

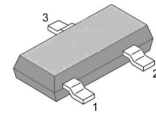
CH412/ CH412N

Open-Collector output Hall latch sensors with reverse voltage protection

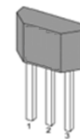
Features

- Bipolar technology
- Reverse battery protection
- 3.5V to 30V Operation voltage
- -40 °C to 150 °C Superior temperature operation
- Open-collector 20 mA output
- Small Size SOT-23, SOT-89 or TO-92S
- Solid-state reliability
- Resistant to physical stress
- Activate with small, commercially available permanent magnets

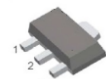
Package



SOT-23-3L

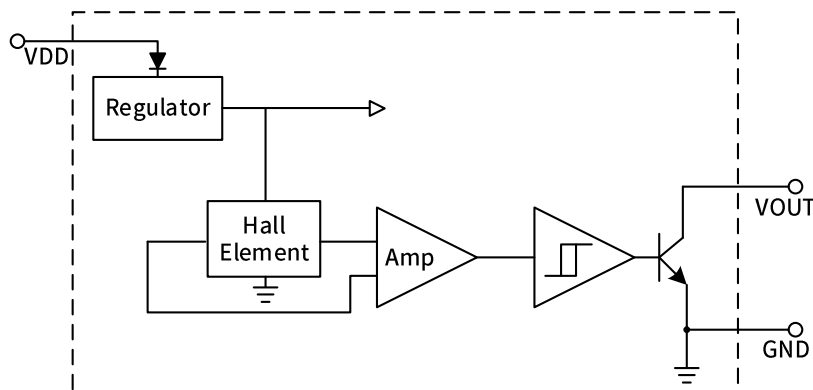


TO-92S



SOT-89-3L

Functional Block Diagram



Applications

- Brushless DC motor commutation
- Automotive, Consumer and Industrial
- Solid-state switch
- Speed measurement
- Revolution counting
- Angular position detection
- Magnetic Encoder

Description

The CH412/CH412N family is a Hall-effect latch designed in bipolar technology. The Hall IC internally includes an on-chip Hall voltage generator, a voltage regulator for operation with supply voltages of 3.5 to 30V, reverse protection diode, temperature compensation circuitry, small-signal amplifier, Schmitt trigger and an output driver; all in a single package.

It is designed to respond to alternating North and South poles. While the magnetic flux density(B) is larger than operate point (Bop), the output will be turned on (Low), the output is held until the magnetic flux density(B) is lower than release point (Brp), then be turned off (High).

Thanks to its wide operating voltage range 3.5 to 30V and extended temperature range from -40°C to +150°C, it is quite suitable for use in automotive, industrial and consumer applications.

The device is delivered in variety of packages to customers: SOT-23, SOT-89 for surface mount and TO-92S flat for through-hole mount. Both 3-lead packages are RoHS compliant.

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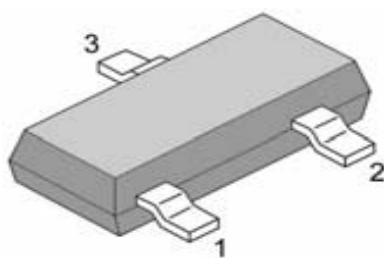
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1. Product Family Members

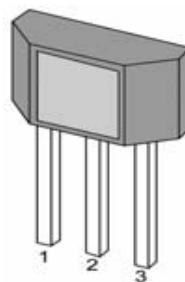
Part Number	Marking ID	Description
CH412TB	C412	Bipolar latching, Hall-effect digital sensor IC, flat, TO-92S package, bulk packing (1000 units per bag)
CH412B-A1	C412	Bipolar latching, Hall-effect digital sensor IC, flat, TO-92S-A1 package, bulk packing (1000 units per bag)
CH412B-A2	C412	Bipolar latching, Hall-effect digital sensor IC, flat, TO-92S-A2 package, bulk packing (1000 units per bag)
CH412B-B2	C412	Bipolar latching, Hall-effect digital sensor IC, flat, TO-92S-B2 package, bulk packing (1000 units per bag)
CH412NTB	412N	Bipolar latching, Hall-effect digital sensor IC, flat, TO-92S package, bulk packing (1000 units per bag)
CH412NTB-A1	412N	Bipolar latching, Hall-effect digital sensor IC, flat, TO-92S-A1 package, bulk packing (1000 units per bag)
CH412NTB-A2	412N	Bipolar latching, Hall-effect digital sensor IC, flat, TO-92S-A2 package, bulk packing (1000 units per bag)
CH412NTB-B2	412N	Bipolar latching, Hall-effect digital sensor IC, flat, TO-92S-B2 package, bulk packing (1000 units per bag)
CH412SR	C412	Bipolar latching, Hall-effect digital sensor IC, SOT-23-3L package, tape and reel packing (3000 units per reel)
CH412ER	C412	Bipolar latching, Hall-effect digital sensor IC, SOT-89-3L package, tape and reel packing (1000 units per reel)
CH412NSR	412N	Bipolar latching, Hall-effect digital sensor IC, SOT-23-3L package, tape and reel packing (3000 units per reel)
CH412NER	412N	Bipolar latching, Hall-effect digital sensor IC, SOT-89-3L package, tape and reel packing (1000 units per reel)

