Magnetic Sensor IC

# Latch Detection High Performance Hall-Effect Sensor IC

**AS1699**

## General Description

Using BiCMOS process, the AS1699 is designed for high performance latch detection hall-effect application, such as automotive, industrial, electric tools, home appliances, rotor position sensing, brushless DC motor etc. The hall IC integrated an on-chip hall voltage generator for magnetic sensing, a comparator that amplifiers the hall voltage, hall sensor with dynamic offset cancellation system, an open drain output, and a Schmitt trigger to provide switching hysteresis for noise rejection, and a voltage regulator for operation with supply voltage of 2.5V to 32V.

AS1699 is designed to respond to alternating North and South poles. White the magnetic flux density (B) is larger than operate point ($B_{OP}$), the output will be turned on (low), the output is held until the magnetic flux density (B) is lower than release point ($B_{RP}$), then turn off (high).

The device is available in SIP-3L and SOT23-3L Package and is rated over the -40°C to 150°C. the package is RoHS compliant.

## Features

- High Performance BiCMOS Process Tech.
- Input Voltage Range : 2.5V to 32V
- Resistant to physical stress
- Bipolar Latch Operation
- High Sensitivity Hall Sensor
- High Chopping Frequency
- Magnetic Sensitivity (typical)
  - ✓ A: $B_{OP}$=20Gauss, $B_{RP}$=-20Gauss
  - ✓ B: $B_{OP}$=30Gauss, $B_{RP}$=-30Gauss
  - ✓ C: $B_{OP}$=40Gauss, $B_{RP}$=-40Gauss
- Open Drain Output
- Small Solution Size
- RoHS Compliant
- SIP-3L and SOT23-3L Packages
- -40℃ to +150 ℃ Temperature Range

## Applications

- Electric Tools
- Automotive, Home appliances, Industrial
- Rotor Position Sensing and Flow Meters
- Brushless DC Motor/Fan
- Speed Measurement
- Revolution Counting
- Valve and Solenoid Status
- Proximity Sensing
- Tachometers
- Magnetic Encoder

## Ordering Information

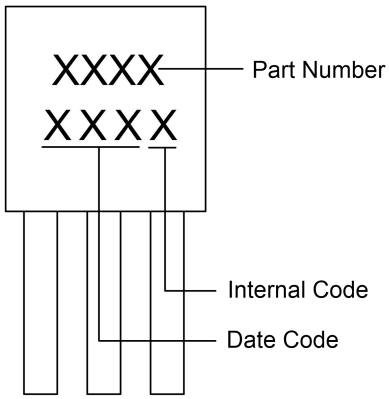
**AS1699XXXX**

- Bop/BRP：
  A: ±20Gauss
  B: ±30Gauss
  C: ±40Gauss
- Package：
  M:SIP-3L
  W: SOT23-3L
- Packing：
  B: Blank
  R:Tape&Reel
- Temperature Grade：
  Z: -40°C~150°C
  Y: -40°C~125°C

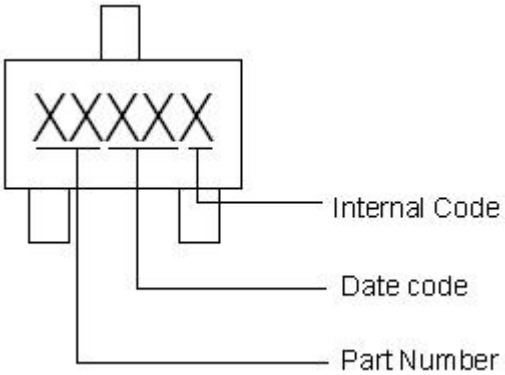
| Part Number | $B_{OP}$/$B_{RP}$ (Gauss) | Package Type | Package Qty | Temperature | Eco Plan |
|---|---|---|---|---|---|
| AS1699AMBZ | ±20 | SIP-3L | 1K/Package | -40～150℃ | RoHS |
| AS1699AWRZ | ±20 | SOT23-3L | 7-in reel 3000pcs/reel | -40～150℃ | RoHS |
| AS1699BMBZ | ±30 | SIP-3L | 1K/Package | -40～150℃ | RoHS |
| AS1699BWRZ | ±30 | SOT23-3L | 7-in reel 3000pcs/reel | -40～150℃ | RoHS |
| AS1699CMBZ | ±40 | SIP-3L | 1K/Package | -40～150℃ | RoHS |
| AS1699CWRZ | ±40 | SOT23-3L | 7-in reel 3000pcs/reel | -40～150℃ | RoHS |

