

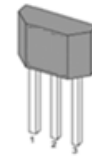
CH44xP / CHA44xP

Hall-Effect Latching Sensor Family with Excellent Magnetic Parameter Performance Over Temperature and Internal Pull-Up Resistor

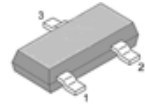
Features

- AEC-Q100 automotive qualified for CHA44XP
- Build in 10K ohm output pull up resistor
- Multiple Sensitivity Options (BOP / BRP):
+15 / -15 Gs; +30 / -30 Gs; +45 / -45 Gs; +120 / -120 Gs;
- Chopper stabilization for stable operate points throughout operating temperature range
- Operation supply voltage 2.5V to 5.5V
- Absolute maximum supply 24V
- Resistant to physical stress
- Output short-circuit protection
- Operation from unregulated supply
- Reverse-battery protection -22V
- Freewheeling protection
- Solid-state reliability
- Wide Operating temperature range: -40 to 150 °C
- Package options: TO-92S, SOT-23, SOT-89 and DFN

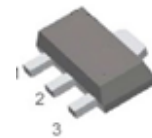
Package



TO-92S



SOT23-3L

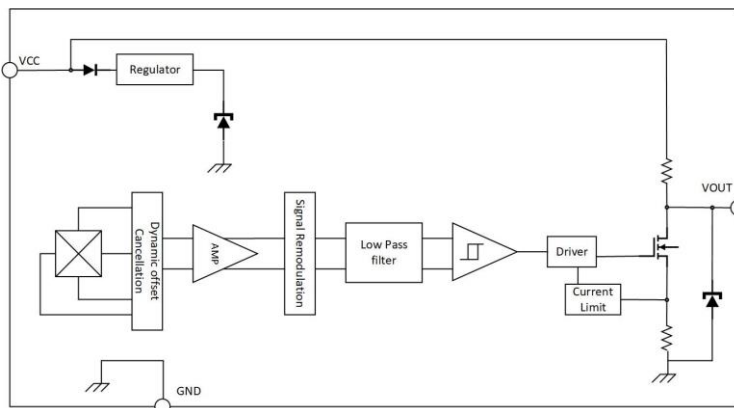


SOT89-3L
(by request)

Application

- Car seat motor position sensor
- BLDC motor commutation
- Car window position sensor
- Flow-rate sensing
- Motor and fan control
- Tiny motor position sensor

Functional Block Diagram



Description

The CHA44XP/CH44XP Hall-effect sensor is extremely temperature-stable and stress-resistant sensor ICs, well suited for operation over extended temperature ranges from -40°C to 150°C. Superior high temperature performance is possible through dynamic offset cancellation, which reduces the residual offset voltage normally caused by device over-molding, temperature dependencies, and thermal stress.

The device includes a voltage regulator, Hall-voltage generator, small-signal amplifier, chopper stabilization, Schmitt trigger, and a short circuit protected open-drain output to sink up to 25 mA. It also integrated internal clamps against supply/output transients; output short circuits protection; reverse battery conditions. The advantage of operating down to 2.5V is that the device can used in 2.5V applications or with additional external resistance in series with the supply pin for greater protection against high-voltage transient events.

The CHA44XP/CH44XP series is latch Hall switch. For the latch mode, there are also invert polarity devices. Normally a south pole of sufficient strength turns on the output; However, for invert polarity devices, a north pole of sufficient strength turns on the output.

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1. Product Family Members

1.1 CHA44XP is automotive class product family

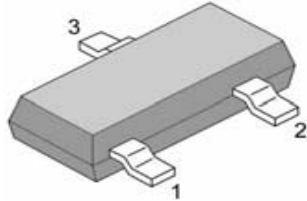
Part Number	Marking ID	Description
CHA441PSR	A441P	Bipolar latching, Hall-effect digital sensor IC, SOT-23-3L package, tape and reel packing (3000 units per reel)
CHA441PTB	A441P	Bipolar latching, Hall-effect digital sensor IC, flat, TO-92S package, bulk packing (1000 units per bag)
CHA441PER	A441P	Bipolar latching, Hall-effect digital sensor IC, SOT-89-3L package, tape and reel packing (1000 units per reel)
CHA442PSR	A442P	Bipolar latching, Hall-effect digital sensor IC, SOT-23-3L package, tape and reel packing (3000 units per reel)
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CHA441PNSR	P441N	Bipolar latching, Hall-effect digital sensor IC, SOT-23-3L package, tape and reel packing (3000 units per reel)
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1.2 CH44XP is industry class product family