2. Pin Definitions and Descriptions

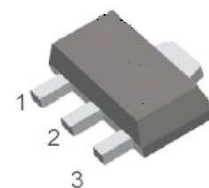
SOT-23-3L	TO-92S	SOT-89-3L	Name	Type	Function
1	1	1	VDD	Supply	Supply Voltage pin
2	3	3	OUT	Output	Open Collector Output pin
3	2	2	GND	Ground	Ground pin



SOT-23-3L



TO-92S



SOT-89-3L

3. Absolute Maximum Ratings

Parameter	Symbol	Min	Max	Units
Supply Voltage	V_{DD}	-	40	V
Reverse Voltage	V_{RDD}	-	-40	V
Supply Current	I_{DD}	-	50	mA
Output Voltage	V_{OUT}	-0.3	40	V
Output Current	I_{OUT}	-	50	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⁾	+/-2000	V
All pins ²⁾	+/-200	V

1) HBM (human body model, 100pF, 1.5k ohm) according to MIL-STD-883H Method 3015.8

2) Machine Model: C=200pF; R=0Ω, JEDEC JESD22-A115

5. Function Description

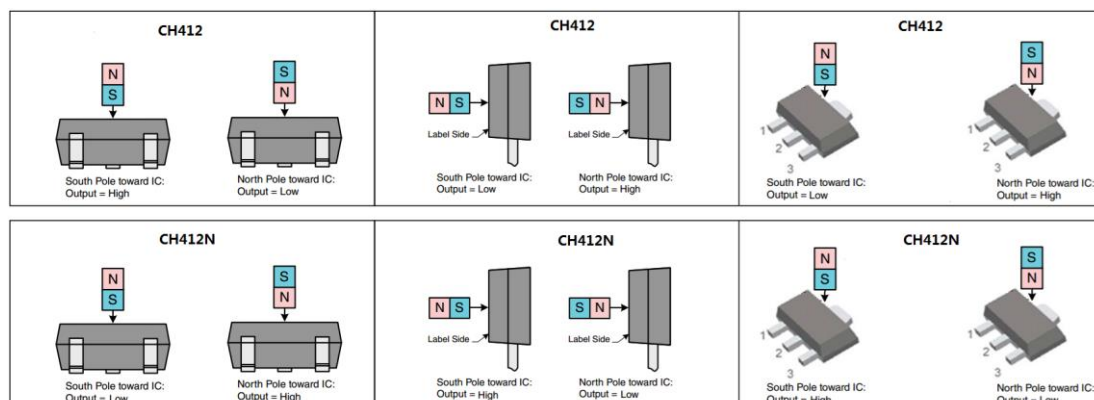
The CH412/CH412N exhibits latch magnetic switching characteristics. Therefore, it requires both south and north poles to operate properly.

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.