## ■ Marking Information

**SIP-3L:**




**SOT23-3L**




## ■ Typical Application Circuit

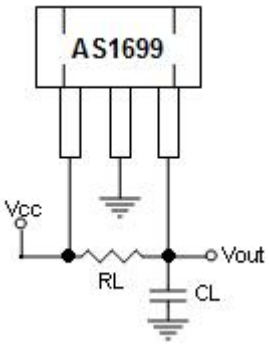
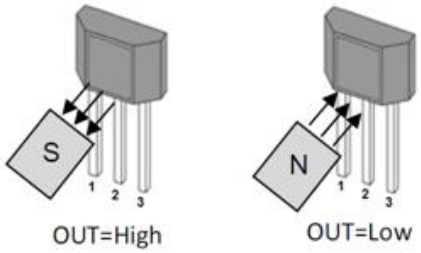



Figure 1, Typical Application Circuit of AS1699

## ■ Pin Configuration

**SIP-3L (Top View)**




**SOT23-3L (Top View)**

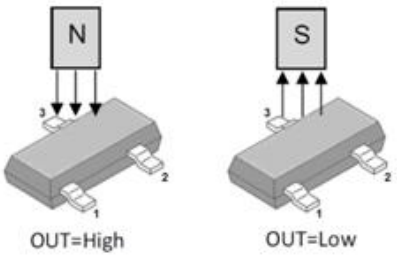



Figure 2, Pin Assignments of AS1699

| Pin Name | Pin No. | | I/O | Pin Function |
|---|---|---|---|---|
| | SIP-3L | SOT23-3L | | |
| VCC | 1 | 1 | P | Input Power Supply |
| GND | 2 | 3 | P | Ground |
| OUTPUT | 3 | 2 | O | Open Collector Output |

## ■ Block Diagram

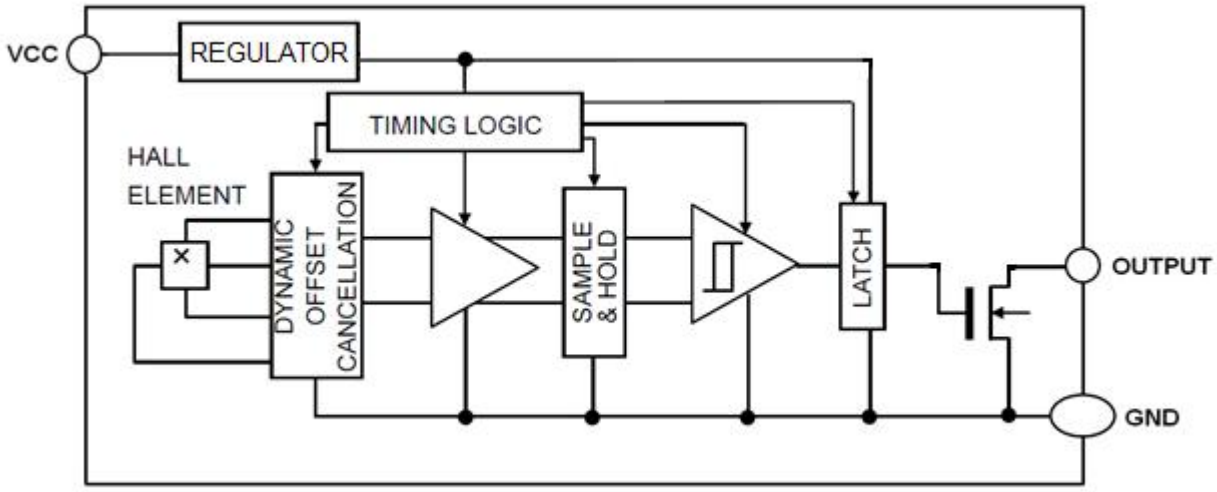



Figure 3, Block Diagram of AS1699

## ■ Absolute Maximum Ratings[1] ($T_A$=25°C, unless otherwise noted)

| Parameter | | Symbol | Rating | Unit |
|---|---|---|---|---|
| $V_{CC}$ Pin to GND | | $V_{CC}$ | -24 to 40 | V |
| Output Pin to GND | | $V_{OUTPUT}$ | -0.3 to 45 | V |
| Max. Continuous Output Current | | $I_{OUTMAX}$ | 30 | mA |
| Thermal Resistance | SIP-3L | $T_{JA}$ | 230 | ℃/W |
| | SOT23-3L | | 310 | |
| ESD HBM | | HBM | 4000 | V |
| Storage Temperature Range | | $T_S$ | -55 to +150 | ℃ |
| Operating Junction Temperature Range | | $T_{OP}$ | -40 to +150 | ℃ |
| Maximum Soldering Temperature (at leads, 10 sec) | | $T_{LEAD}$ | 300 | ℃ |

## ■ Recommended Operating Conditions[2]

| Parameter | Symbol | Rating | Unit |
|---|---|---|---|
| $V_{CC}$ Pin to GND | $V_{CC}$ | 2.5 to 32 | V |
| Continuous Output Current | $I_{OUT}$ | 30 | mA |
| Operating Temperature Range | $T_{OP}$ | -40 to +150 | ℃ |

