


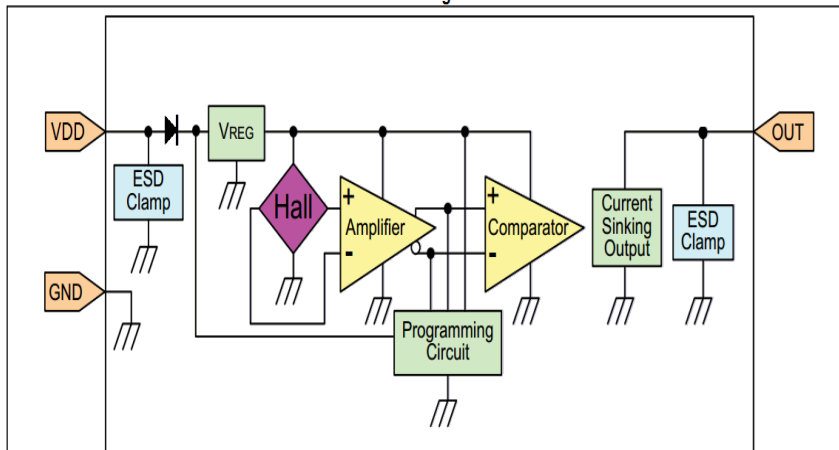
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|  | Cosemitech | CH421 |
| | Industry Product Group | <small>This is advanced information on a new product now in development or undergoing evaluation. Details are subject to change without notice and Cosemitech assumes no obligation for future manufacture of this product. Contact Cosemitech for the latest status.</small> |

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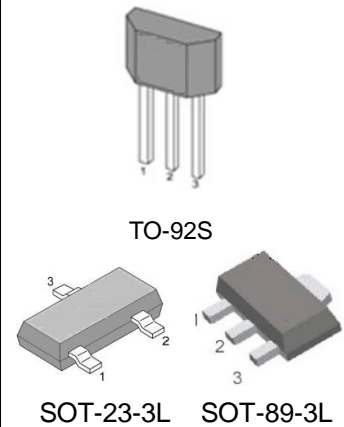
FEATURES and FUNCTIONAL DIAGRAM

- Enhanced sensitivity: will operate from only 45 Gauss typical, at 25°C allowing the use of smaller, potentially lower-cost magnets or wider air gaps
- Subminiature, SOT-23-3L(CH421S) or SOT-89-3L(CH421E) surface mount package supplied on tape and reel allows for a compact design with automated component placement, helping to reduce manufacturing costs
- Small, leaded, flat, TO-92S package (CH421T) allows for a compact PCB layout
- Bipolar latching magnetics respond to alternating North and South poles, making these products well-suited for accurate speed sensing and RPM (revolutions per minute) measurement
- Wide operating voltage range of 3.3V to 30V makes these sensors useable in a wide range of applications
- Built-in reverse voltage capability enhances the protection of the sensor and the circuits with which it is used
- Robust design: will operate up to 150 °C
- RoHS-compliant material meets directive 2011/65/EU

Function Block Diagram



PACKAGE



APPLICATIONS

- Transportation
- Speed and RPM (revolutions per minute) sensing
 - Tachometer, counter pickup
 - Motor and fan control
 - Electric window lift
 - Convertible roof position
 - Automotive transmission position
- Industrial
- Speed and RPM sensing
 - Tachometer, counter pickup
 - Flow-rate sensing
 - Brushless dc (direct current) motor commutation
 - Motor and fan control
 - Robotics control
- Medical
- Motor assemblies
 - Medication dispense control

DESCRIPTION

The CH421S, CH421E and CH421T are small, versatile digital Hall effect devices that are operated by the magnetic field from a permanent magnet or an electromagnet, designed to respond to alternating North and South poles.

These bipolar latching sensor ICs have enhanced sensitivity, which often allows for the use of less expensive magnets.

These sensor ICs are available in three package styles, the CH421S in the subminiature SOT-23-3L surface mount package, the CH421E in the subminiature SOT-89-3L surface mount package, and the CH421T in the leaded, flat TO-92S package.