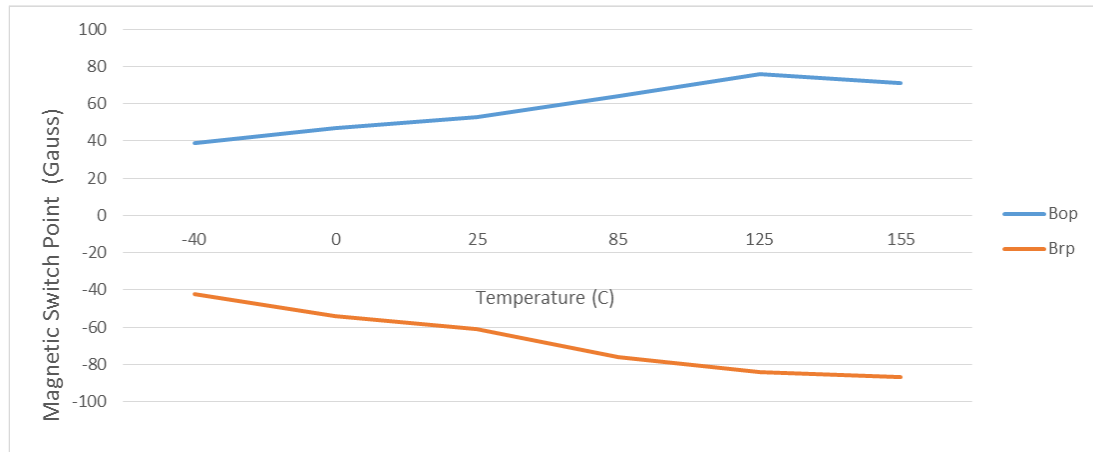
Removing the magnetic field ($B \rightarrow 0$) keeps the output in its previous state. This latching property defines the device as a magnetic memory.

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

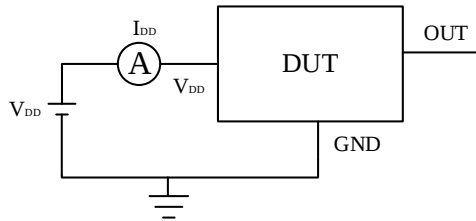
The voltages are referred to GND.

3.5V < VDD < 30V; TJ = -40 to 150°C, unless otherwise specified.

Symbol	Parameter	Test Condition		Min	Typ	Max	Units
V _{DD}	Supply voltage	Operating		3.5	5	30	V
I _{DD}	Supply Current	B<BRP			4.0	9	mA
V _{DSon}	Output saturation voltage	I _{out} =15mA, B>BOP				0.4	V
I _{OFF}	Output Leakage Current	B<BRP, V _{OUT} =30V				10	uA
T _R	Output rise time	RL=1Kohm, CL=20pF				1.5	uS
T _F	Output fall time	RL=1Kohm, CL=20pF				1.5	uS
F _{SW}	Maximum Switching Frequency					100	KHz
B _{OP}	Magnetic operating point	CH412	TA=25°C	5	35	75	Gauss
B _{RP}	Magnetic release point		TA=25°C	-75	-35	-5	Gauss
B _{HYST}	Magnetic hysteresis window		TA=25°C B _{OP} -B _{RP}	40	70	90	Gauss
B _{OP}	Magnetic operating point	CH412N	TA=25°C	-75	-35	-5	Gauss
B _{RP}	Magnetic release point		TA=25°C	5	35	75	Gauss
B _{HYST}	Magnetic hysteresis window		TA=25°C B _{OP} -B _{RP}	40	70	90	Gauss

9. Test Conditions

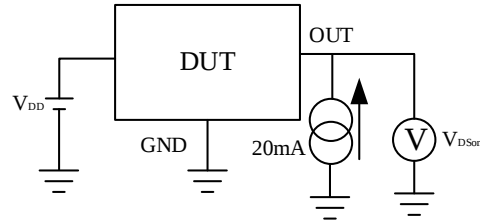
Supply Current



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 $B < B_{RP}$

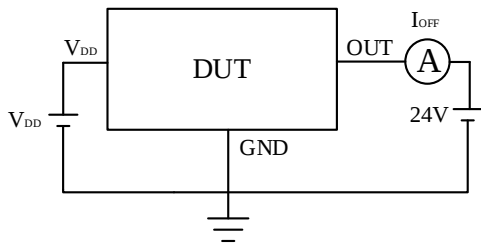
Output Saturation Voltage



Note 1 - The output saturation voltage V_{DSon} is measured at $V_{DD}=3.5V$ and $V_{DD}=24V$.