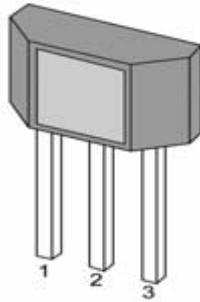
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2. Pin Definitions and Descriptions

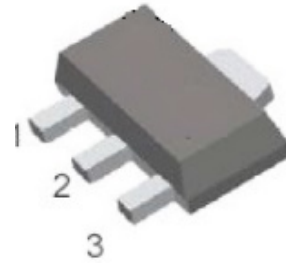
SOT-23-3L (S)	TO-92S (T)	SOT-89-3L (E)	Name	Type	Function
1	1	1	VDD	Supply	Supply Voltage pin
2	3	3	OUT	Output	Output pin with pull up resistor
3	2	2	GND	Ground	Ground pin



SOT23-3L



TO-92S



SOT89-3L

3. Absolute Maximum Ratings

Parameter	Symbol	Min	Max	Units
Supply Voltage	V_{DD}	-	24	V
VDD Reverse Voltage VDD	V_{RDD}	-22		V
Supply Current	I_{DD}	-	20	mA
Output Voltage	V_{OUT}	-0.3	24	V
Output Current	I_{OUT}	-	25	mA
Operating Ambient Temperature	T_A	-40	150	°C
Storage Temperature	T_S	-50	150	°C
Junction temperature	T_J	-50	165	°C
Magnetic Flux	B	No Limit		Gauss

Note: Exceeding the absolute maximum ratings may cause permanent damage. Exposure to absolute-maximum- rated conditions for extended periods may affect device reliability.

4. ESD Protections

Parameter	Value	Unit
All pins ¹⁾	+/-8000	V
All pins ²⁾	+/-200	V
All pins ³⁾	+/-750	V

1) HBM (Human Body Mode) according to AEC-Q100-002

2) MM (Machine Mode) according to AEC-Q100-003

3) CDM (charged device mode) according to AEC-Q100-011

5. Function Description

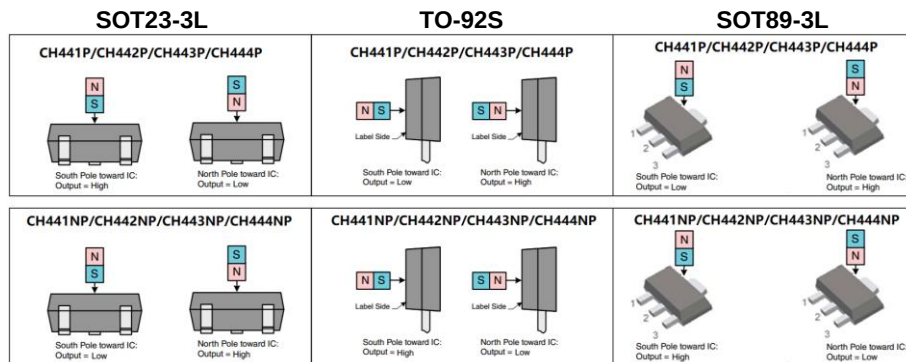
The CHA44XP/CH44XP exhibits latch magnetic switching characteristics. Therefore, it requires both south and north poles to operate properly.

The device behaves as a latch with symmetric operating and release switching points ($BOP=|BRP|$). This means magnetic fields with equivalent strength and opposite direction drive the output high and low.