The CH421S and CH421E's small size requires less PC board space, allowing it to be used in smaller assemblies. Its 3V capability allows for use in low voltage applications, promoting energy efficiency.


The CH421S and CH421E are available on tape and reel; the CH421T is available in a bulk package (1000 units per bag).

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Table of Contents

| | | |
|---|--|---|
| 1. Product Family Members | | 3 |
| 2. Pin Definitions and Descriptions | | 3 |
| 3. Absolute Maximum Ratings | | 3 |
| 4. ESD Protections | | 4 |
| 5. Function Description | | 4 |
| 6. Definition of Switching Function | | 4 |
| 7. Temperature Characterization..... | | 4 |
| 8. Parameters Specification | | 5 |
| 9. Test Conditions | | 6 |
| 10. Typical Application Circuit | | 6 |
| 11. Typical Output Waveform..... | | 6 |
| 12. Package Information | | 7 |

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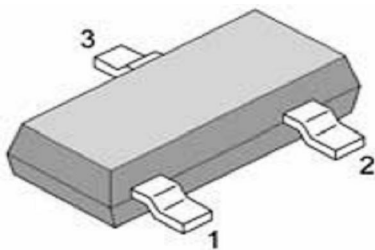
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1. Product Family Members

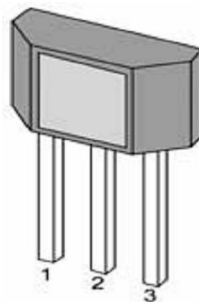
| Part Number | Marking ID | Description |
|-------------|------------|---|
| CH421SR | C421 | Bipolar latching, Hall-effect digital sensor IC, SOT-23-3L package, tape and reel packing (3000 units per reel) |
| CH421TB | C421 | Bipolar latching, Hall-effect digital sensor IC, flat, TO-92S package, bulk packing (1000 units per bag) |
| CH421ER | C421 | Bipolar latching, Hall-effect digital sensor IC, SOT-89-3L package, tape and reel packing (1000 units per reel) |

2. Pin Definitions and Descriptions

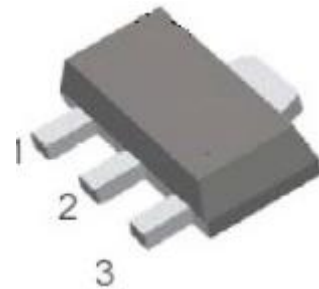
| SOT-23-3L (S) | TO-92S (T) | SOT-89-3L (E) | Name | Type | Function |
|---------------|------------|---------------|------|--------|---------------------------|
| 1 | 1 | 1 | VDD | Supply | Supply Voltage pin |
| 2 | 3 | 3 | OUT | Output | Open Collector Output pin |
| 3 | 2 | 2 | GND | Ground | Ground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



SOT-23-3L



TO-92S



SOT-89-3L

3. Absolute Maximum Ratings

| Parameter | Symbol | Min | Max | Units |
|-------------------------------|------------------|----------|-----|-------|
| Supply Voltage | V _{DD} | - | 40 | V |
| VDD Reverse Voltage VDD | V _{RDD} | - | -40 | V |
| Supply Current | I _{DD} | - | 20 | mA |
| Output Voltage | V _{OUT} | -0.3 | 40 | 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.

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4. ESD Protections

| Parameter | Value | Unit |
|------------------------|---------|------|
| All pins ¹⁾ | +/-3000 | V |
| All pins ²⁾ | +/-200 | V |
| All pins ³⁾ | +/-750 | V |

1) HBM (human body mode, 100pF, 1.5 kohm) according to MIL-STD-883H Method 3015.8

