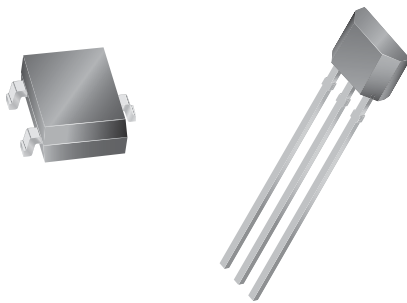


## Continuous-Time Ratiometric Linear Hall Effect Sensors

### Features and Benefits

- Low-noise output
- Fast power-on time
- Ratiometric rail-to-rail output
- 4.5 to 6.0 V operation
- Solid-state reliability
- Factory-programmed at end-of-line for optimum performance
- Robust ESD performance

**Packages: 3 pin SOT23W (suffix LH), and 3 pin SIP (suffix UA)**



*Not to scale*

### Description

The A1301 and A1302 are continuous-time, ratiometric, linear Hall-effect sensors. They are optimized to accurately provide a voltage output that is proportional to an applied magnetic field. These devices have a quiescent output voltage that is 50% of the supply voltage. Two output sensitivity options are provided: 2.5 mV/G typical for the A1301, and 1.3 mV/G typical for the A1302.

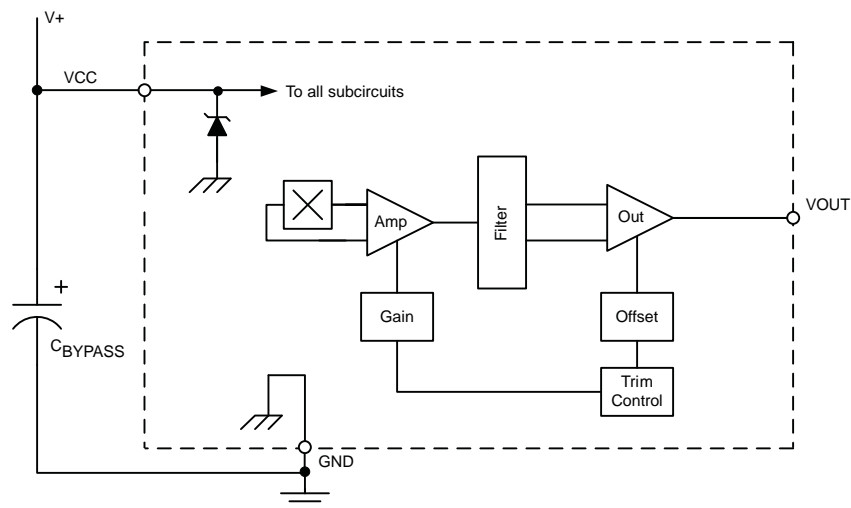
The Hall-effect integrated circuit included in each device includes a Hall sensing element, a linear amplifier, and a CMOS Class A output structure. Integrating the Hall sensing element and the amplifier on a single chip minimizes many of the problems normally associated with low voltage level analog signals.

High precision in output levels is obtained by internal gain and offset trim adjustments made at end-of-line during the manufacturing process.

These features make the A1301 and A1302 ideal for use in position sensing systems, for both linear target motion and rotational target motion. They are well-suited for industrial applications over extended temperature ranges, from  $-40^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ .

Two device package types are available: LH, a 3-pin SOT23W type for surface mount, and UA, a 3-pin ultramini SIP for through-hole mount. They are lead (Pb) free (suffix,  $-T$ ) with 100% matte tin plated leadframes.

### Functional Block Diagram



# A1301 and A1302

# Continuous-Time Ratiometric Linear Hall Effect Sensors

Selection Guide				
Part Number	Packing <sup>1</sup>	Package	Ambient, T <sub>A</sub>	Sensitivity (Typical)
<del>A1301ELHLT-T<sup>2</sup></del>	7-in. tape and reel, 3000 pieces/reel	Surface Mount	-40°C to 85°C	2.5 mV/G
A1301EUA-T	Bulk, 500 pieces/bag	SIP		
A1301KLHLT-T	7-in. tape and reel, 3000 pieces/reel	Surface Mount	-40°C to 125°C	
A1301KUA-T	Bulk, 500 pieces/bag	SIP		
A1302ELHLT-T	7-in. tape and reel, 3000 pieces/reel	Surface Mount	-40°C to 85°C	1.3 mV/G
<del>A1302EUA-T<sup>3</sup></del>	Bulk, 500 pieces/bag	SIP		
A1302KLHLT-T	7-in. tape and reel, 3000 pieces/reel	Surface Mount	-40°C to 125°C	
A1302KUA-T	Bulk, 500 pieces/bag	SIP		

<sup>1</sup>Contact Allegro for additional packing options.