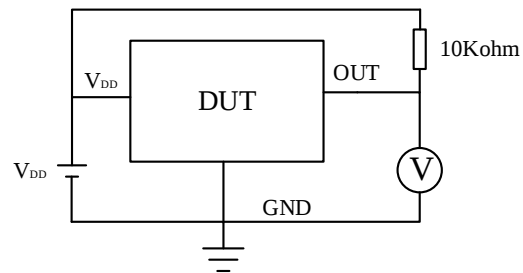
Note 2 - The device is put under magnetic field with $B > B_{OP}$

Output Leakage Current



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

Magnetic Thresholds



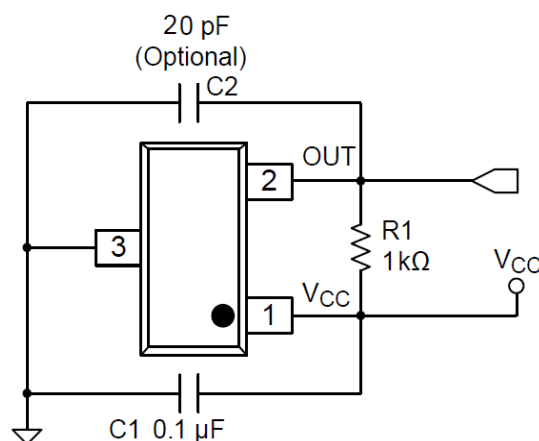
Note 1 - B_{op} is determined by putting the device under magnetic field swept from B_{RPmin} up to B_{OPmax} until the output is switched on.

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.

10. Application Information

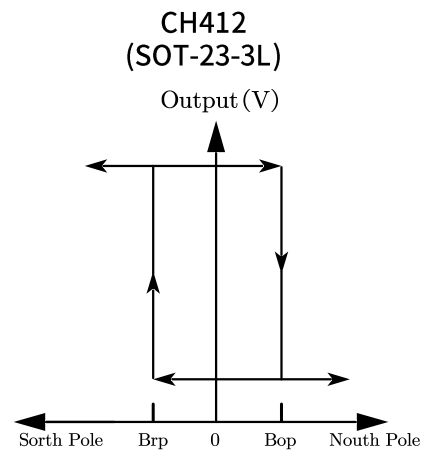
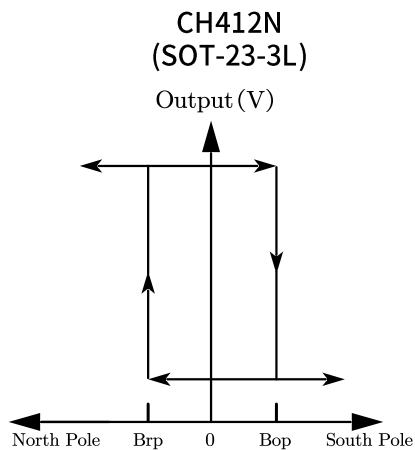
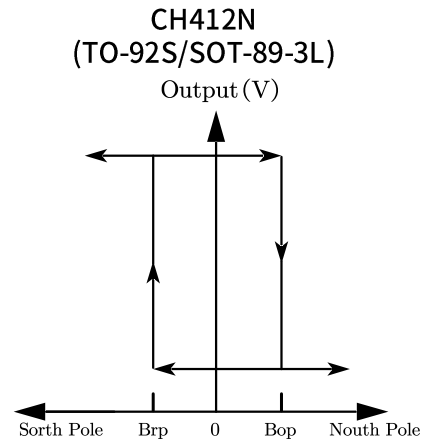
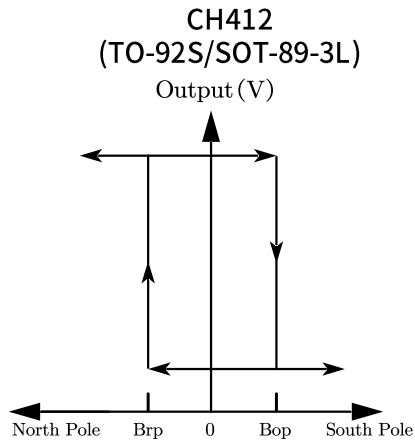
10.1 Typical Application