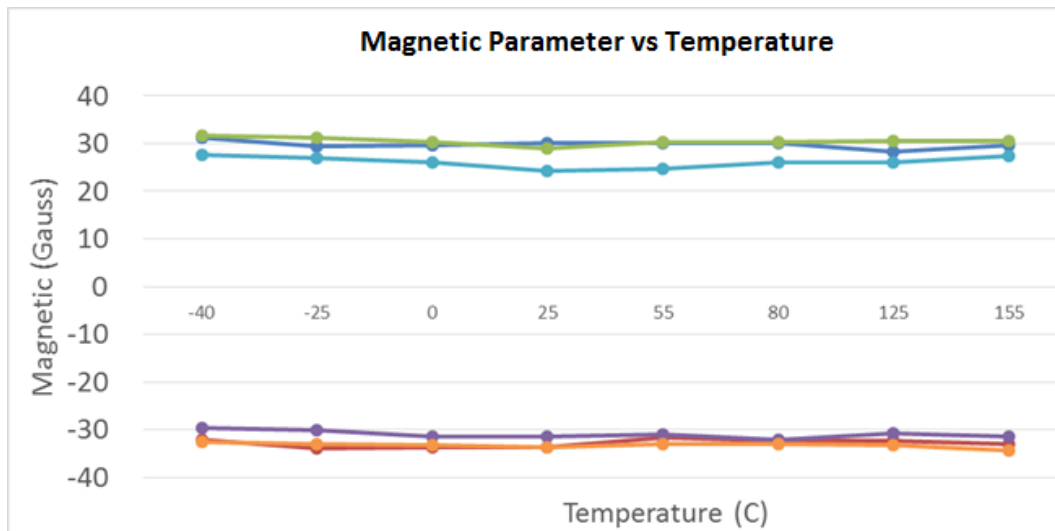
Removing the magnetic field ($B \rightarrow 0$), it keeps the output in its previous state. This latching property defines the device as a magnetic memory.

A magnetic hysteresis BHYST keeps BOP and BRP separated by a minimal value. This hysteresis prevents output oscillation near the switching point.

6. Magnetic Activation



7. Temperature Characteristics



8. Parameters Specification

(VCC=3.3V supply, T_A= -40 °C to 150 °C except where otherwise specified.)

Symbol	Parameter	Test Condition	Min	Typ.	Max	Units
V _{DD}	Supply voltage	-40 °C to 150 °C	2.5	-	5.5	V
I _{DD}	Supply Current	V _{DD} = 3.3V	-	1.6	3	mA
V _{ZSUPPLY}	Supply Zener Clamp Voltage	I _{CC} = 7 mA; T _A = 25°C	24			V
V _{ZOUT}	Output Zener Clamp Voltage	I _{OUT} = 3mA	24			V
V _{RCC}	Reverse Battery Zener				-22	V
I _{RCC}	Reverse Battery Current	V _{CC} = -22 V	-5			mA
F _C	Chopping Frequency			500		KHz
t _{PO}	Power-On Time	T _A = 25°C; C _{LOAD} = 10 pF	—	—	30	μs
V _{DSon}	Output saturation voltage	at 20mA, Gauss >BOP	-	-	0.4	V
I _{OFF}	Output Leakage Current	V _{OUT} = 24 V; Switch state = Off	-	-	10	μA
I _{OUT(lim)}	Output Current Limit	Short-Circuit Protection	30	—	90	mA
T _R	Output rise time	R _{LOAD} = 820 Ω, C _{LOAD} = 10 pF;	-	0.2	2	μs
T _F	Output fall time	R _{LOAD} = 820Ω, C _{LOAD} = 10 pF;	-	0.1	2	μs
T _d	Output delay Time	B=Brp-100G to Bop+100G in 1us		13	25	μs
R _{PU}	Internal pull up resistor			10		Kohm
R _{TH}	Thermal resistance: SOT-23-3L TO-92S SOT-89-3L	-	-	303	-	°C /W
			-	203	-	°C/W
			-	230	-	°C/W
F _{SW} ⁽²⁾	Maximum Switching Frequency		20	30		KHz
T	Operating temperature	-	-40	-	150	°C
T _S	Storage temperature:	-	-40	-	150	°C
CHA441P/CH441P						
B _{OP}	Magnetic operating point	T _A =-40°C to 150°C	6	15	36	Gauss
B _{RP}	Magnetic release point	T _A =-40°C to 150°C	-36	-15	-6	Gauss
B _{HYST}	Magnetic hysteresis window BOP-BRP	T _A =-40°C to 150°C	12	30	50	Gauss
B ₀	Magnetic offset; B ₀ = (BOP + BRP) / 2	T _A =-40°C to 150°C	-15	0	15	Gauss
CHA442P/CH442P						
B _{OP}	Magnetic operating point	T _A =-40°C to 150°C	10	30	50	Gauss
B _{RP}	Magnetic release point	T _A =-40°C to 150°C	-50	-30	-10	Gauss
B _{HYST}	Magnetic hysteresis window BOP-BRP	T _A =-40°C to 150°C	35	60	85	Gauss
B ₀	Magnetic offset; B ₀ = (BOP + BRP) / 2	T _A =-40°C to 150°C	-15	0	15	Gauss
CHA443P/CH443P						
B _{OP}	Magnetic operating point	T _A =-40°C to 150°C	20	45	75	Gauss