## ■ Electrical Characteristics

($T_A$ = -40 to +150℃ unless otherwise noted. Typical values are at $T_A$ = +25℃, $V_{CC}$ = 2.5V to 32V)

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $V_{CC}$ | Input Voltage | | 2.5 | - | 32 | V |
| $V_{CCDZ}$ | Supply Zener Voltage | | - | 35 | - | V |
| $I_Q$ | Supply Current | | - | 1.5 | 2.5 | mA |
| $t_{ON}$ | Power On Time | | - | 28 | 50 | uS |
| $V_{SON}$ | Output Saturation Voltage | $V_{CC}$ = 5V, $I_{OUT}$=10mA | - | 0.20 | - | V |
| $V_{OVP}$ | Output Over Voltage Protection | | - | 36 | - | V |
| $I_{OFF}$ | Off-state Leakage Current | Output Hi-Z | - | - | 3.0 | uA |
| $T_R$ | Output Rise Time | $R_L$=1K, $C_L$=50pF | - | 0.45 | - | uS |
| $T_F$ | Output Fall Time | $R_L$=1K, $C_L$=50pF | - | 0.09 | 0.2 | uS |
| $T_D$ | Output Delay Time | B=$B_{RP}$-100Gs to $B_{OP}$+100Gs | - | 15 | 25 | uS |
| $f_{BW}$ | Operation Bandwidth | | - | 100 | - | KHz |
| **A: +20/-20Gauss** | | | | | | |
| $B_{OP}$ | Magnetic Operating Point | $T_A$ = +25℃ | 10 | 20 | 30 | Gauss |
| $B_{RP}$ | Magnetic Release Point | $T_A$ = +25℃ | -30 | -20 | -10 | Gauss |
| $B_{HYS}$ | Hysteresis Window | $T_A$ = +25℃ | - | 40 | - | Gauss |
| **B: +30/-30Gauss** | | | | | | |
| $B_{OP}$ | Magnetic Operating Point | $T_A$ = +25℃ | 10 | 30 | 50 | Gauss |
| $B_{RP}$ | Magnetic Release Point | $T_A$ = +25℃ | -50 | -30 | -10 | Gauss |
| $B_{HYS}$ | Hysteresis Window | $T_A$ = +25℃ | - | 60 | - | Gauss |
| **C: +40/-40Gauss** | | | | | | |
| $B_{OP}$ | Magnetic Operating Point | $T_A$ = +25℃ | 15 | 40 | 65 | Gauss |
| $B_{RP}$ | Magnetic Release Point | $T_A$ = +25℃ | -65 | -40 | -15 | Gauss |
| $B_{HYS}$ | Hysteresis Window | $T_A$ = +25℃ | - | 80 | - | Gauss |

Note: 1: Stresses above those listed in absolute maximum ratings may cause permanent damage to the device. Functional operation at conditions other than the operating conditions specified is not implied. Only one absolute maximum rating should be applied at any one time.

2: The device is not guaranteed to function outside of its operating conditions.

