
Analog Output Linear Hall Sensor

1. Features

- 3.3 to 10.5V wide supply voltage range
- Output voltage proportional to magnetic flux density
- Analog output linear Hall sensor
- Fast power-on time
- -40°C to 150°C wide ambient temperature range
- Resistant to mechanical stress
- PKG Type
 - TO-92S(UA)
 - SOT23-3L(SO)
 - SOT89-3(BU)

2. Applications

- Electric Vehicle handlebars
- Angular sensing
- Position sensing
- Over-current detection
- BLDC motor current monitoring
- Weigh and liquid level sensing

3. Description

The SC400X are high performance small versatile linear Hall-Effect devices which are operated by the magnetic field from a permanent magnet or an electromagnet. The radiometric output voltage is set by the supply voltage and varies in proportion to the strength of the magnetic. The quiescent output voltage of the SC4002 and SC4003 is 50% of the supply voltage, The sensitivity of 5V power supply is 3.125mV/Gs, 5.0mV/Gs, and 2.5 mV/Gs, respectively.

The SC4002/SC4003/SC4005 provide low-noise output with temperature compensation. The linear position sensor ICs have an operating temperature range of -40°C to 150°C, appropriate for industrial environments These devices are available in a 3-pin SIP / SOT23 / SOT89 packages. Both packages are lead(Pb) free, with 100% matte tin lead frame plating.

Not to scale

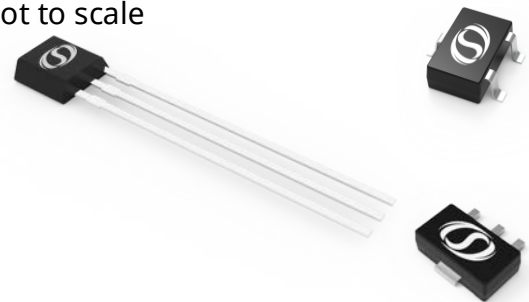


Fig.1 TO-92S(Left) & SOT23-3L & SOT89-3(Right) PKG Outline

CONTENTS

1. Features	1	9. Operating Characteristics	6
2. Applications	1	10. Block Diagram	7
3. Description	1	11. Function Description	7
4. Terminal Configuration	3	12. Typical Application	8
5. Ordering Information	4	13. Package Information “SOT23-3L(SO)”	9
6. Absolute Maximum Ratings	5	14. Package Information “TO-92S(UA)”	10
7. ESD Protection	5	15. Package Information “SOT89-3(BU)”	11
8. Thermal characteristics	5	16. Revision History	12