2) MM (Machine Mode C=200pF, R=0 Ω) according to JEDEC EIA/JESD22-A115

3) CDM (charged device mode) according to JEDEC EIA/JESD22-C101F

5. Function Description

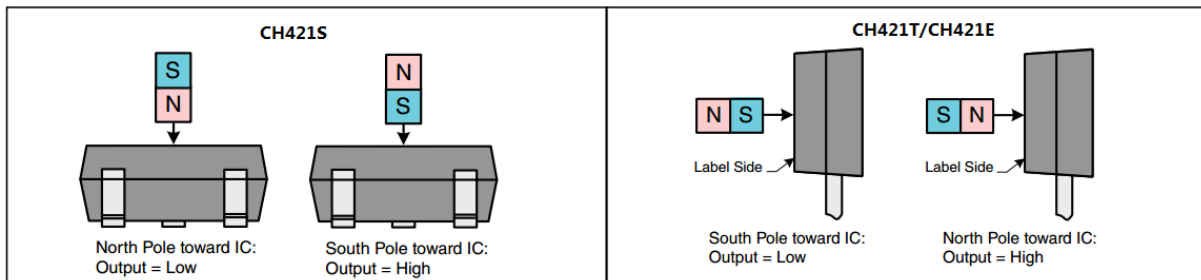
The CH421S/CH421T/CH421E exhibits latch magnetic switching characteristics. Therefore, it requires both south and north poles to operate properly.

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.

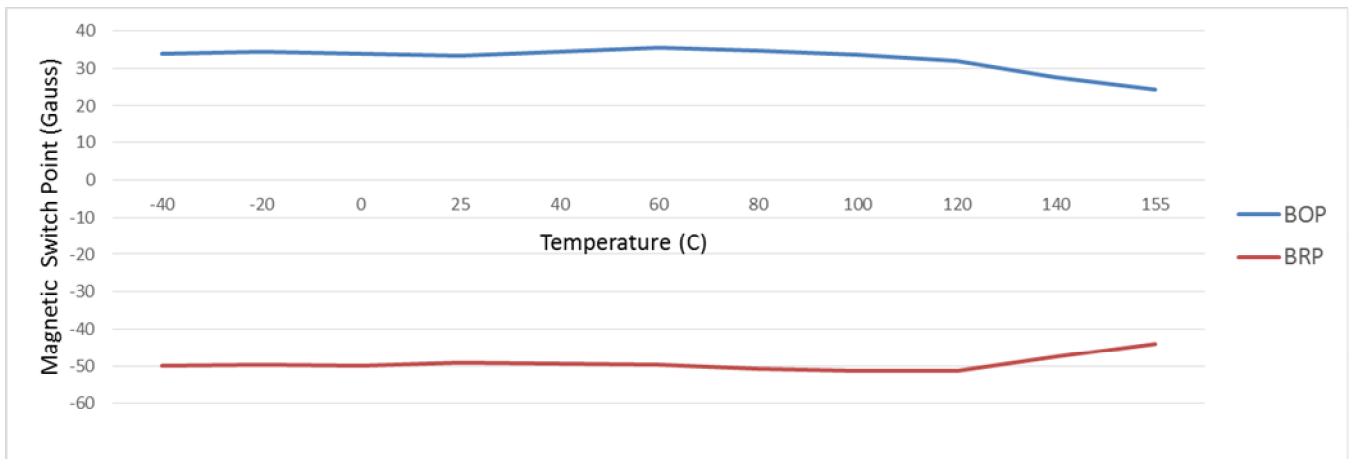
Removing the magnetic field (B = 0) keeps the output in its previous state. This latching property defines the device as a magnetic memory.

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



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8. Parameters Specification (At 3.3V to 30V supply, 20mA load, TA= -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 | 3.3 | - | 30 | V |
| I _{DD} | Supply Current | V _{DD} = 5V | - | 3.5 | 8 | mA |
| V _{DSon} | Output saturation voltage | at 20mA, Gauss >120 | - | - | 0.4 | V |
| I _{OFF} | Output Leakage Current | B<-120GS | - | - | 10 | uA |
| T _R | Output rise time | V _{DD} =12V at 25 °C C _L = 20 pF | - | - | 1.5 | uS |
| T _F | Output fall time | V _{DD} =12V at 25 °C C _L = 20 pF | - | - | 1.5 | uS |
| R _{TH} | Thermal resistance: CH421S (SOT-23-3L) CH421T (TO-92S) CH421E (SOT-89-3L) | - | - | 303 203 230 | - | °C /W °C/W °C/W |
| B _{OP} | Magnetic operating point | T _A =25°C | 10 | 45 | 90 | Gauss |
| B _{RP} | Magnetic release point | T _A =25°C | -90 | -45 | -10 | Gauss |
| B _{HYST} | Magnetic hysteresis window | T _A =25°C B _{OP} -B _{RP} | 60 | 90 | 120 | Gauss |
| F _{SW} | Maximum Switching Frequency | | | | 100 | KHz |
| T | Operating temperature | - | -40 | - | 150 | °C |
| T _S | Storage temperature: | - | -40 | - | 150 | °C |