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



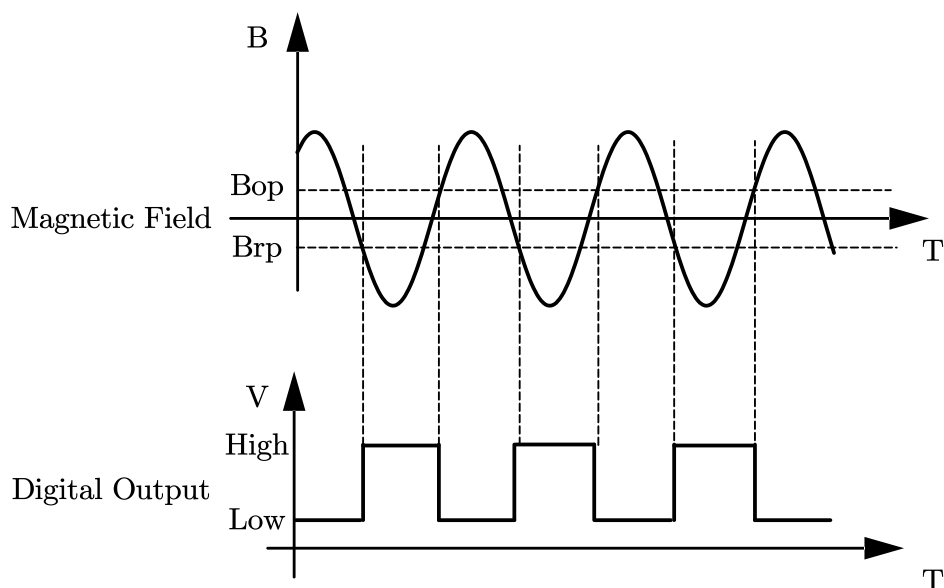
10.2 Device Output

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.



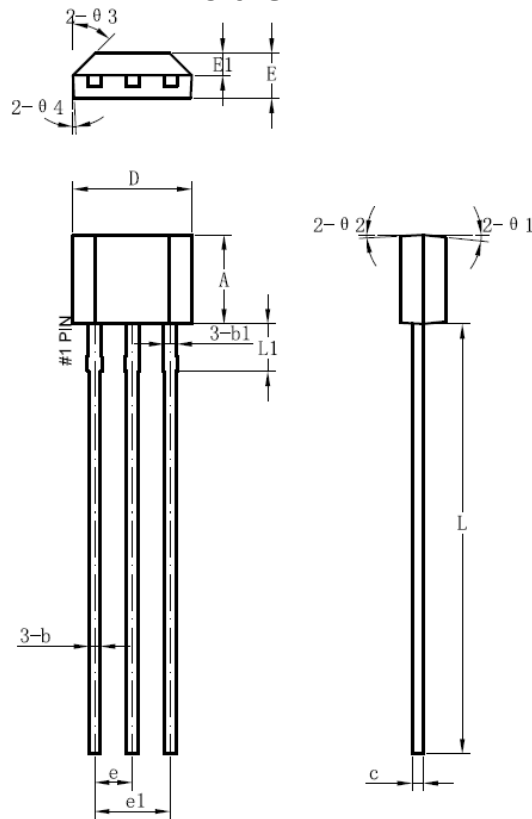
10.3. Typical Output Waveform

(The TO-92S package as an example)



11. Package Information

Package Designator TO-92S



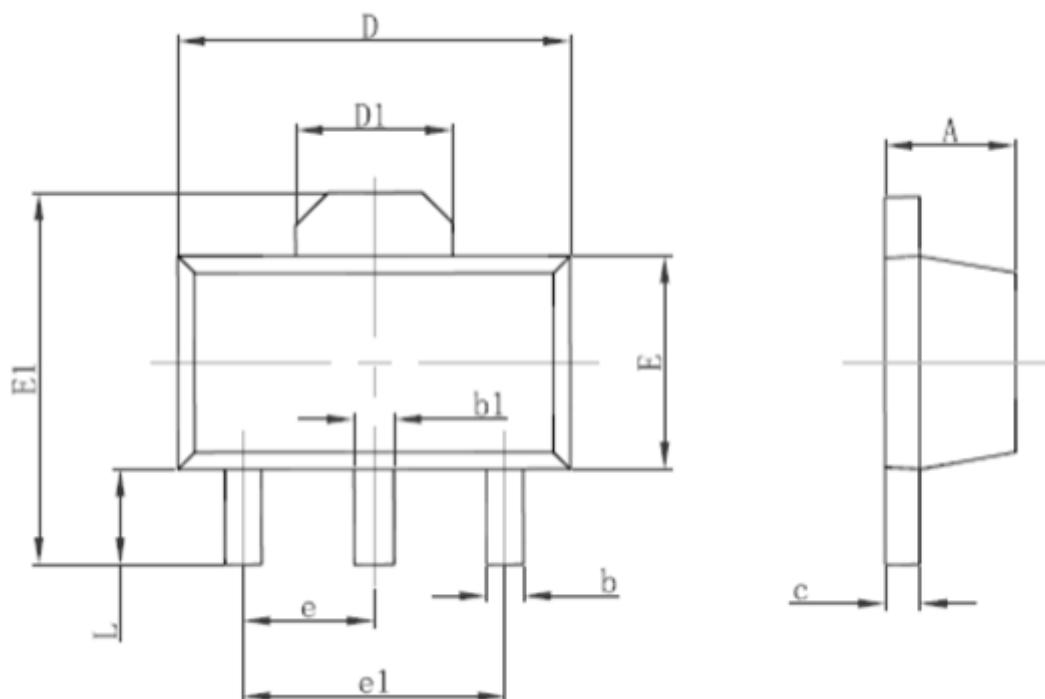
TO-92S Dimensions			
Symbol	Dimensions In Millimeters		
	Min	Typ	Max
A	2.9	3.0	3.1
b	0.35	0.39	0.56
b1		0.44	
c	0.36	0.38	0.51
D	3.9	4.0	4.1
E	1.42	1.52	1.62
E1		0.75	
e		1.27	
e1		2.54	
L	13.5	14.5	15.5
L1		1.6	
$\theta 1$		6°	
$\theta 2$		3°	
$\theta 3$		45°	
$\theta 4$		3°	