4. Terminal Configuration

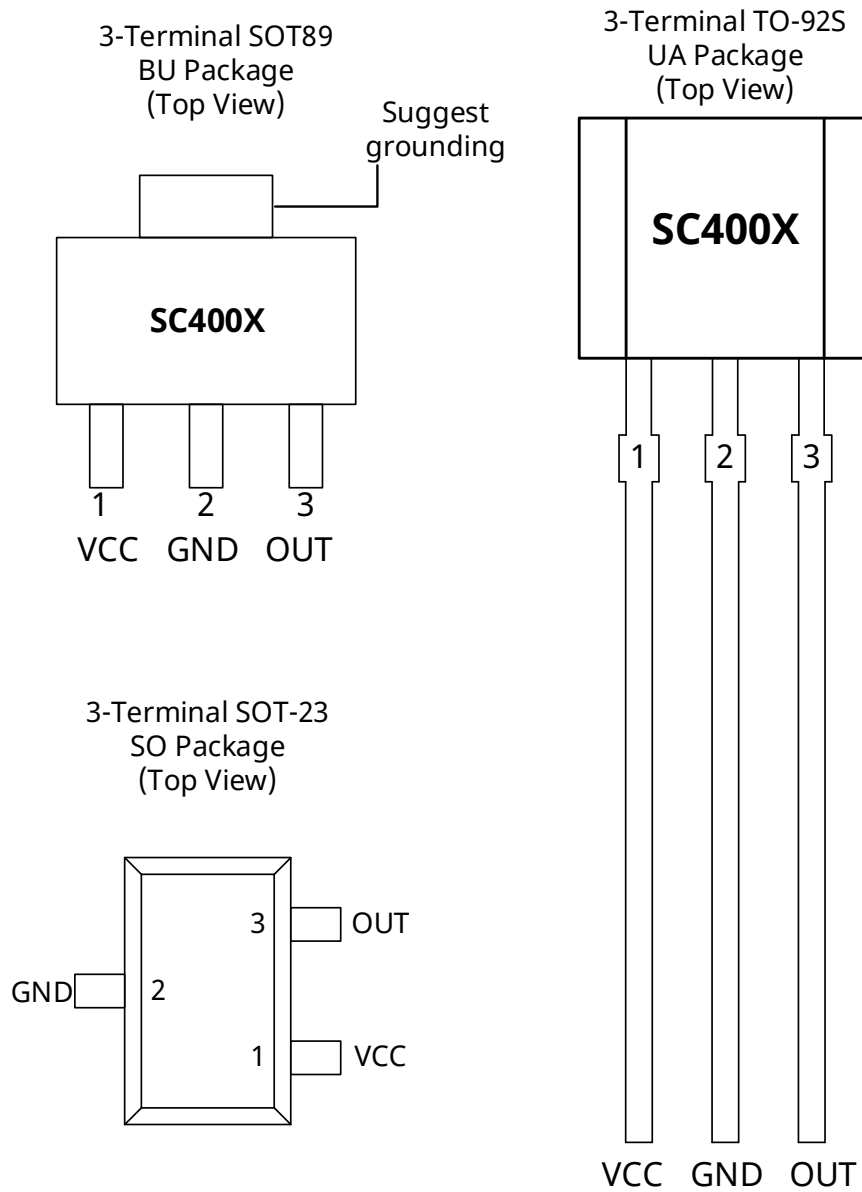


Fig.2 SOT23-3L & SOT89-3(Left) and TO-92S(Right)Pin Description

Name	SOT89-3 & SOT23-3L & TO-92S	
	Number	Description
VDD	1	Power supply
GND	2	Ground
OUT	3	Output

5. Ordering Information

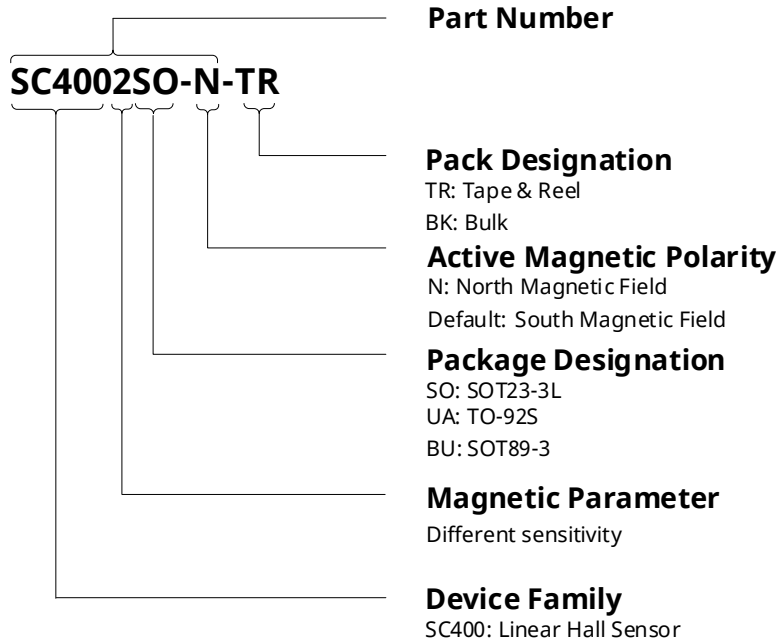
Ordering Information	Sens(mV/Gs) ⁽¹⁾	Ambient, T _A (°C)	Package	Packing	Quantity
SC4002UA-BK ⁽²⁾	3.125	-40-150	TO92S-UA	BK	1000
SC4002BU-TR	3.125	-40-150	SOT89-3	TR	3000
SC4002SO-N-TR	3.125	-40-150	SOT23-3L	TR	3000
SC4003UA-BK	5	-40-150	TO92S-UA	BK	1000
SC4005UA-BK	2.5	-40-150	TO92S-UA	BK	1000
SC4005CUA-BK-Q	2.5	-40-150	TO92S-UA	BK	1000