<sup>2</sup>Variant is in production but has been determined to be LAST TIME BUY. This classification indicates that the variant is obsolete and notice has been given. Sale of the variant is currently restricted to existing customer applications. The variant should not be purchased for new design applications because of obsolescence in the near future. Samples are no longer available. Status date change May 4, 2009. Deadline for receipt of LAST TIME BUY orders is November 4, 2009.

<sup>3</sup>Variant is in production but has been determined to be NOT FOR NEW DESIGN. This classification indicates that sale of the variant is currently restricted to existing customer applications. The variant should not be purchased for new design applications because obsolescence in the near future is probable. Samples are no longer available. Status change: May 4, 2009.

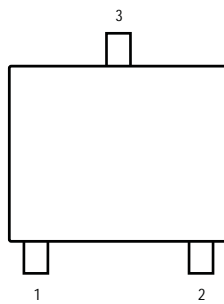


## Absolute Maximum Ratings

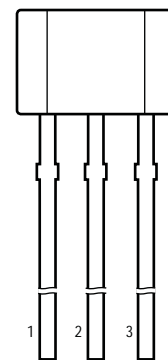
Characteristic	Symbol	Notes	Rating	Units
Supply Voltage	V <sub>CC</sub>		8	V
Output Voltage	V <sub>OUT</sub>		8	V
Reverse Supply Voltage	V <sub>RCC</sub>		-0.1	V
Reverse Supply Voltage	V <sub>RCC</sub>		-0.1	V
Output Sink Current	I <sub>OUT</sub>		10	mA
Operating Ambient Temperature	T <sub>A</sub>	Range E	-40 to 85	°C
		Range K	-40 to 125	°C
Maximum Junction Temperature	T <sub>J(max)</sub>		165	°C
Storage Temperature	T <sub>stg</sub>		-65 to 170	°C

Pin-out Drawings

Package LH



Package UA



Terminal List

Symbol	Number		Description
	Package LH	Package UA	
VCC	1	1	Connects power supply to chip
VOUT	2	3	Output from circuit
GND	3	2	Ground

**DEVICE CHARACTERISTICS** over operating temperature range,  $T_A$ , and  $V_{CC} = 5\text{ V}$ , unless otherwise noted