B_{RP}	Magnetic release point	$T_A = -40^{\circ}\text{C}$ to 150°C	-75	-45	-20	Gauss
B_{HYST}	Magnetic hysteresis window $ BOP - BRP $	$T_A = -40^{\circ}\text{C}$ to 150°C	70	90	110	Gauss
B_O	Magnetic offset; $B_O = (BOP + BRP) / 2$	$T_A = -40^{\circ}\text{C}$ to 150°C	-20	0	20	Gauss
CHA444P/CH444P						
B_{OP}	Magnetic operating point	$T_A = -40^{\circ}\text{C}$ to 150°C	70	120	170	Gauss
B_{RP}	Magnetic release point	$T_A = -40^{\circ}\text{C}$ to 150°C	-170	-120	-70	Gauss
B_{HYST}	Magnetic hysteresis window $ BOP - BRP $	$T_A = -40^{\circ}\text{C}$ to 150°C	180	240	300	Gauss
B_O	Magnetic offset; $B_O = (BOP + BRP) / 2$	$T_A = -40^{\circ}\text{C}$ to 150°C	-30	0	30	Gauss
CHA441NP/CH441NP						
B_{OP}	Magnetic operating point	$T_A = -40^{\circ}\text{C}$ to 150°C	-36	-15	-6	Gauss
B_{RP}	Magnetic release point	$T_A = -40^{\circ}\text{C}$ to 150°C	6	15	36	Gauss
B_{HYST}	Magnetic hysteresis window $ BOP - BRP $	$T_A = -40^{\circ}\text{C}$ to 150°C	15	30	50	Gauss
B_O	Magnetic offset; $B_O = (BOP + BRP) / 2$	$T_A = -40^{\circ}\text{C}$ to 150°C	-15	0	15	Gauss
CHA442NP/CH442NP						
B_{OP}	Magnetic operating point	$T_A = -40^{\circ}\text{C}$ to 150°C	-50	-30	-10	Gauss
B_{RP}	Magnetic release point	$T_A = -40^{\circ}\text{C}$ to 150°C	10	30	50	Gauss
B_{HYST}	Magnetic hysteresis window $ BOP - BRP $	$T_A = -40^{\circ}\text{C}$ to 150°C	35	60	85	Gauss
B_O	Magnetic offset; $B_O = (BOP + BRP) / 2$	$T_A = -40^{\circ}\text{C}$ to 150°C	-15	0	15	Gauss
CHA443NP/CH443NP						
B_{OP}	Magnetic operating point	$T_A = -40^{\circ}\text{C}$ to 150°C	-75	-45	-20	Gauss
B_{RP}	Magnetic release point	$T_A = -40^{\circ}\text{C}$ to 150°C	20	45	75	Gauss
B_{HYST}	Magnetic hysteresis window $ BOP - BRP $	$T_A = -40^{\circ}\text{C}$ to 150°C	70	90	110	Gauss
B_O	Magnetic offset; $B_O = (BOP + BRP) / 2$	$T_A = -40^{\circ}\text{C}$ to 150°C	-18	0	18	Gauss
CHA444NP/CH444NP						
B_{OP}	Magnetic operating point	$T_A = -40^{\circ}\text{C}$ to 150°C	-180	-120	-70	Gauss
B_{RP}	Magnetic release point	$T_A = -40^{\circ}\text{C}$ to 150°C	70	120	180	Gauss
B_{HYST}	Magnetic hysteresis window $ BOP - BRP $	$T_A = -40^{\circ}\text{C}$ to 150°C	180	240	300	Gauss
B_O	Magnetic offset; $B_O = (BOP + BRP) / 2$	$T_A = -40^{\circ}\text{C}$ to 150°C	-20	0	20	Gauss

(1) 1 mT = 10 Gauss

(2) Bandwidth describes the fastest changing magnetic field that can be detected and translated to the output.