NOTICE

Bipolar Hall-effect sensor ICs may have an initial output in either the ON or OFF state if powered up with an applied magnetic field in the differential zone (applied magnetic field >Brp and <Bop). Cosemitech recommends allowing 10 μs for output voltage to stabilize after supply voltage has reached 5V.

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.

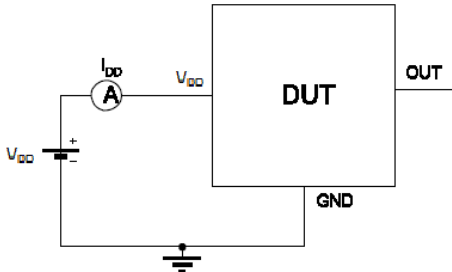
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9. Test Conditions

Note: DUT=Device Under Test

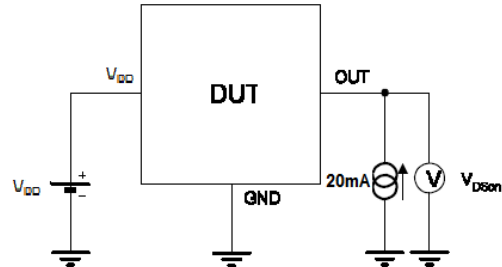
Supply Current



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 $B < B_{RP}$

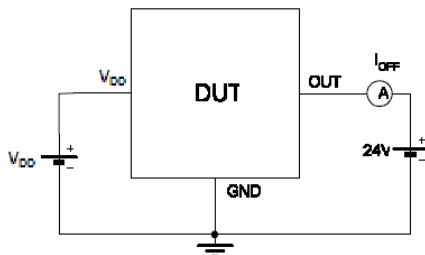
Output Saturation Voltage



Note 1 - The output saturation voltage $V_{DS(on)}$ is measured at $V_{DD}=3.8V$ and $V_{DD}=24V$

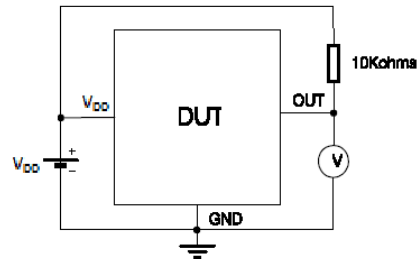
Note 2 - The device is put under magnetic field with $B > B_{OP}$

Output Leakage Current



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

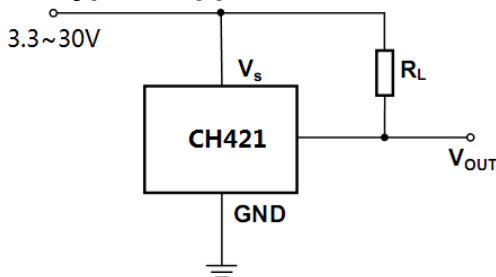
Magnetic Thresholds



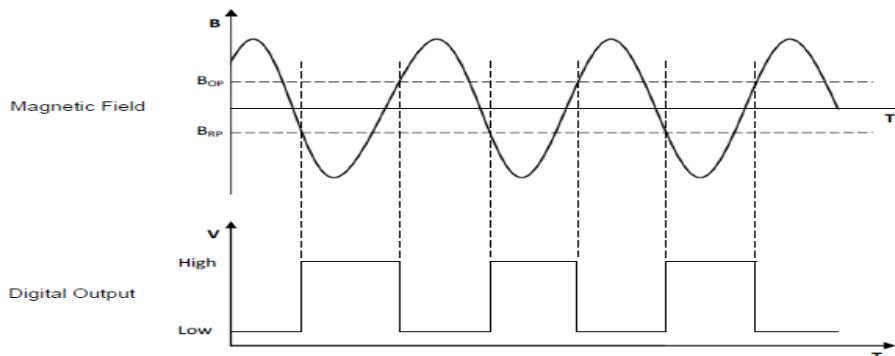
Note 1 - B_{OP} is determined by putting the device under magnetic field swept from B_{RPmin} up to B_{OPmax} until the output is switched on.

