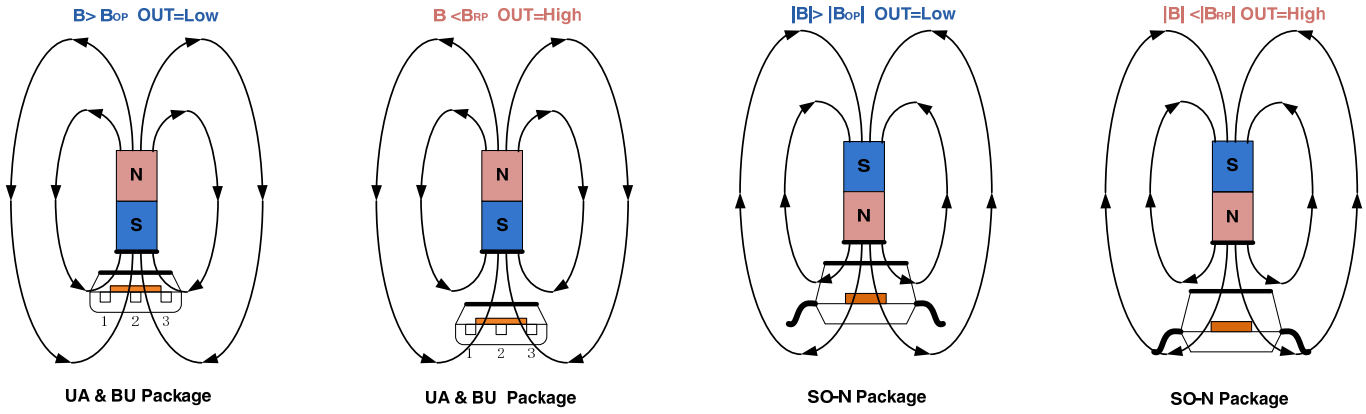
(1) Maximum voltage must be adjusted for power dissipation and junction temperature, see Thermal Characteristics