TO-92S-A1 Dimensions			
Symbol	Dimensions In Millimeters		
	Min	Typ	Min
A	3.08	3.18	3.28
b	0.38	0.44	0.56
b1		0.44	
c	0.36	0.38	0.51
D	4.0	4.1	4.2
E	1.47	1.57	1.67
E1		0.76	
e		1.27	
e1		2.54	
L	13.5	14.5	15.5
L1		2.8	
θ1		6°	
θ2		3°	
θ3		45°	
θ4		3°	

TO-92S-A2 Dimensions			
Symbol	Dimensions In Millimeters		
	Min	Typ	Min
A	3.08	3.18	3.28
b	0.38	0.44	0.56
b1		0.44	
c	0.36	0.38	0.51
D	4.0	4.1	4.2
E	1.47	1.57	1.67
E1		0.76	
e		1.27	
e1		2.54	
L	15.5	15.7	16.2
L1		2.8	
θ1		6°	
θ2		3°	
θ3		45°	
θ4		3°	

TO-92S-B2 Dimensions			
Symbol	Dimensions In Millimeters		
	Min	Typ	Min
A	2.9	3.0	3.1
b	0.35	0.39	0.56
b1		0.44	
c	0.36	0.38	0.51
D	3.9	4.0	4.1
E	1.42	1.52	1.62
E1		0.75	
e		1.27	
e1		2.54	
L	15.5	15.7	16.2
L1		1.6	
θ1		6°	
θ2		3°	
θ3		45°	
θ4		3°	

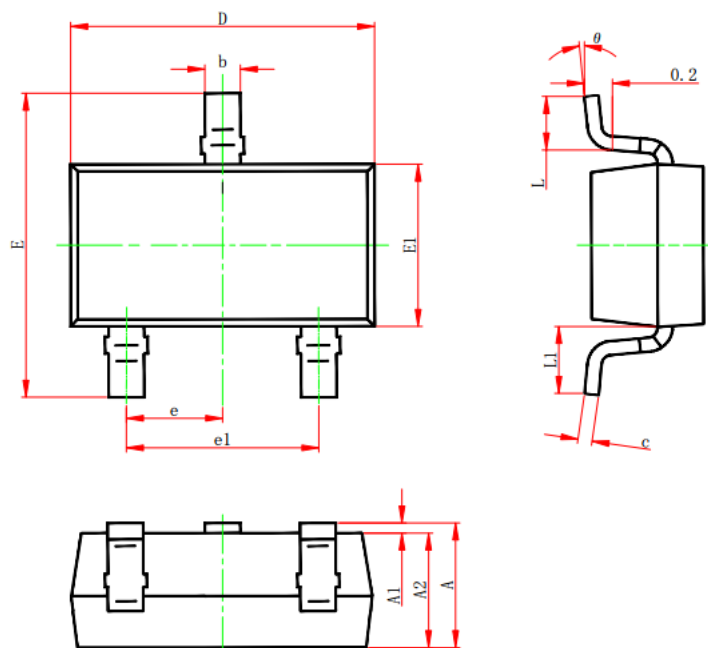
Package Designator
SOT-89-3L



SOT-89-3L Dimensions

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

Package Designator
SOT-23-3L



SOT-23-3L Dimensions				
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°

12. Revision History

Date	Revision	Change
Mar 2021	0.1	Initial release
Mar 2022	0.4	Update Package
Jul 2023	1.3	Update Format、 Application Information

13. Disclaimer

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