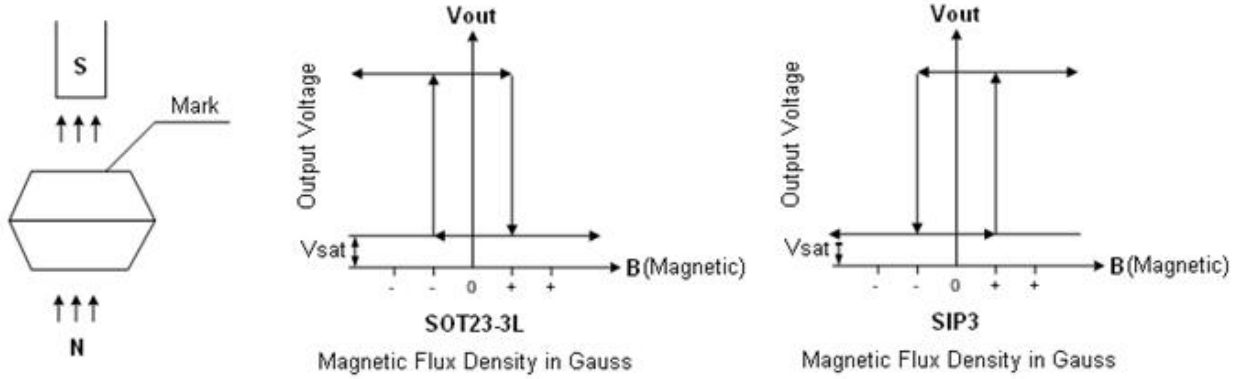



Fig 4, Magnetic Operation Characteristic of AS1699

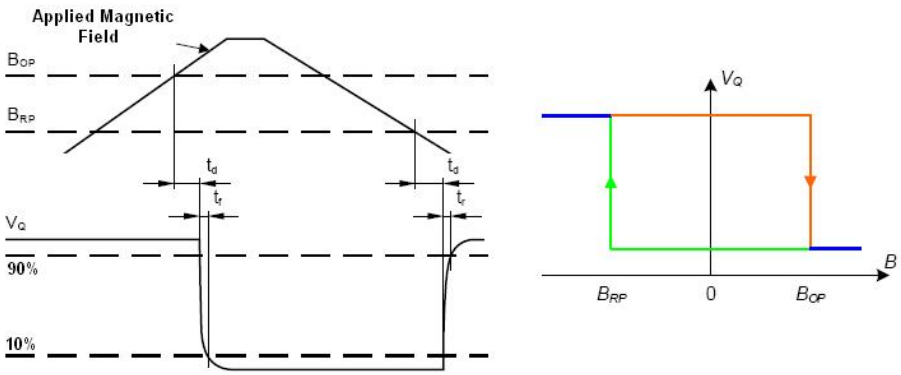
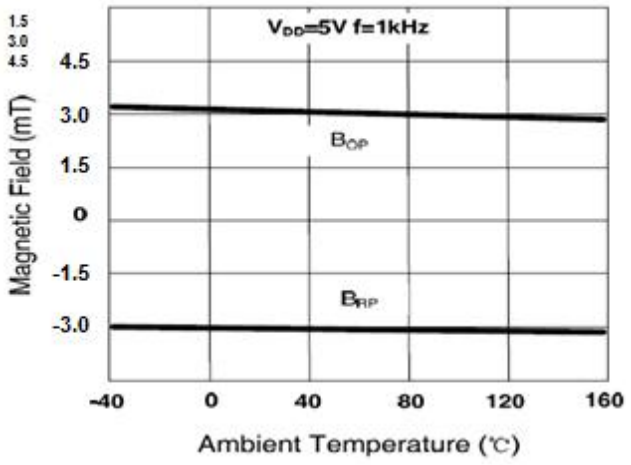



Fig 5, SOT23-3L Package Magnetic Operation Theory of AS1699

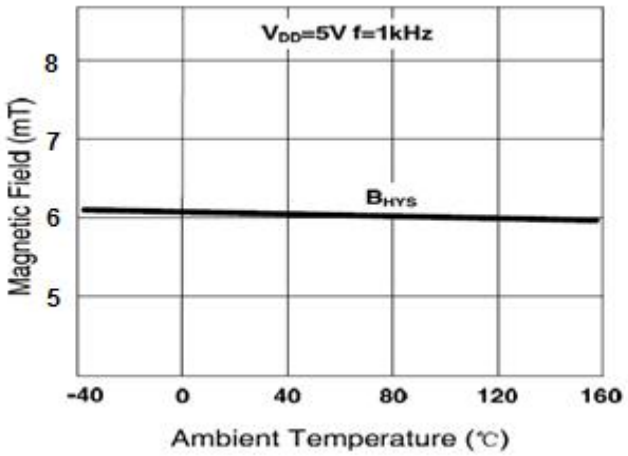
## ■ Typical Characteristics—AS1699

(Unless otherwise noted, typical values are at $T_A$ = +25℃, $V_{CC}$ = 5.0V)

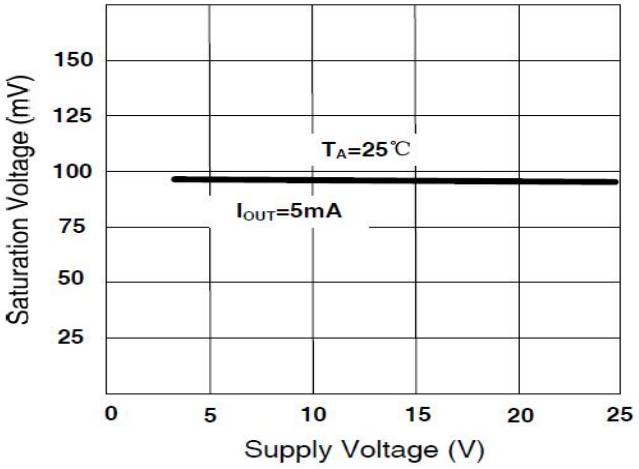
**Operation/Release Point Magnetic Vs. Temperature**