Note:

(1) This sensitivity data is available under 5v application conditions

(2) TR: Tape & Reel; BK: Bulk

Order information format description



6. Absolute Maximum Ratings

Symbol	Parameter	Notes	Min.	Max.	Units
V_{CC}	Power End Withstand Voltage	$B = 0\text{mT}$, $T_A = 25^\circ\text{C}$	-0.5	30.0	V
V_{OUT}	Output Withstand Voltage	-	-0.3	30.0	V
I_{CC}	Supply Current	$V_{CC} = 5.0\text{V}$, $B = 0\text{mT}$	-	20	mA
I_{OUT}	Current Output	-	-	2	mA
T_A	Operating Temperature Range	-	-40	150	$^\circ\text{C}$
T_J	Storage Temperature Range	-	-50	165	$^\circ\text{C}$
T_{STG}	Maximum Junction Temperature	-	-65	175	$^\circ\text{C}$

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 ANSI/ESDA/JEDEC JS-001 standard ⁽¹⁾	-4	+4	kV
V_{ESD_CDM}	CDM	Refer to ANSI/ESDA/JEDEC JS-002 standard ⁽²⁾	-750	+750	V

Note:

(1) JEDEC document JEP155 states that 4000V HBM allows safe manufacturing using standard ESD control processes.

(2) JEDEC document JEP157 states that 740V CDM allows safe manufacturing using standard ESD control processes.

8. Thermal characteristics

Symbol	Parameter	Test conditions	Value ⁽¹⁾	Units
$R_{\theta JA}$	TO-92S	Single-layer PCBs, JEDEC 2s2p and 1s0p are defined in JESD 51-7 and JESD 51-3	177	$^\circ\text{C/W}$
	SOT23-3L		313	
	SOT89-3		250	

Note:

(1) The maximum operating voltage must meet the requirements of power consumption and junction temperature, refer to thermal characteristics

9. Operating Characteristics

($T_A = -40^\circ\text{C} \sim 105^\circ\text{C}$, $V_{DD} = 2.5\text{V} \sim 5.5\text{V}$, unless otherwise noted)

Symbol	Parameter	Test Condition	Min	TYP	MAX	Unit
V_{CC}	Operating Voltage	$T_J < T_{J(\text{Max})}$	3.3	5.0	10.5	V
I_{CC}	Operating Current	$V_{CC} = 5.0\text{V}$, $T_A = 25^\circ\text{C}$	-	4.5	10.0	mA
R_L	Output load resistance	OUT to VCC	2	-	-	k Ω
$V_{\text{OUT(H)}}$	Output Voltage Range	$T_A = 25^\circ\text{C}$, $B = 1000\text{Gs}$	2	-	-	V
$V_{\text{OUT(L)}}$		$T_A = 25^\circ\text{C}$, $B = -1000\text{Gs}$	4.8	4.9	-	V
$V_{\text{OUT(Q)}}$	Static Output Voltage	$V_{CC} = 3.3\text{V}$, $B = 0\text{Gs}$, $T_A = 25^\circ\text{C}$	-	0.1	0.2	V
		$V_{CC} = 5\text{V}$, $B = 0\text{Gs}$, $T_A = 25^\circ\text{C}$	1.55	1.65	1.75	V
S	Sensitivity	$V_{CC} = 5\text{V}$, $T_A = 25^\circ\text{C}$	1.9	2.4	2.9	mV/Gs
		$V_{CC} = 3.3\text{V}$, $T_A = 25^\circ\text{C}$	1.1	1.4	1.7	mV/Gs
		SC4005, $V_{CC} = 3.3\text{V}$, $T_A = 25^\circ\text{C}$	1.7	1.875	2	mV/Gs
		SC4002, $V_{CC} = 5\text{V}$, $T_A = 25^\circ\text{C}$	2.75	3.125	3.5	mV/Gs
		SC4003, $V_{CC} = 5\text{V}$, $T_A = 25^\circ\text{C}$	4.0	5.0	6.0	mV/Gs
		SC4005, $V_{CC} = 5\text{V}$, $T_A = 25^\circ\text{C}$	2.0	2.5	3.0	mV/Gs
Lin	Linearity	-	-1	-	+1	%
ΔSens	Sensitivity	$T_A = -40^\circ\text{C}$ to 105°C	-10	-	+10	%
T_{RESP}	Step response time	The delayed output signal reaches 90%	-	1	-	μs