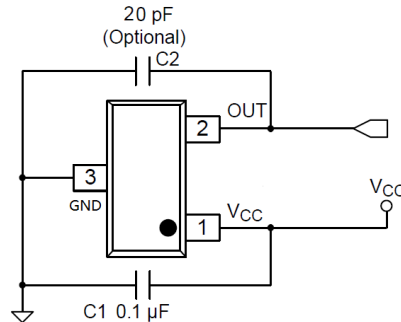
NOTICE

The magnetic field strength (Gauss) required to cause the switch to change state (operate and release) will be as specified in the magnetic characteristics. To test the switch against the specified magnetic characteristics, the switch must be placed in a uniform magnetic field.

9. Application Information

9.1 Typical Application

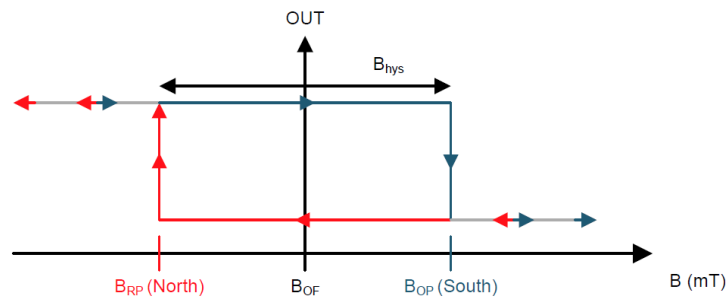
It is recommended that an external capacitor C1 is connected to the supply. This can reduce the noise injected into the device. Normal 0.1µF is suggested.



Typical Application Circuit

9.2 Device Output

If the device is powered on with a magnetic field strength between BRP and BOP, then the device output is indeterminate and can either be Hi-Z or Low. If the field strength is greater than BOP, then the output is pulled low. If the field strength is less than BRP, then the output is released.



9.3 Output Stage

The CH44XP output stage uses an open-drain NMOS with a 10K ohm internal pull up resistor. Select a value for C2 based on the system bandwidth specifications as shown in [Equation 1](#).

$$2 \times f_{BW} \text{ (Hz)} < \frac{1}{2\pi \times R_{PU} \times C2} \quad (1)$$

Most applications do not require this C2 filtering capacitor.

9.4 Protection Circuits

The CH44XP device is fully protected against overcurrent and reverse-supply conditions.

9.5 Overcurrent Protection (OCP)

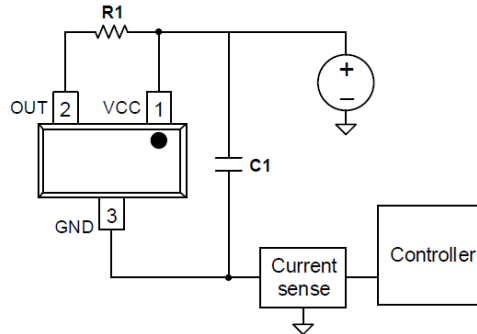
An analog current-limit circuit limits the current through the FET. The driver current is clamped to IOCP. During this clamping, the rDS(on) of the output FET is increased from the nominal value.

9.6 Reverse Supply Protection

The CH44XP device is protected in the event that the VCC pin and the GND pin are reversed (up to -22 V). There is 10K ohm resistor will conduct some small current at this case, but it will not damage the device.

9.7 Alternative Two-Wire Application

For systems that require minimal wire count, the device output can be connected to VCC through a resistor, and the total supplied current can be sensed near the controller.



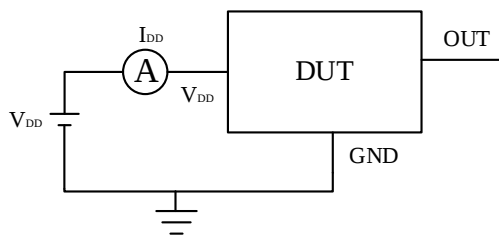
2-Wire Application

Current can be sensed using a shunt resistor or other circuitry.