(2) 1mT=10Gs

FUNCTION DESCRIPTION

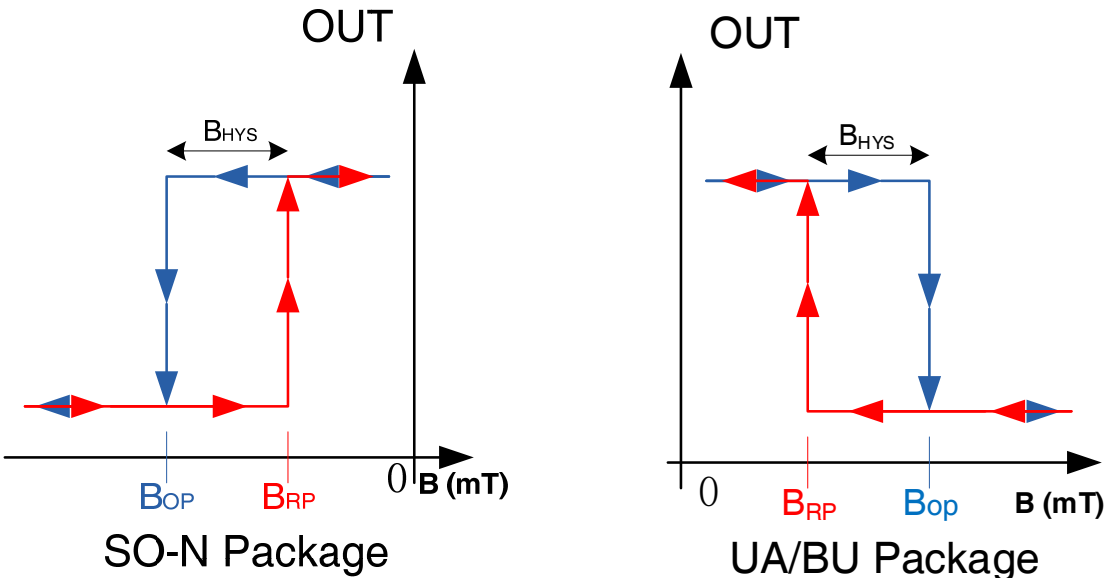
Field Direction Definition

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

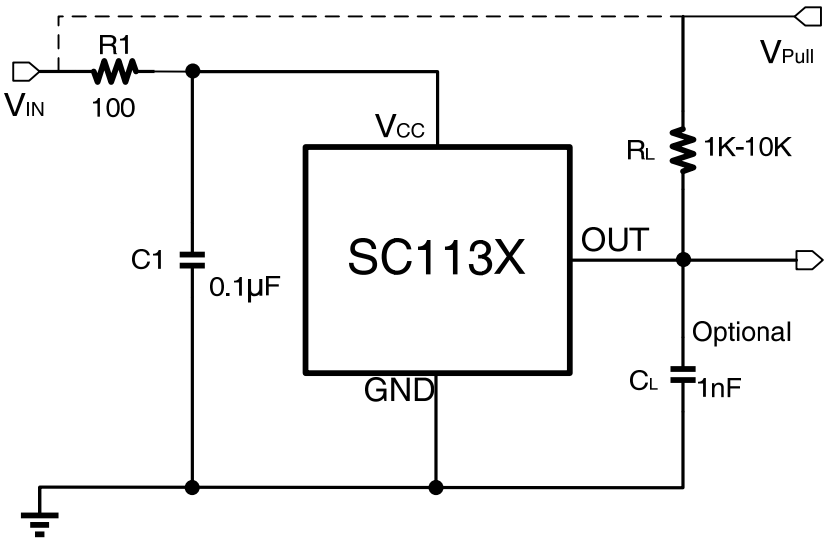


Transfer Function

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 SC113X 