10. Block Diagram

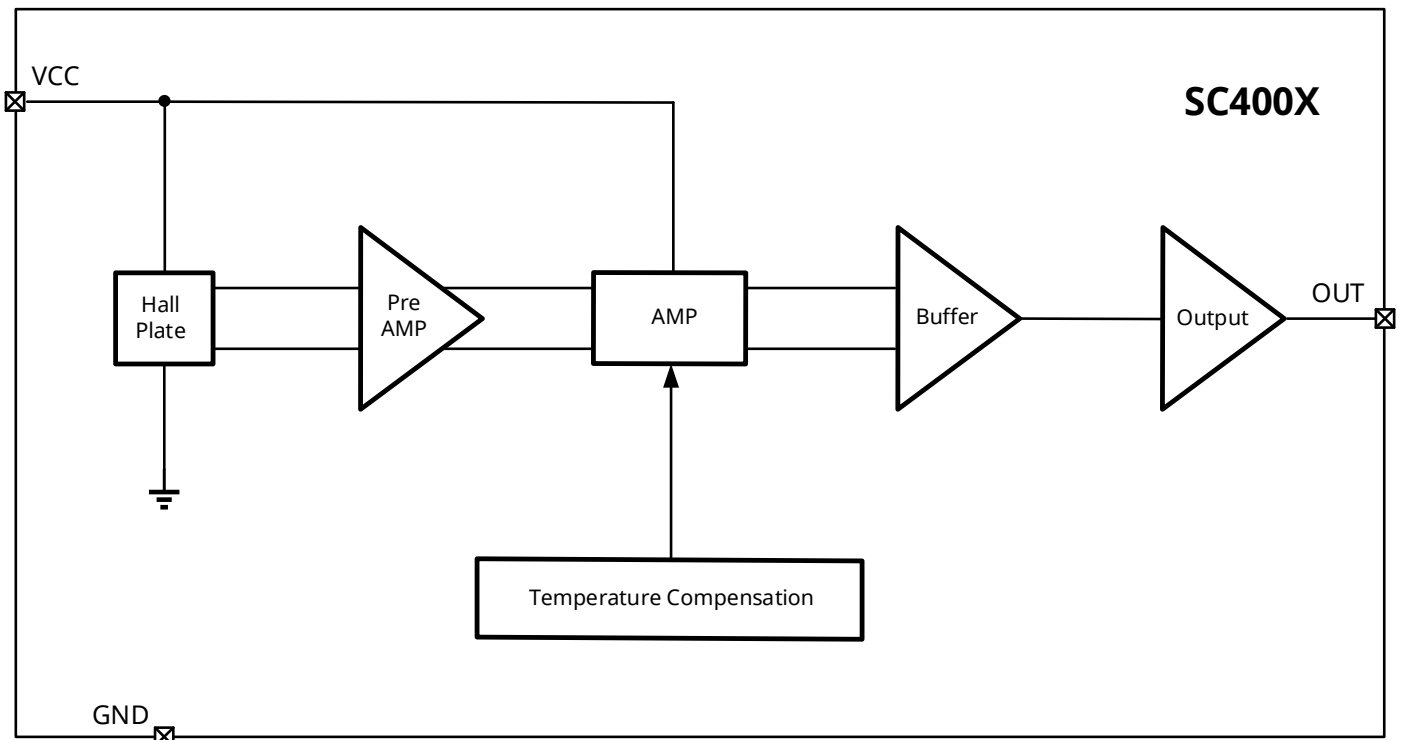


Fig.3 Block Diagram

11. Function Description

Magnetic Field Direction Definition: TO-92S(UA) & SOT89-3(BU) package, the magnetic field S pole is defined as the positive magnetic field on the chip screen; SOT23-3L(SO) package, the magnetic field S pole is defined as a negative magnetic field on the marking.

Quiescent Output Voltage (V_{OUTQ}): Quiescent Output Voltage indicates the output voltage of the IC when there is no magnetic field.

Sensitivity(S)

$$Sens = [VOUT(B1) - VOUT(B2)] / (B1 - B2)$$

When the South Pole magnetic field perpendicular to the chip tagged side approaches, the output voltage increases proportionally, until it reaches supply voltage. Conversely, when the North Pole magnetic field perpendicular to the chip tagged side approaches, the output voltage decreases proportionally, until it reaches ground level. Sensitivity is defined as the specific value of the output voltage variation and the magnetic field variation, commonly in mV/Gs or mV/mT.

12. Typical Application

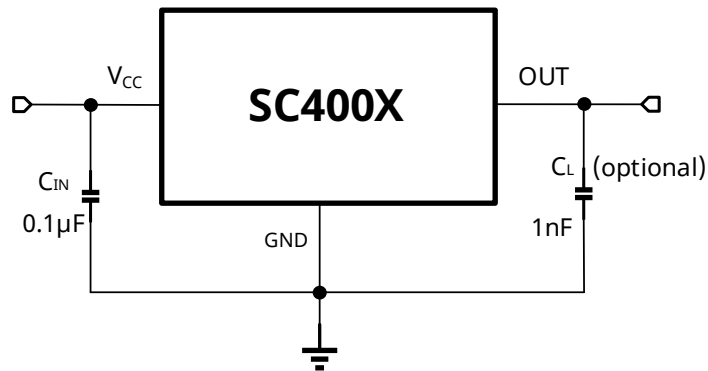


Fig.4 Typical Application Circuit

The static (zero field strength) output voltage of the chip, V_Q , is usually half of the power supply voltage in the operating voltage range of the power supply. When the S-pole magnetic field perpendicular to the screen surface of the chip increases, the output voltage of the chip increases proportionally. In contrast, when the N electrode is applied to the silkscreen surface of the chip, the output voltage drops synchronously in the same proportion. These devices are available in three magnetic sensitivities, 3.125mV/Gs, 5.0mV/Gs, and 2.5 mV/Gs.