Characteristic	Symbol	Test Conditions	Min.	Typ.	Max.	Units
<b>Electrical Characteristics</b>						
Supply Voltage	$V_{CC}$	Running, $T_J < 165^\circ\text{C}$	4.5	–	6	V
Supply Current	$I_{CC}$	Output open	–	–	11	mA
Output Voltage	$V_{OUT(High)}$	$I_{SOURCE} = -1\text{ mA}$ , Sens = nominal	4.65	4.7	–	V
	$V_{OUT(Low)}$	$I_{SINK} = 1\text{ mA}$ , Sens = nominal	–	0.2	0.25	V
Output Bandwidth	BW		–	20	–	kHz
Power-On Time	$t_{PO}$	$V_{CC(min)}$ to $0.95 V_{OUT}$ ; $B = \pm 1400\text{ G}$ ; Slew rate = $4.5\text{ V}/\mu\text{s}$ to $4.5\text{ V}/100\text{ ns}$	–	3	5	$\mu\text{s}$
Output Resistance	$R_{OUT}$	$I_{SINK} \leq 1\text{ mA}$ , $I_{SOURCE} \geq -1\text{ mA}$	–	2	5	$\Omega$
Wide Band Output Noise, rms	$V_{OUTN}$	External output low pass filter $\leq 10\text{ kHz}$ ; Sens = nominal	–	150	–	$\mu\text{V}$
<b>Ratiometry</b>						
Quiescent Output Voltage Error with respect to $\Delta V_{CC}$ <sup>1</sup>	$\Delta V_{OUTQ(V)}$	$T_A = 25^\circ\text{C}$	–	–	$\pm 3.0$	%
Magnetic Sensitivity Error with respect to $\Delta V_{CC}$ <sup>2</sup>	$\Delta \text{Sens}_{(V)}$	$T_A = 25^\circ\text{C}$	–	–	$\pm 3.0$	%
<b>Output</b>						
Linearity	Lin	$T_A = 25^\circ\text{C}$	–	–	$\pm 2.5$	%
Symmetry	Sym	$T_A = 25^\circ\text{C}$	–	–	$\pm 3.0$	%
<b>Magnetic Characteristics</b>						
Quiescent Output Voltage	$V_{OUTQ}$	$B = 0\text{ G}$ ; $T_A = 25^\circ\text{C}$	2.4	2.5	2.6	V
Quiescent Output Voltage over Operating Temperature Range	$V_{OUTQ(\Delta T_A)}$	$B = 0\text{ G}$	2.2	–	2.8	V
Magnetic Sensitivity	Sens	A1301; $T_A = 25^\circ\text{C}$	2.0	2.5	3.0	mV/G
		A1302; $T_A = 25^\circ\text{C}$	1.0	1.3	1.6	mV/G
Magnetic Sensitivity over Operating Temperature Range	$\text{Sens}_{(\Delta T_A)}$	A1301	1.8	–	3.2	mV/G
		A1302	0.85	–	1.75	mV/G

<sup>1</sup>Refer to equation (4) in Ratiometric section on page 4.

<sup>2</sup>Refer to equation (5) in Ratiometric section on page 4.

**Characteristic Definitions**

**Quiescent Output Voltage.** In the quiescent state (no significant magnetic field:  $B = 0$ ), the output,  $V_{OUTQ}$ , equals one half of the supply voltage,  $V_{CC}$ , throughout the entire operating ranges of  $V_{CC}$  and ambient temperature,  $T_A$ . Due to internal component tolerances and thermal considerations, there is a tolerance on the quiescent output voltage,  $\Delta V_{OUTQ}$ , which is a function of both  $\Delta V_{CC}$  and  $\Delta T_A$ . For purposes of specification, the quiescent output voltage as a function of temperature,  $\Delta V_{OUTQ(\Delta T_A)}$ , is defined as:

$$\Delta V_{OUTQ(\Delta T_A)} = \frac{V_{OUTQ(T_A)} - V_{OUTQ(25^\circ C)}}{Sens_{(25^\circ C)}} \quad (1)$$

where  $Sens$  is in mV/G, and the result is the device equivalent accuracy, in gauss (G), applicable over the entire operating temperature range.

**Sensitivity.** The presence of a south-polarity (+B) magnetic field, perpendicular to the branded face of the device package, increases the output voltage,  $V_{OUT}$ , in proportion to the magnetic field applied, from  $V_{OUTQ}$  toward the  $V_{CC}$  rail. Conversely, the application of a north polarity (-B) magnetic field, in the same orientation, proportionally decreases the output voltage from its quiescent value. This proportionality is specified as the magnetic sensitivity of the device and is defined as:

$$Sens = \frac{V_{OUT(-B)} - V_{OUT(+B)}}{2B} \quad (2)$$

The stability of the device magnetic sensitivity as a function of ambient temperature,  $\Delta Sens_{(\Delta T_A)}$  (%) is defined as:

$$\Delta Sens_{(\Delta T_A)} = \frac{Sens_{(T_A)} - Sens_{(25^\circ C)}}{Sens_{(25^\circ C)}} \times 100\% \quad (3)$$

**Ratiometric.** The A1301 and A1302 feature a ratiometric output. This means that the quiescent voltage output,  $V_{OUTQ}$ , and the magnetic sensitivity,  $Sens$ , are proportional to the supply voltage,  $V_{CC}$ .