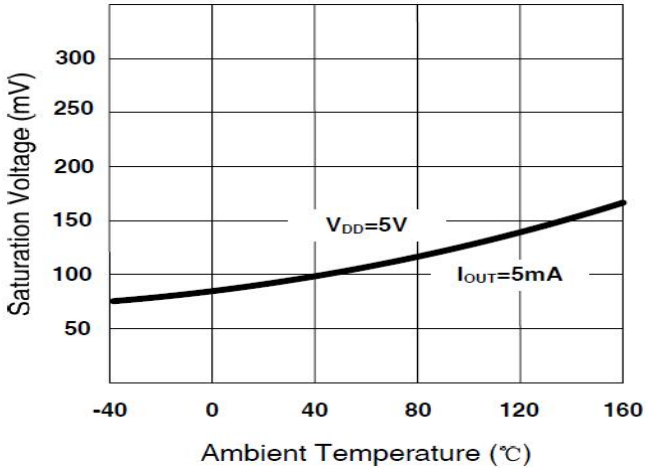

**Magnetic Hysteresis Vs. Temperature**



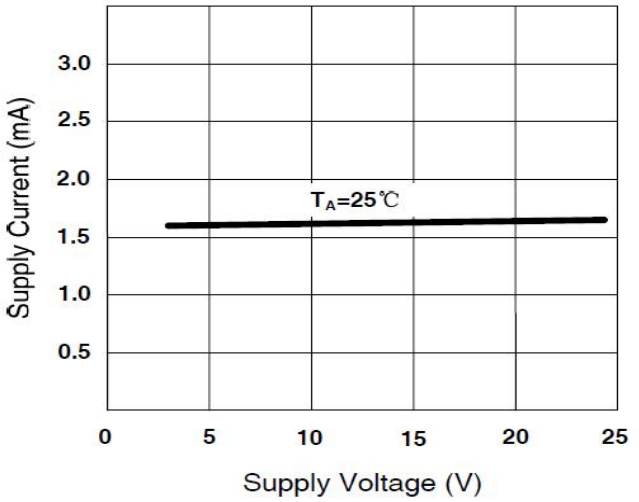

**Output Saturation Voltage Vs. Supply Voltage**



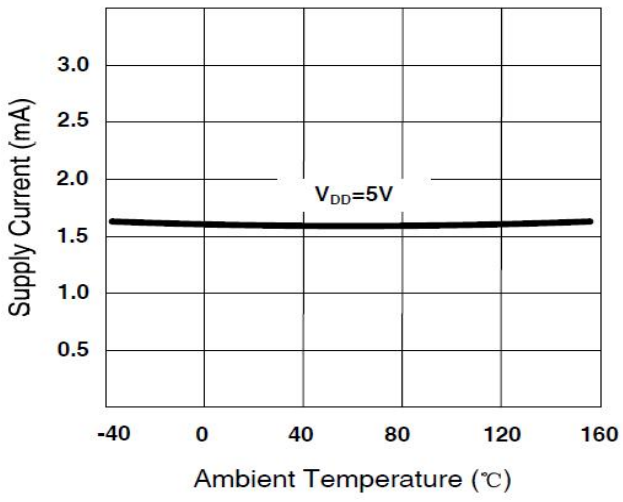

**Output Saturation Voltage Vs. Temperature**




**Supply Current Vs. Supply Voltage**

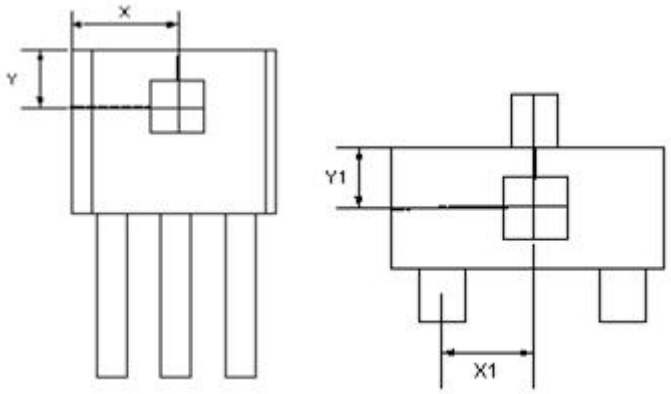



**Supply Current Vs. Temperature**



## ■ Hall Sensor Location

The Fig 7 is hall sensor location, where marks the IC number.

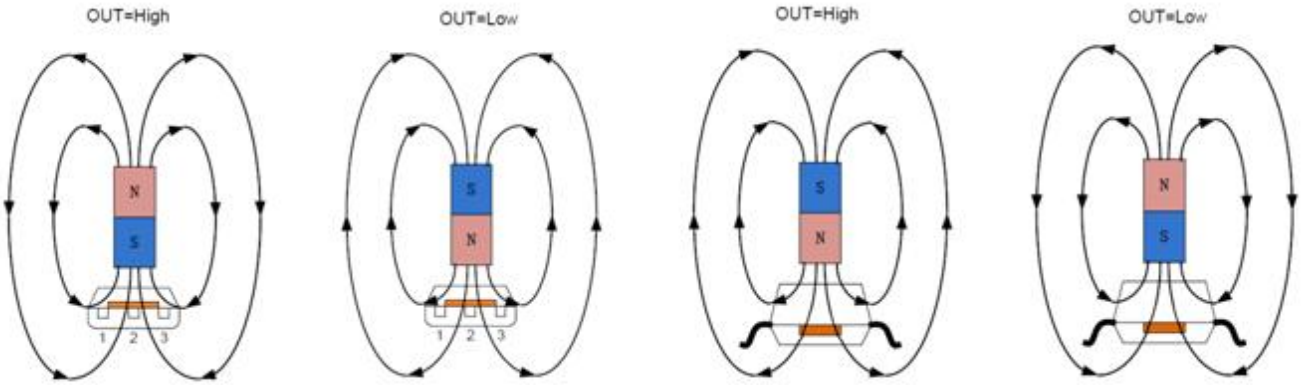



| | | unit |
|---|---|---|
| X | 2.00 | mm |
| Y | 1.35 | mm |
| X1 | 0.95 | mm |
| Y1 | 0.8±0.05 | mm |