10. Test Conditions

Note: DUT=Device Under Test

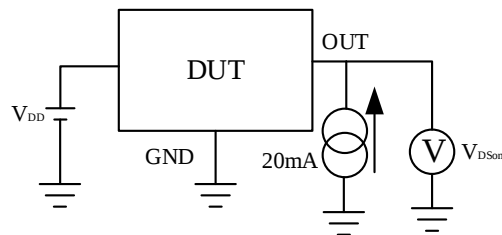
Supply Current



Note 1 - The supply current I_{DD} represents the static supply current.
OUT is left open during measurement

Note 2 - The device is put under magnetic field with $B < B_{RP}$

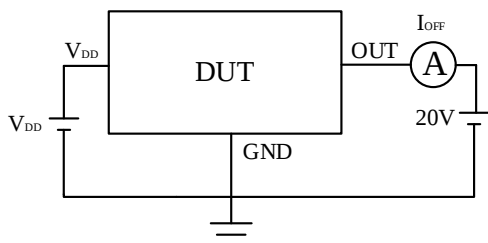
Output Saturation Voltage



Note 1 - The output saturation voltage V_{DSon} is measured at $V_{DD}=3.3\text{V}$ and $V_{DD}=20\text{V}$.

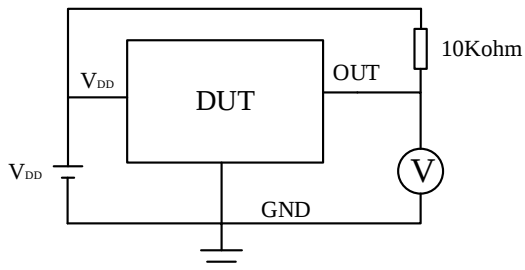
Note 2 - The device is put under magnetic field with $B > B_{OP}$

Output Leakage Current



Note 1 - The device is put under magnetic field with $B < B_{RP}$

Magnetic Thresholds

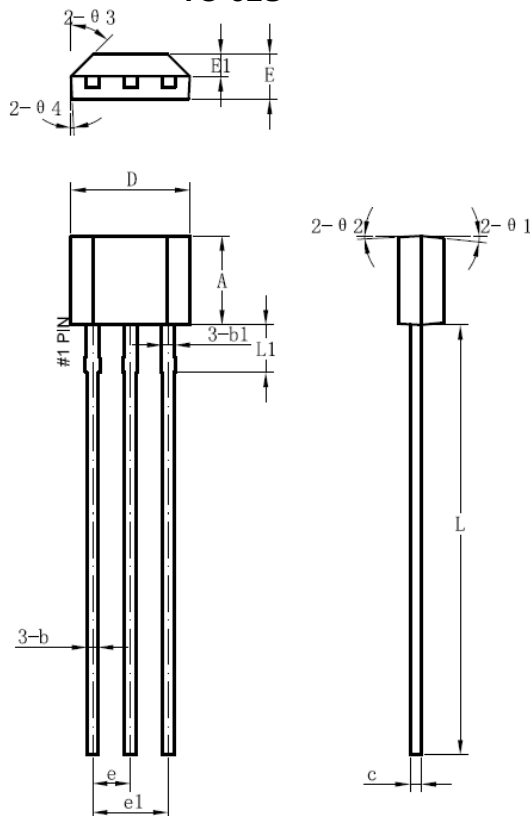


Note 1 - B_{op} is determined by putting the device under magnetic field swept from B_{RPmin} up to B_{OPmax} until the output is switched on.

Note 2 - B_{RP} is determined by putting the device under magnetic field swept from B_{OPmax} down to B_{RPmin} until the output is switched off.