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 shunt C1 capacitors to the ground near the chip V_{CC} 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.

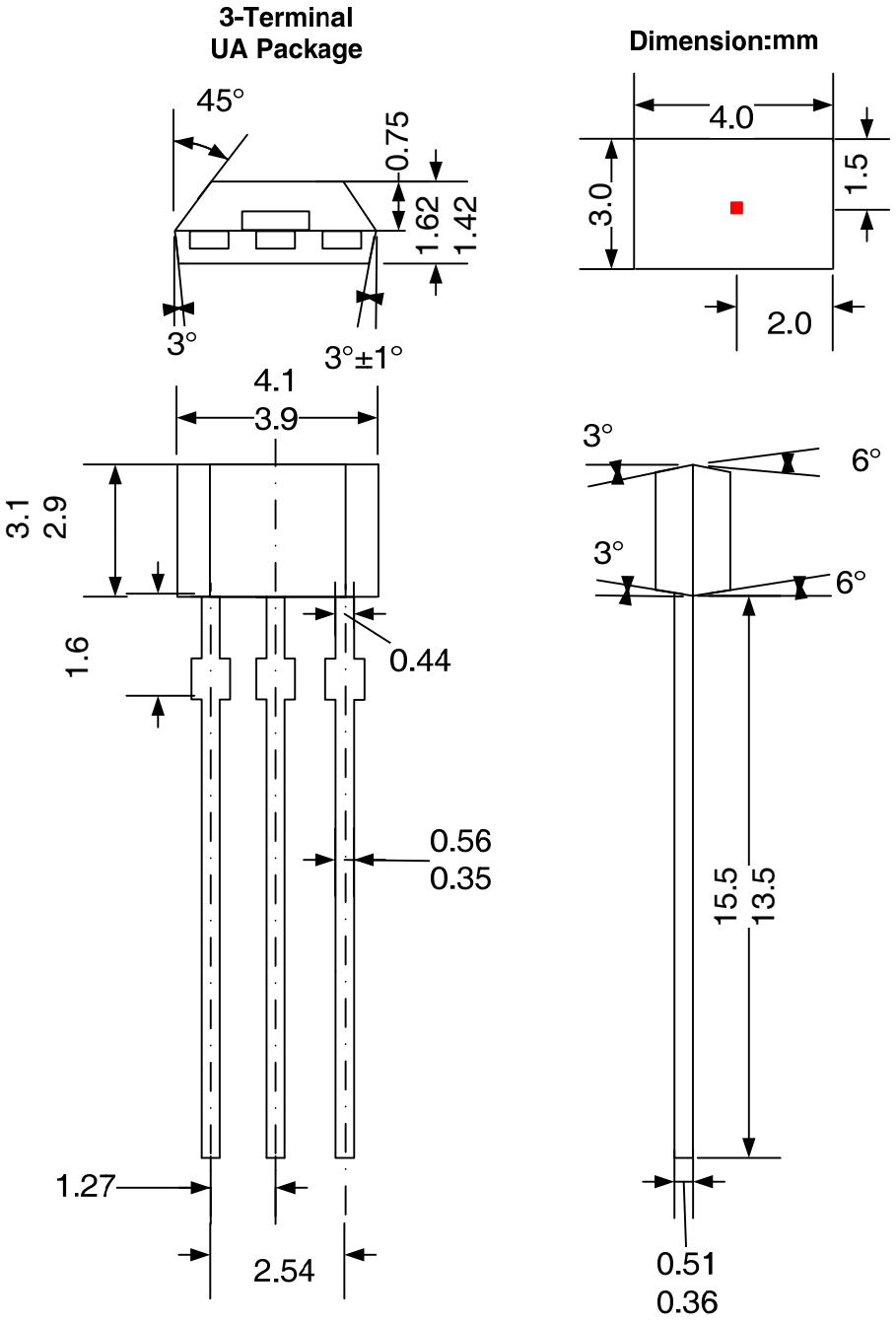
Select a value for C_L based on the system bandwidth specifications as:

$$C_L = \frac{1}{2\pi \times R \times f\ (Hz)}$$

The output stage of the SC113X device is Open collector NPN tube which provides a load capacity of 20mA.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 R_L for faster switching.

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

PACKAGE INFORMATION(TO-92S-B1)

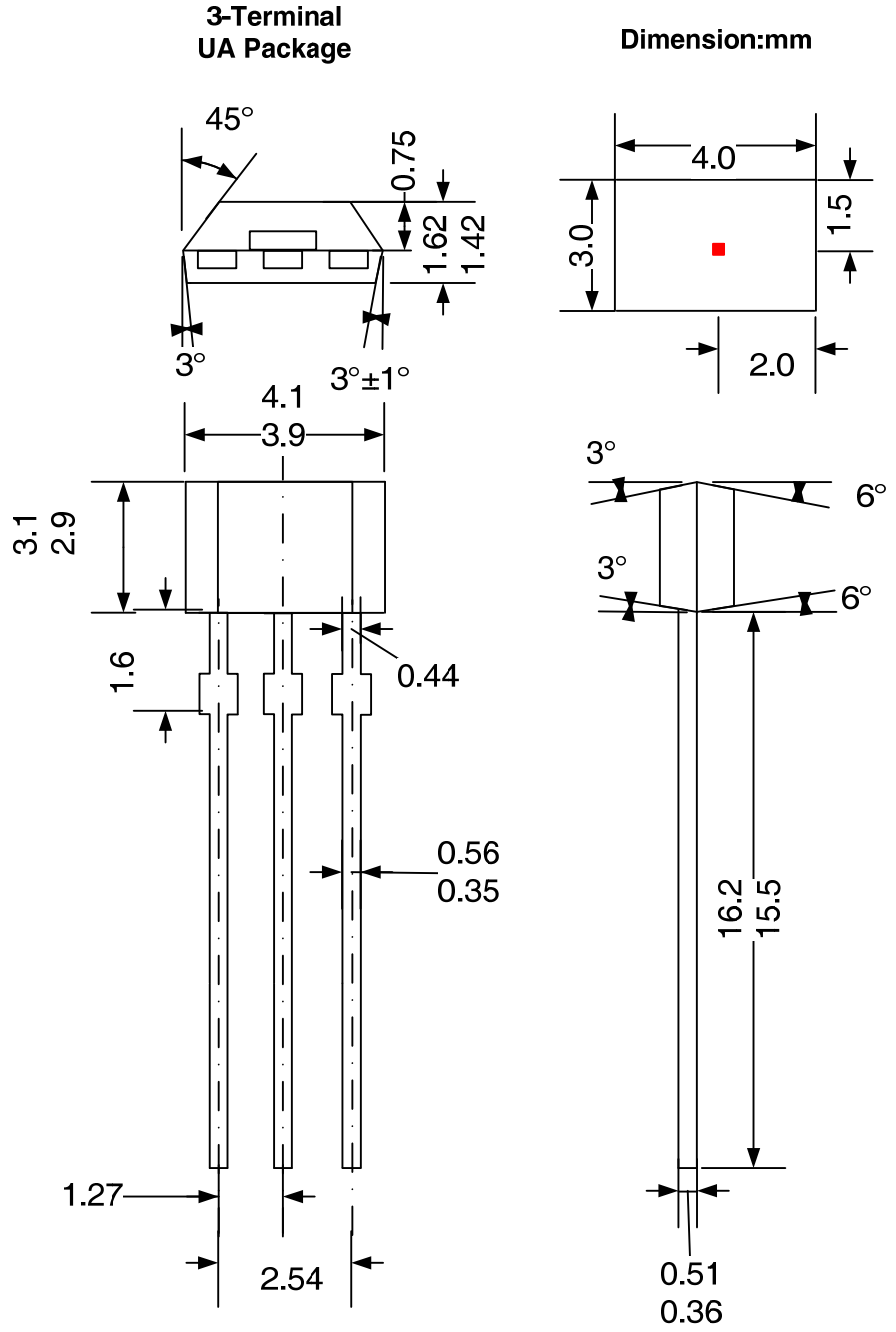


Notes:

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.

PACKAGE INFORMATION(TO-92S-B2)



Notes:

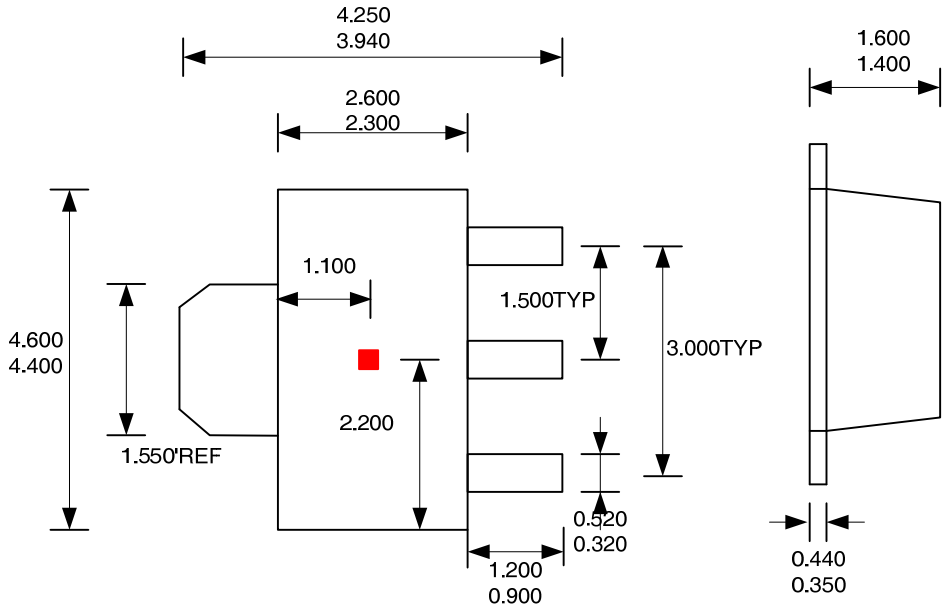
1. *Exact body and lead configuration at vendor's option within limits shown.*
2. *Height does not include mold gate flash.*

Where no tolerance is specified, dimension is nominal.