Fig 7, AS1699 Hall Sensor Location

## ■ Hall Sensor Location

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




If the device is powered on with a magnetic field strength between BRP and BOP, then the device output is determinate High. For SIP-3L package, if the field strength is greater than BOP, then the output is pulled low. If the field strength is less than BRP, the output is released. For SOT23-3L package, however, if the field strength is less than BOP, then the output is pulled low. If the field strength is greater than BRP, the output is released.

## ■ Typical Output Waveform:

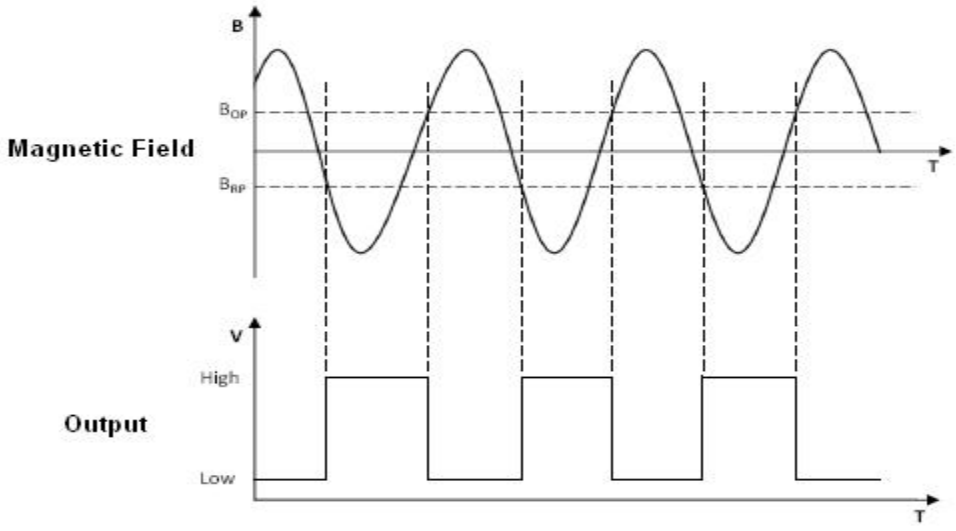



Fig 6, Typical Output Waveform of AS1699

**Thermal Considerations**

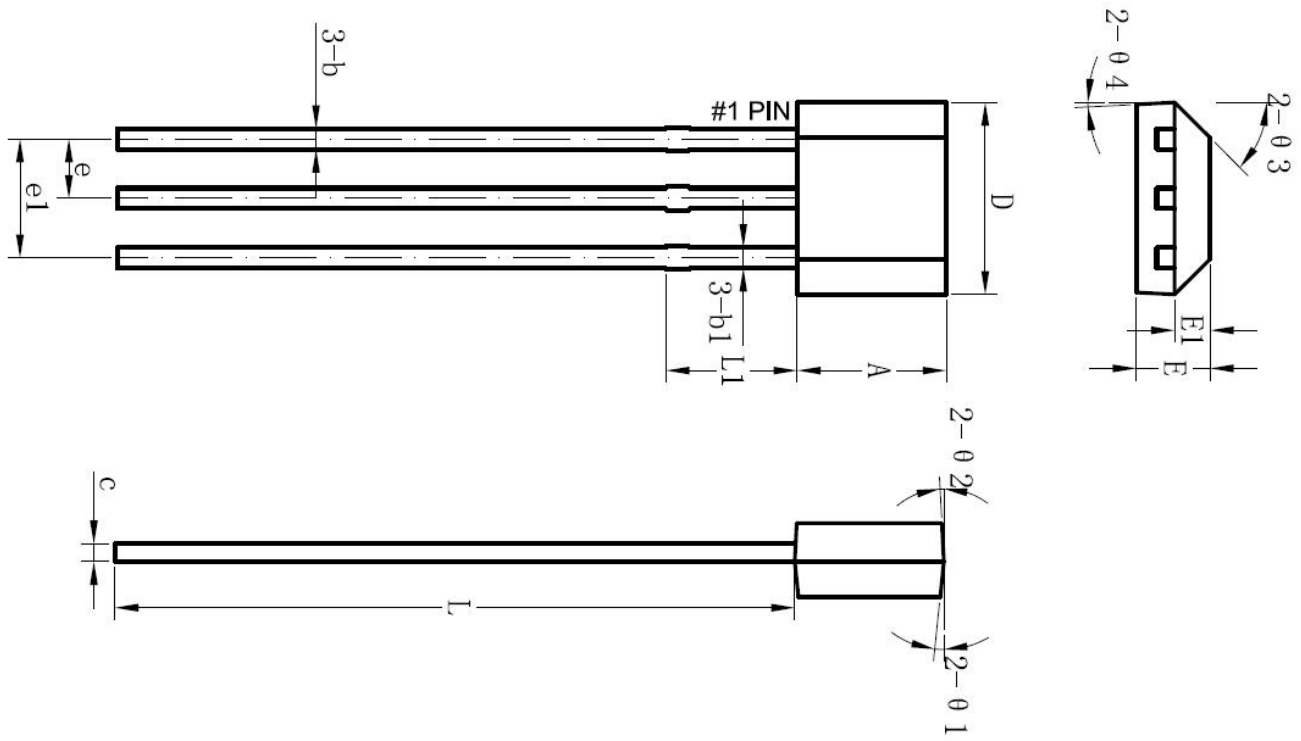
The maximum IC junction temperature should be restricted to 125°C under normal operating conditions. This restriction limits the power dissipation of the AS1699. Calculate the maximum allowable dissipation, $P_{D(max)}$, and keep the actual dissipation less than or equal to $P_{D(max)}$. The maximum-power-dissipation limit is determined using following equation:

$$P_{D(MAX)} = \frac{125℃ - T_A}{R_{\theta JA}}$$

Where, $T_A$ is the maximum ambient temperature for the application. $R_{\theta JA}$ is the thermal resistance junction-to-ambient given in Power Dissipation Table.

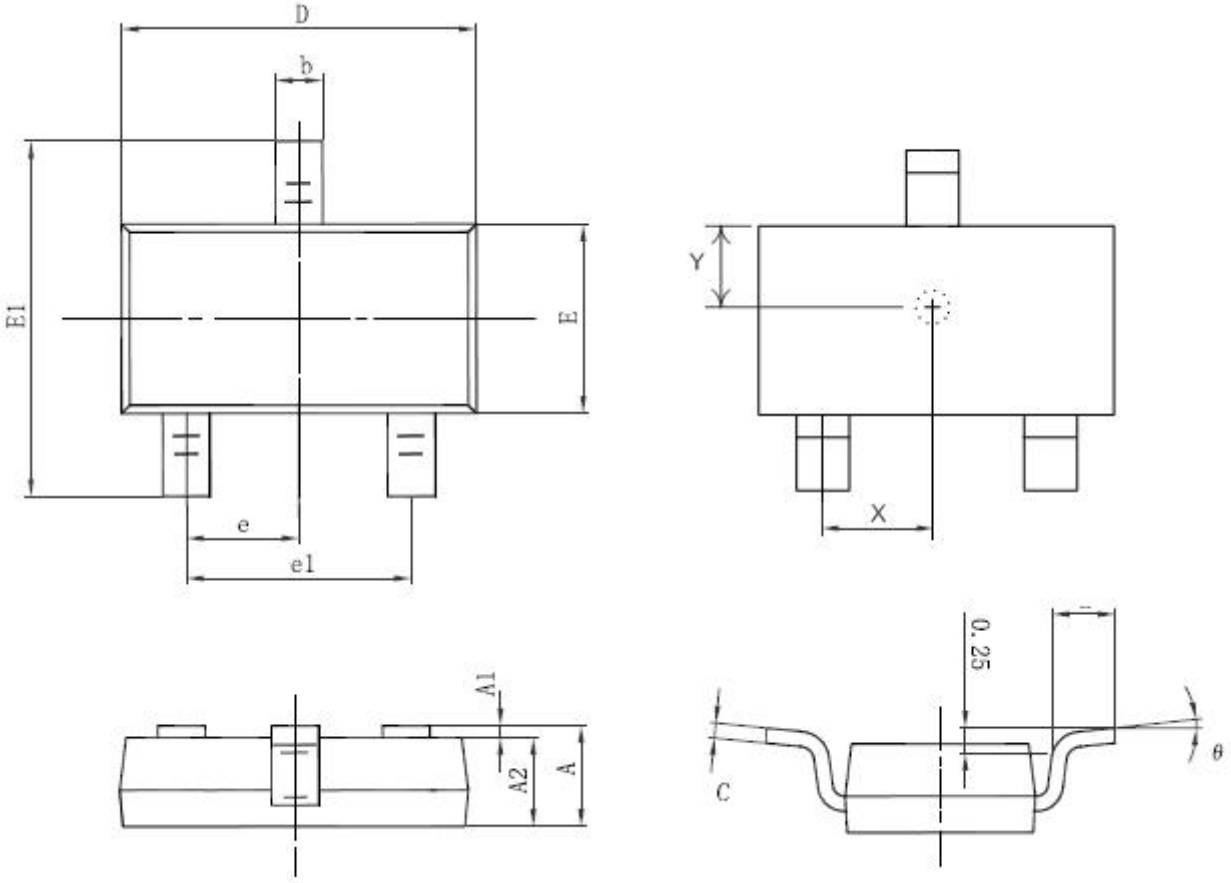
## ■ Package Information

**SIP-3L:**




| Symbol | Dimensions In Millimeters | | | Dimensions In Inches | | |
|---|---|---|---|---|---|---|
| | Min. | Typ. | Max. | Min. | Typ. | Max. |
| A | 2.900 | 3.000 | 3.100 | 0.114 | 0.118 | 0.122 |
| b | 0.350 | 0.390 | 0.560 | 0.014 | 0.015 | 0.022 |
| b1 | - | 0.440 | - | - | 0.017 | - |
| C | 0.360 | 0.380 | 0.510 | 0.014 | 0.015 | 0.020 |
| D | 3.900 | 4.000 | 4.100 | 0.153 | 0.157 | 0.161 |
| E | 1.420 | 1.520 | 1.620 | 0.056 | 0.060 | 0.064 |
| E1 | - | 0.750 | - | - | 0.030 | - |
| E | - | 1.270 | - | - | 0.050 | - |
| e1 | - | 2.540 | - | - | 0.100 | - |