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. Typical Application Circuit

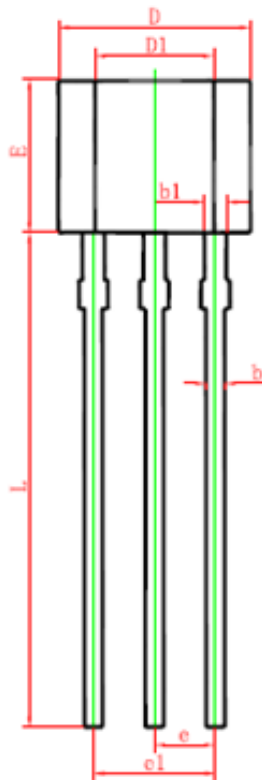
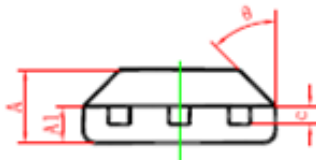


11. Typical Output Waveform (The TO-92S package as an example)



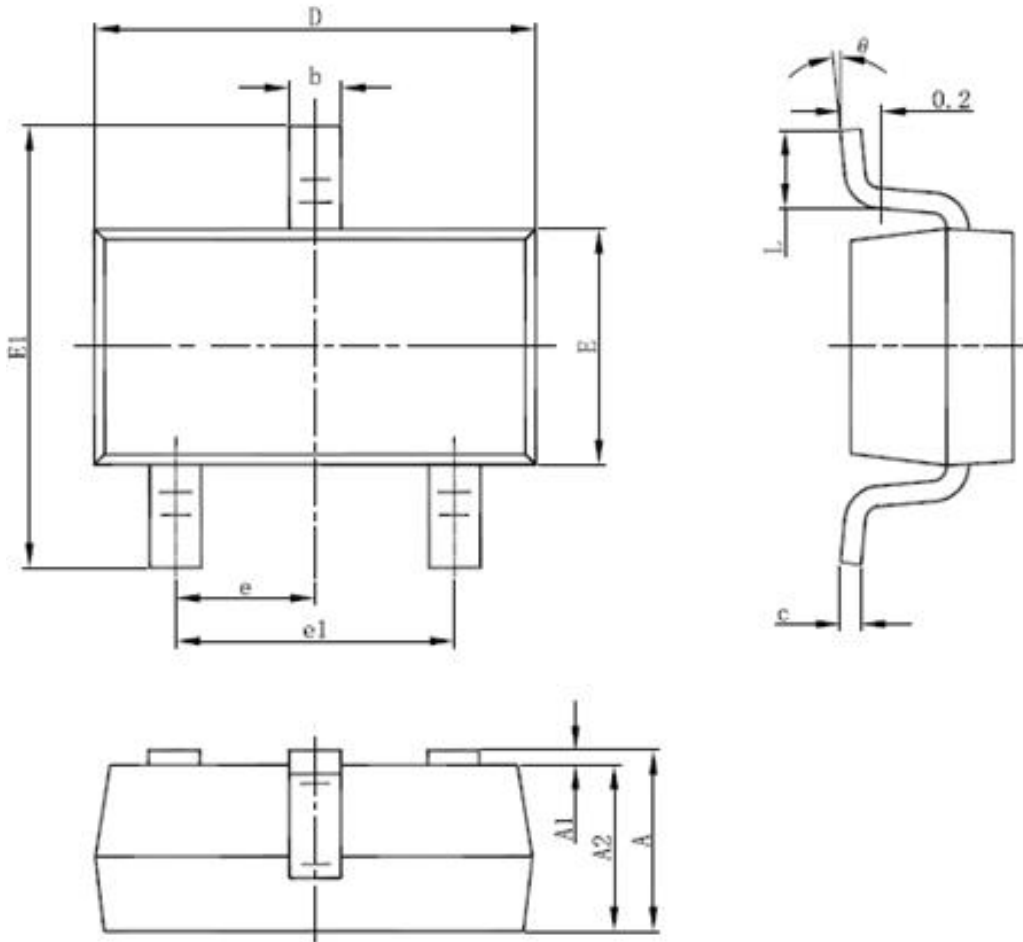
12. Package Information:

PACKAGE DESIGNATOR
TO-92S



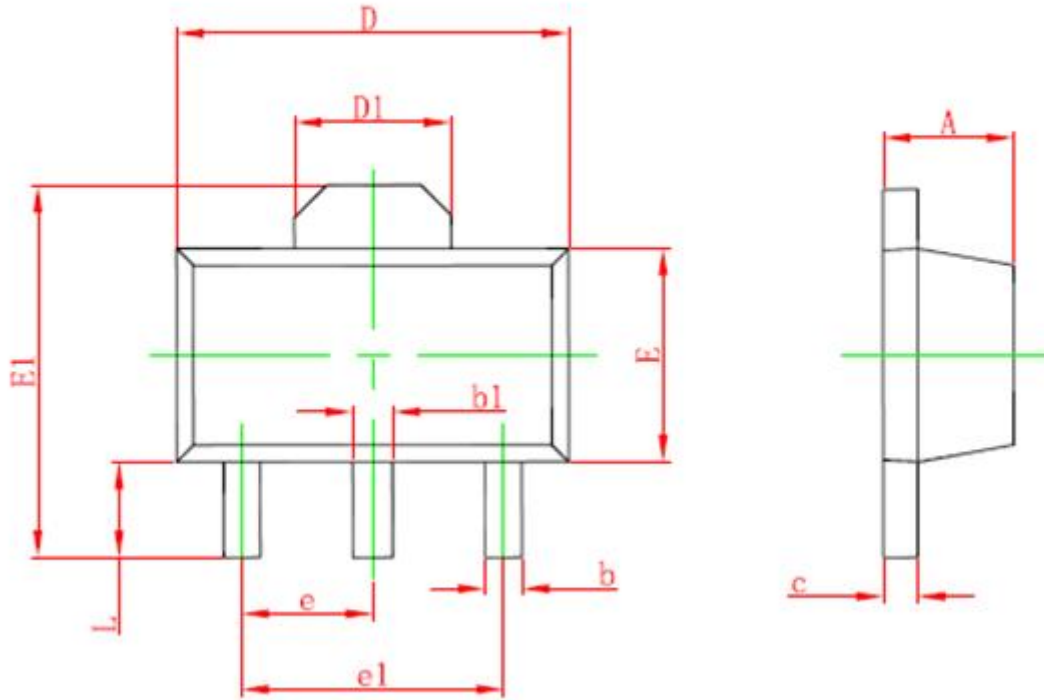
| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|--------|---------------------------|--------|----------------------|-------|
| | Min. | Max. | Min. | Max. |
| A | 1.420 | 1.620 | 0.056 | 0.064 |
| A1 | 0.660 | 0.860 | 0.026 | 0.034 |
| b | 0.350 | 0.480 | 0.014 | 0.019 |
| b1 | 0.400 | 0.550 | 0.016 | 0.022 |
| c | 0.360 | 0.510 | 0.014 | 0.020 |
| D | 3.900 | 4.100 | 0.154 | 0.161 |
| D1 | 2.280 | 2.680 | 0.090 | 0.106 |
| E | 3.050 | 3.250 | 0.120 | 0.128 |
| e | 1.270 TYP. | | 0.050 TYP. | |
| e1 | 2.440 | 2.640 | 0.096 | 0.104 |
| L | 15.100 | 15.500 | 0.594 | 0.610 |
| θ | 45° TYP. | | 45° TYP. | |

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 |

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