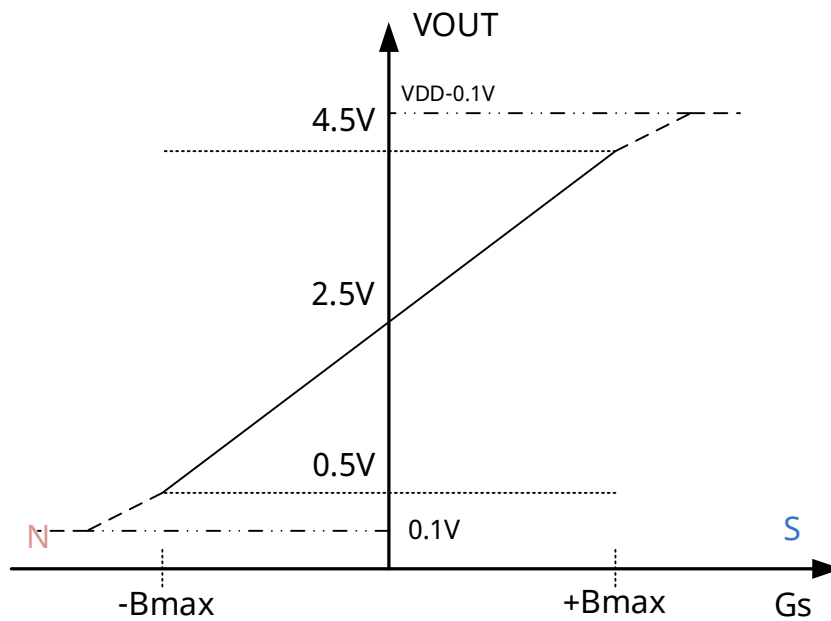
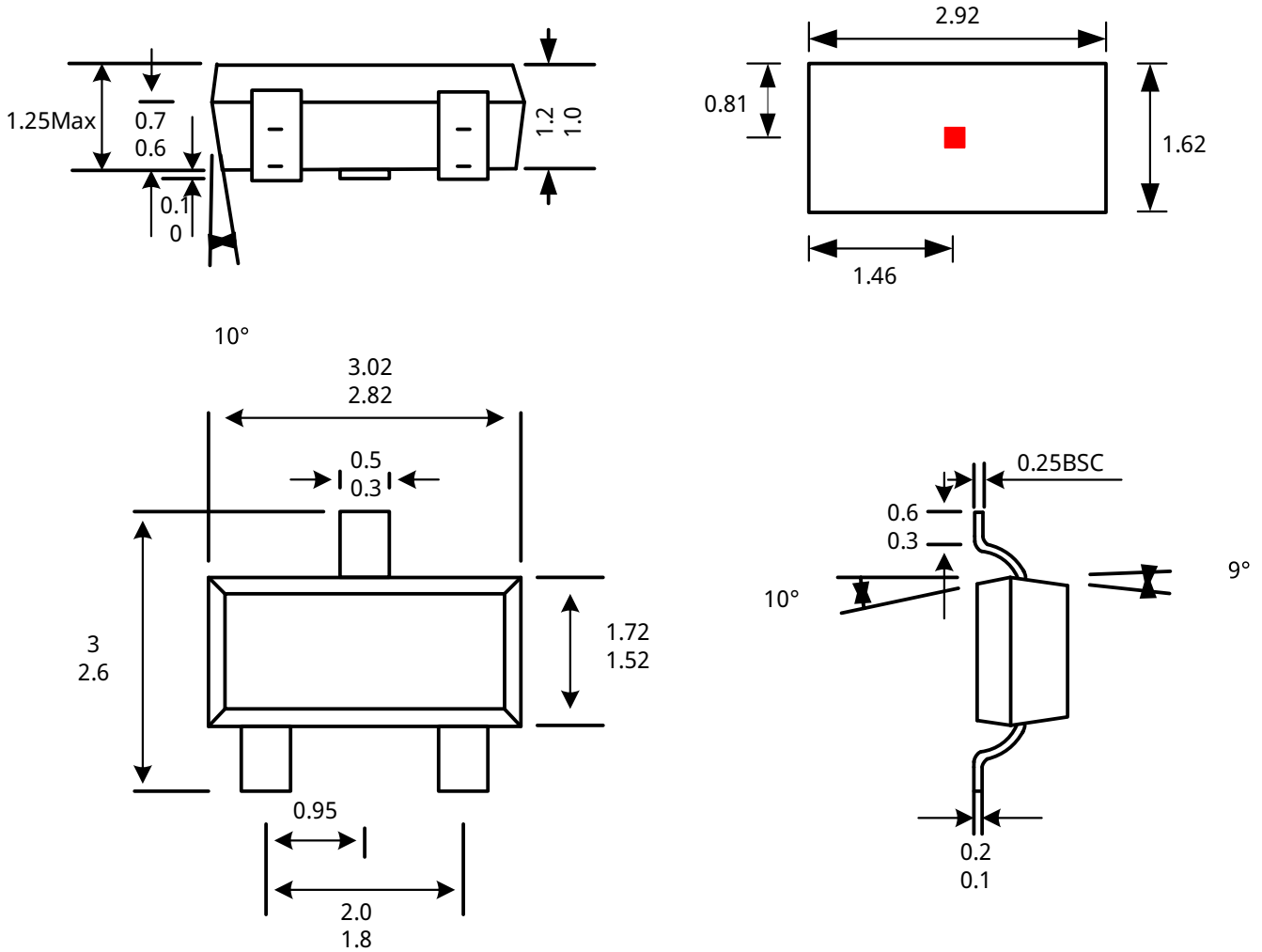