PACKAGE INFORMATION(BU)

3-Terminal
BU Package

Dimention: mm



Notes:

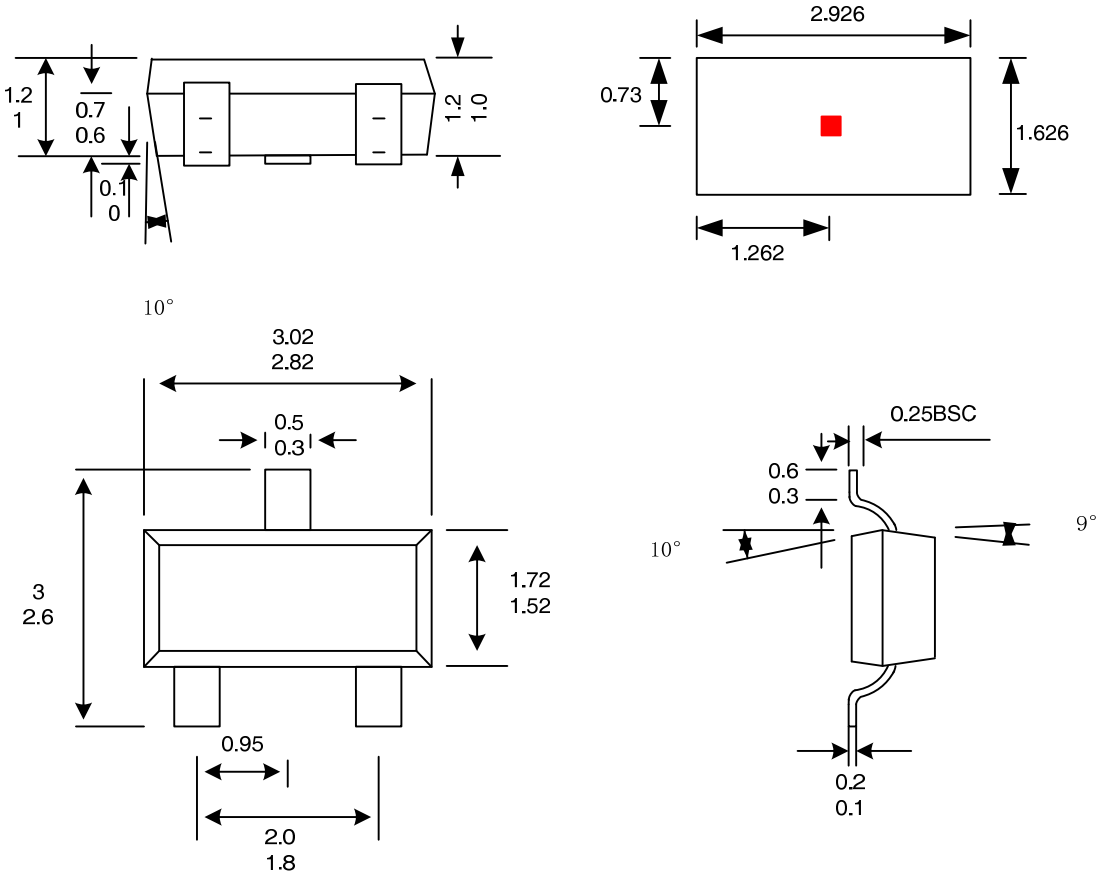
1. *Exact body and lead configuration at vendor's option within limits shown.*
2. *Height does not include mold gate flash.*

Where no tolerance is specified, dimension is nominal.

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.

REVISON HISTORY

Revision	Date	Description
Rev.0.1	2014-05-06	Preliminary datasheet
Rev.2.3	2018-07-05	The final revision of old datasheet
Rev.A/1.0	2020-11--19	Unified datasheet format
Rev.A/1.1	2024-05--08	Update file header to SC113X