| L | 13.50 | 14.50 | 15.50 | 0.531 | 0.571 | 0.610 |
| L1 | - | 1.600 | - | - | 0.063 | - |
| θ 1 | - | 6° | - | - | 6° | - |
| θ 2 | - | 3° | - | - | 3° | - |
| θ 3 | - | 45° | - | - | 45° | - |
| θ 4 | - | 3° | - | - | 3° | - |

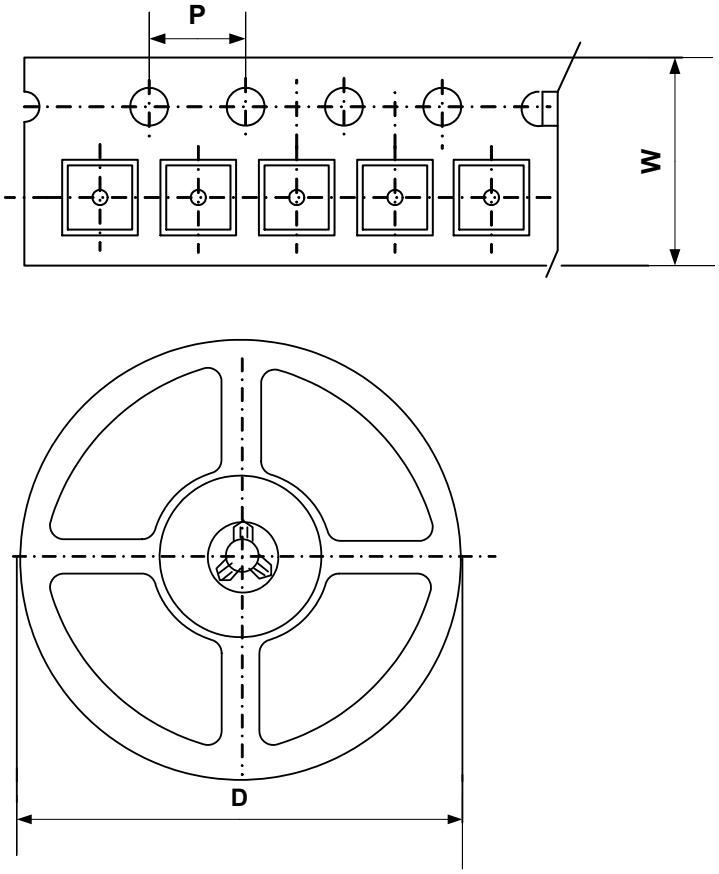
**SOT23-3L:**




| 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 | 2.82 | 3.020 | 0.111 | 0.119 |
| E | 1.500 | 1.700 | 0.059 | 0.067 |
| E1 | 2.650 | 2.95 | 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° |
| X | 0.950(BSC) | | 0.037(BSC) | |
| Y | 0.750 | 0.850 | 0.030 | 0.033 |

## ■ Packing Information

**SOT23-3L**




| Package Type | Carrier Width (W) | Pitch (P) | Reel Size(D) | Packing Minimum |
|---|---|---|---|---|
| SOT23-3L | 8.0±0.1 mm | 4.0±0.1 mm | 180±1 mm | 3000pcs |

Note: Carrier Tape Dimension, Reel Size and Packing Minimum

## ■ Packing Information

1. Packing type: Bulk
2. Packing minimum: 1000pcs