Fig.5 Output function

13. Package Information “SOT23-3L(SO)”

**3-PIN
SOT23-3L
Package**

Unit: mm

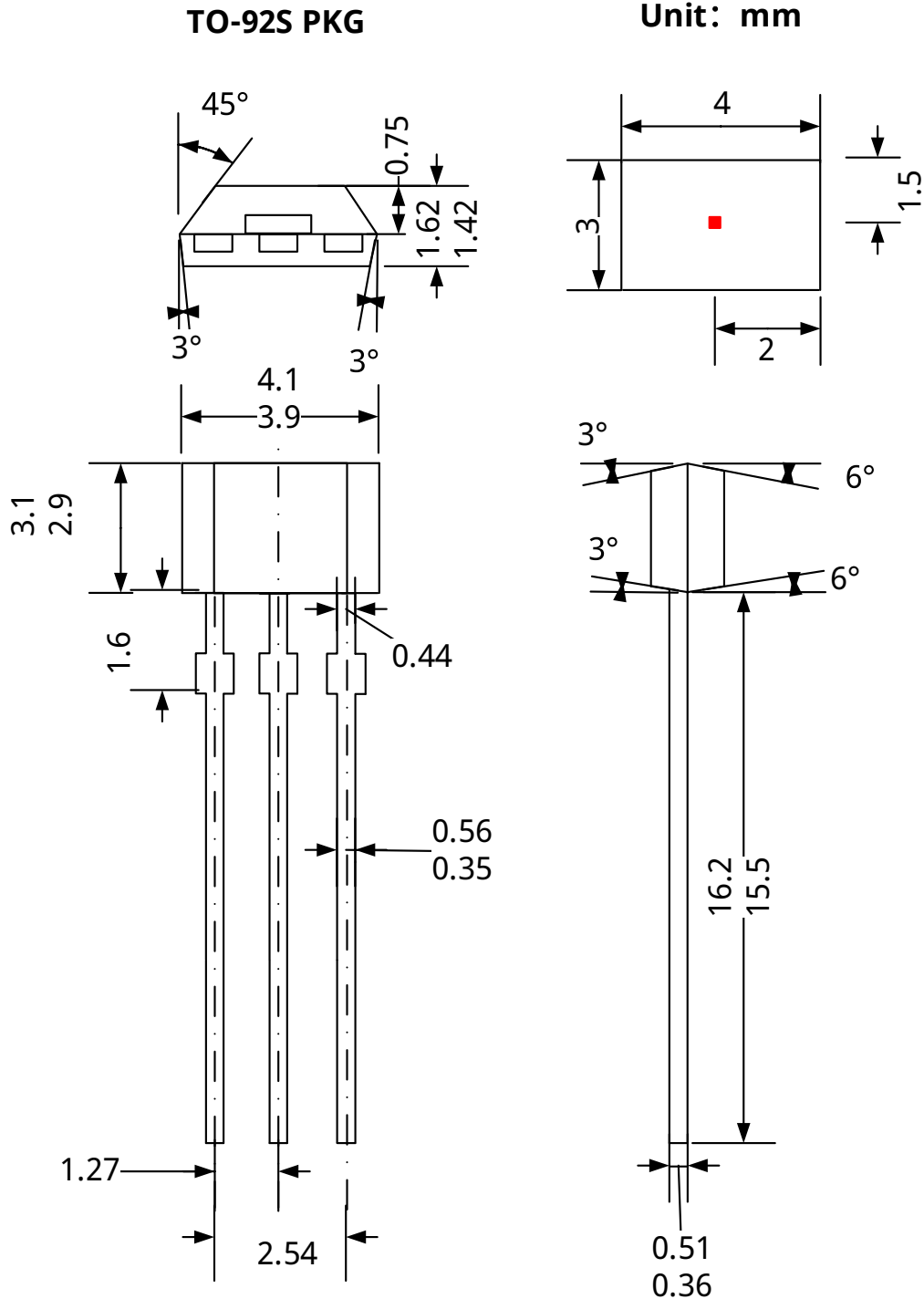


Notes:

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.

14. Package Information “TO-92S(UA)”



Notes:

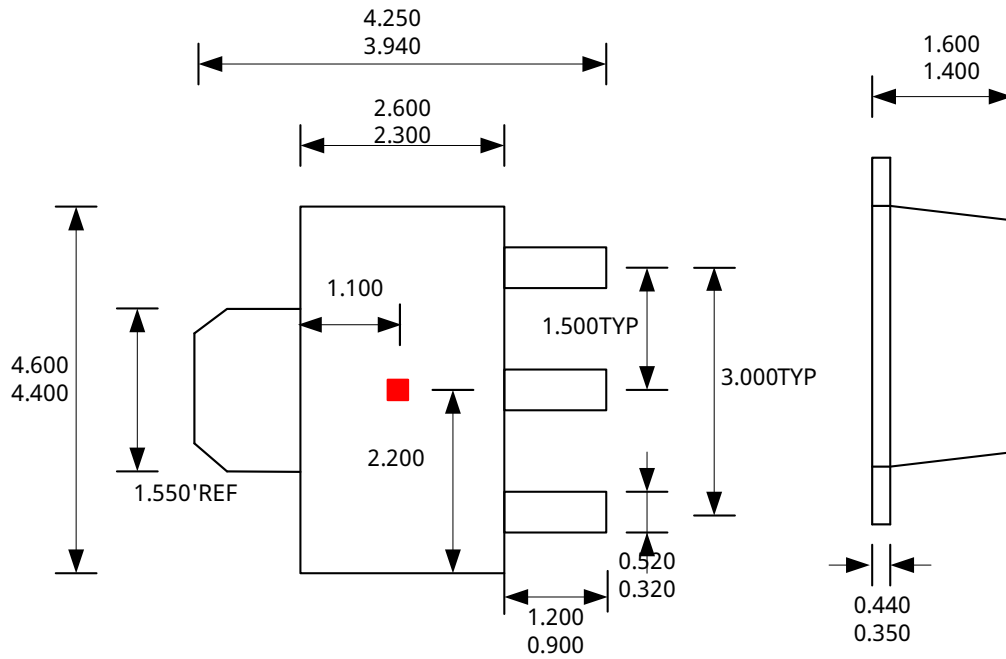
1. Exact body and lead configuration at vendor's option within limits shown.
2. Height does not include mold gate flash.

Where no tolerance is specified, dimension is nominal.

15. Package Information “SOT89-3(BU)”

TO-92S PKG

Unit: 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.

16. Revision History

Revision	Date	Description
Rev.0.1	2019-07-06	Preliminary datasheet
Rev.A1.0	2020-11-19	Unified datasheet format
Rev.A1.1	2024-07-08	Add SOT23-3L PKG
Rev.A1.2	2024-11-27	Add order information