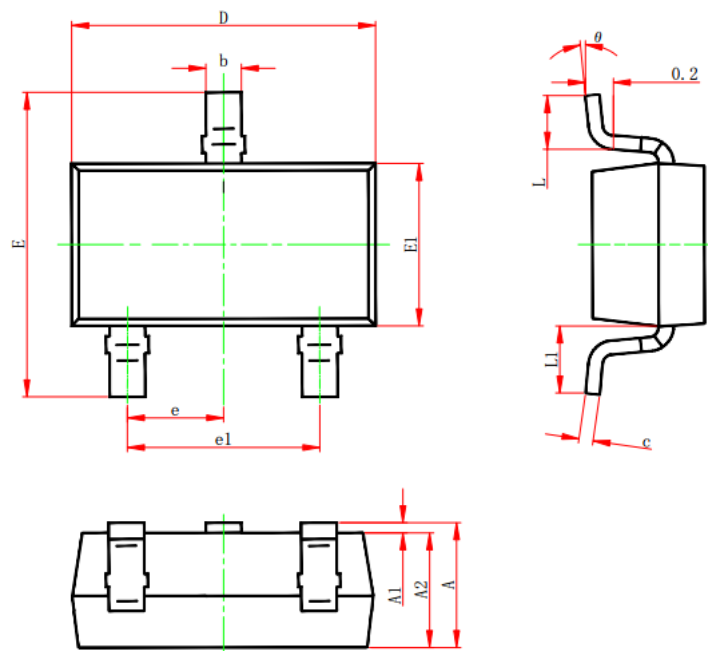
11. Package Information

Package Designator TO-92S



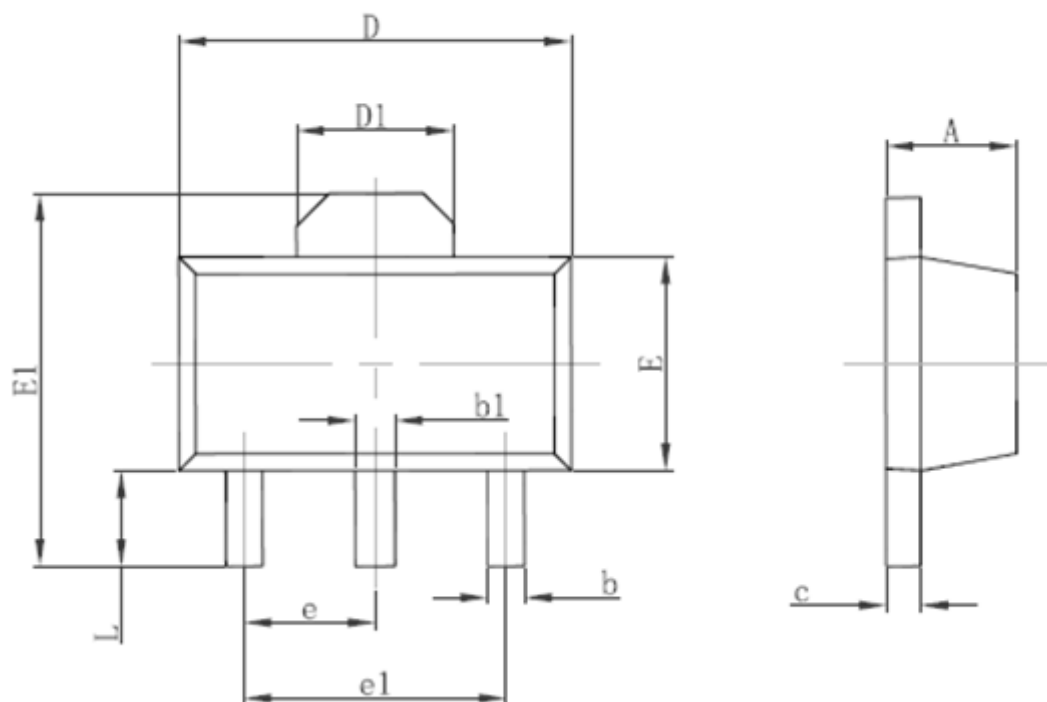
Symbol	Dimensions in Millimeters		
	Min.	Typ.	Max.
A	2.9	3	3.1
b	0.35	0.39	0.56
b1		0.44	
c	0.36	0.38	0.51
D	3.9	4	4.1
E	1.42	1.52	1.62
E1		0.75	
e		1.27	
e1		2.54	
L	13.5	14.5	15.5
L1		1.6	
$\theta 1$		6°	
$\theta 2$		3°	
$\theta 3$		45°	
$\theta 4$		3°	

Package Designator
SOT-23-3L



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950(BSC)		0.037(BSC)	
e1	1.800	2.000	0.071	0.079
L	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°

PACKAGE DESIGNATOR
SOT-89-3L



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.400	1.600	0.055	0.063
b	0.320	0.520	0.013	0.020
b1	0.400	0.580	0.016	0.023
c	0.350	0.440	0.014	0.017
D	4.400	4.600	0.173	0.181
D1	1.550 REF		0.061 REF	
E	2.300	2.600	0.091	0.102
E1	3.940	4.250	0.155	0.167
e	1.500 TYP		0.060 TYP	
e1	3.000 TYP		0.118 TYP	
L	0.900	1.200	0.035	0.047

12. Revision History

Date	Revision	Change
April 2018	1	Initial release
July 2021	1.1	Refreshed datasheet format
Dec 2021	1.2	Added a DFN package, 2mm x 2mm x 0.53mm, preliminary status
Dec 2021	1.3	Operation voltage range limited to 5.5V
Jul 2023	1.4	Update Package

13. Disclaimer

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