The ratiometric change (%) in the quiescent voltage output is defined as:

$$\Delta V_{OUTQ(\Delta V)} = \frac{V_{OUTQ(V_{CC})} / V_{OUTQ(5V)}}{V_{CC} / 5V} \times 100\% \quad (4)$$

and the ratiometric change (%) in sensitivity is defined as:

$$\Delta Sens_{(\Delta V)} = \frac{Sens_{(V_{CC})} / Sens_{(5V)}}{V_{CC} / 5V} \times 100\% \quad (5)$$

**Linearity and Symmetry.** The on-chip output stage is designed to provide linear output at a supply voltage of 5 V. Although the application of very high magnetic fields does not damage these devices, it does force their output into a nonlinear region. Linearity in percent is measured and defined as:

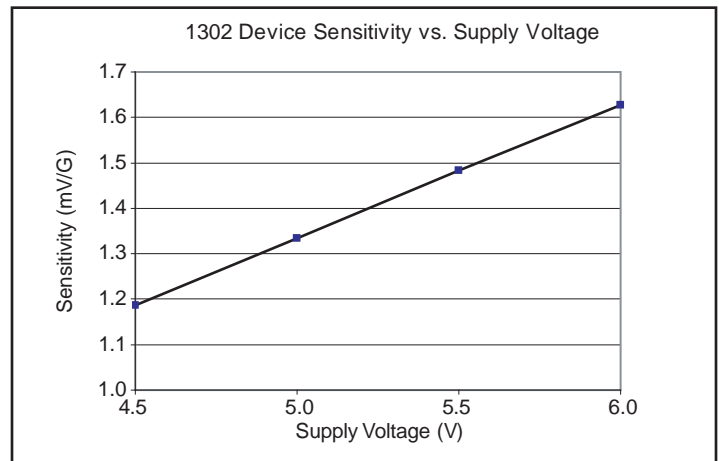
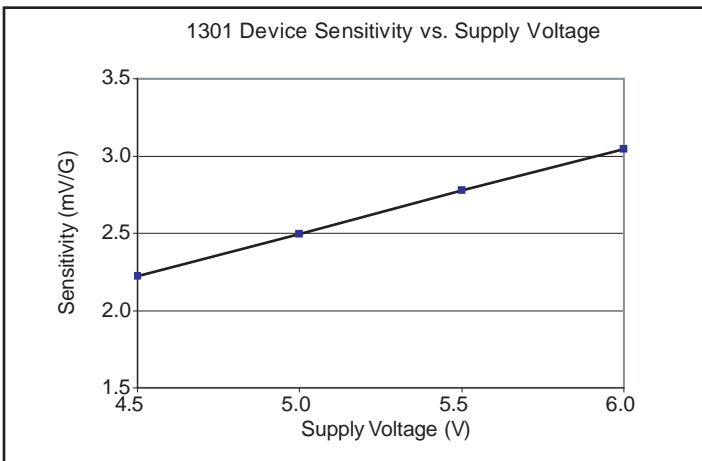
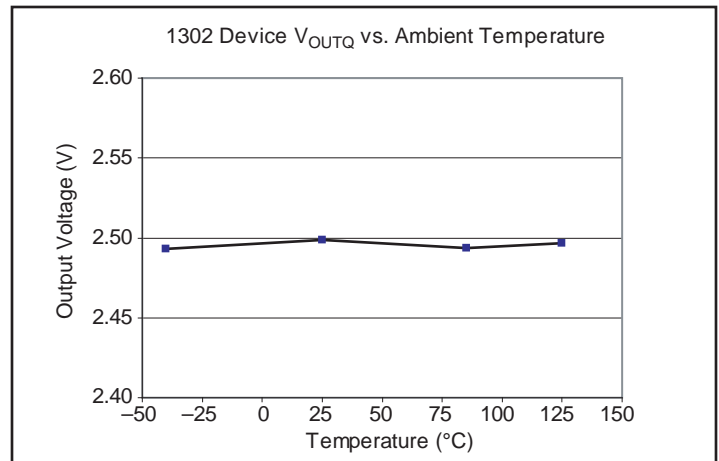
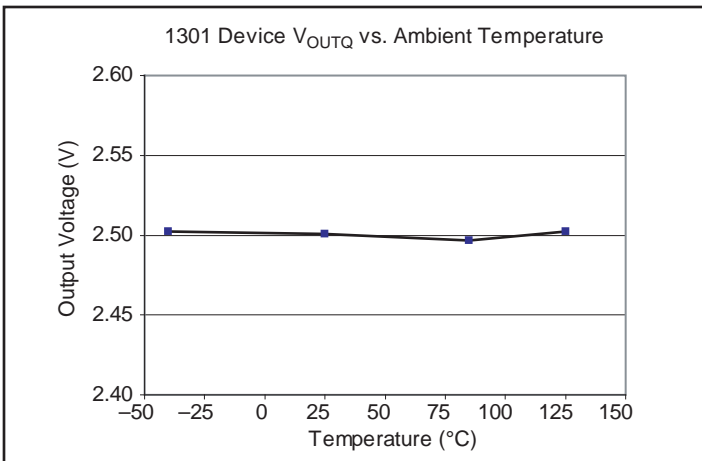
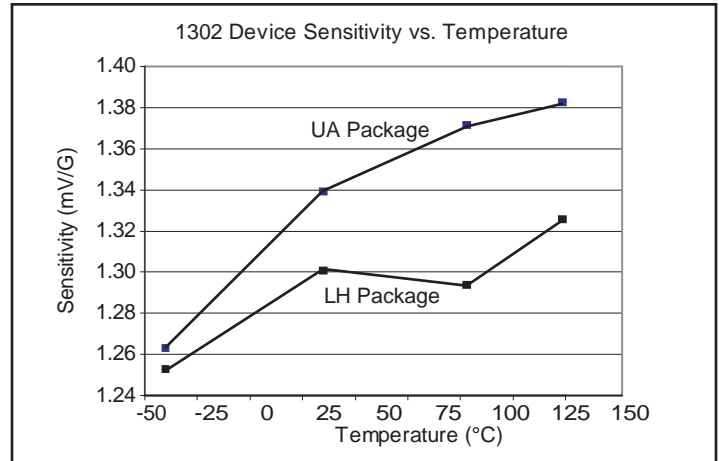
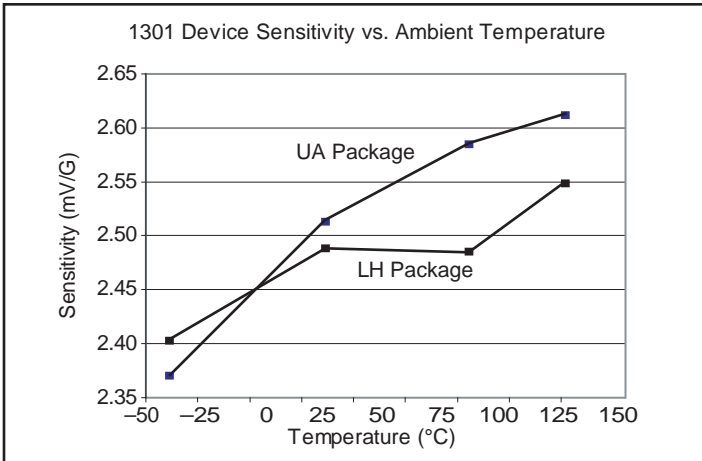
$$Lin+ = \frac{V_{OUT(+B)} - V_{OUTQ}}{2(V_{OUT(+B/2)} - V_{OUTQ})} \times 100\% \quad (6)$$

$$Lin- = \frac{V_{OUT(-B)} - V_{OUTQ}}{2(V_{OUT(-B/2)} - V_{OUTQ})} \times 100\% \quad (7)$$

and output symmetry as:

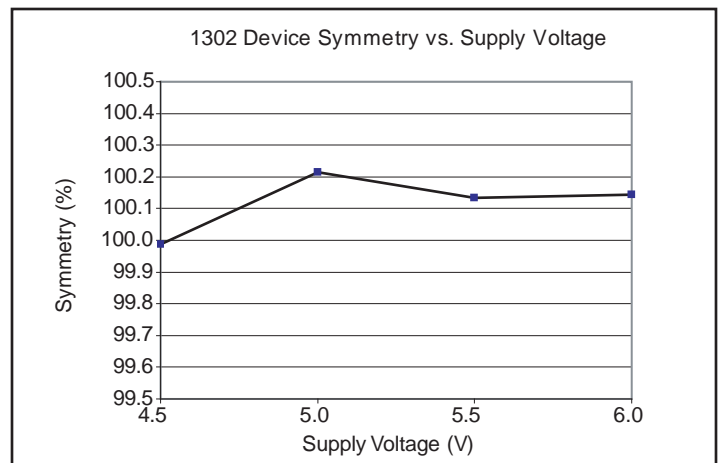
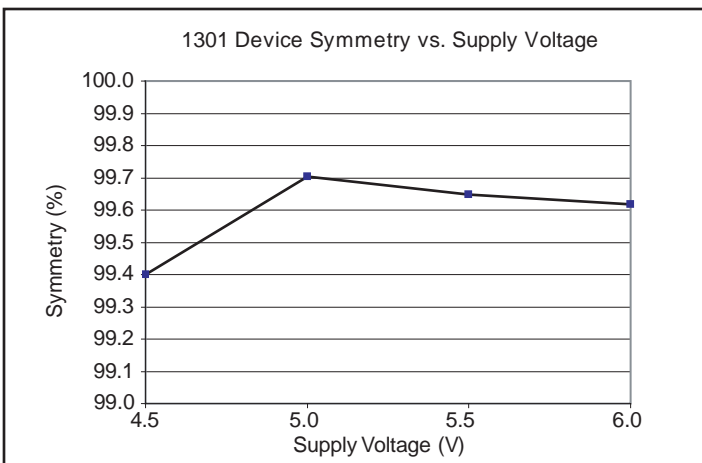
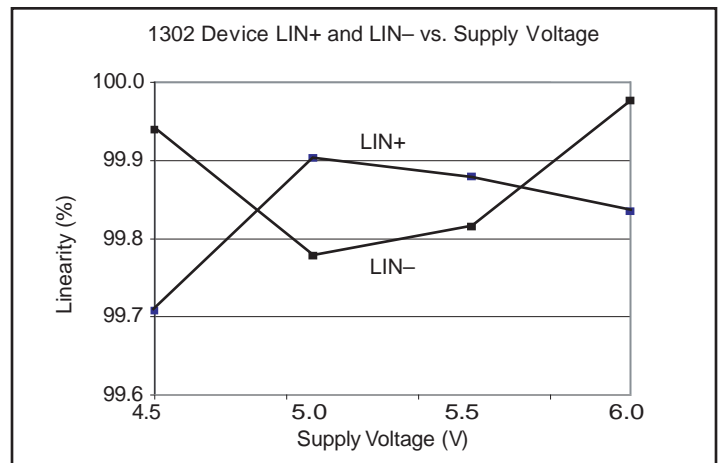
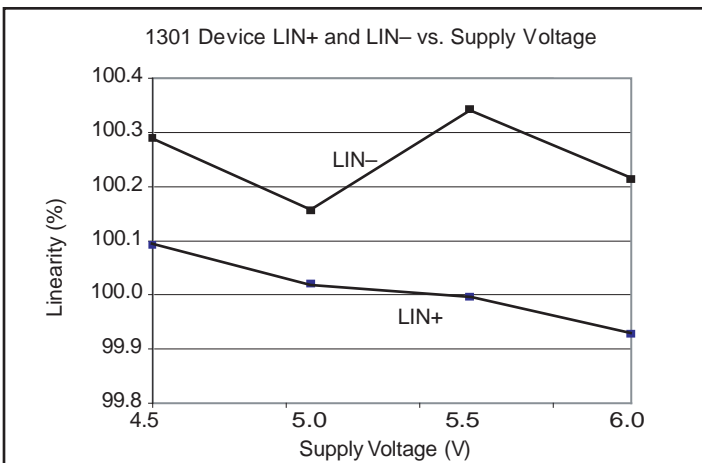
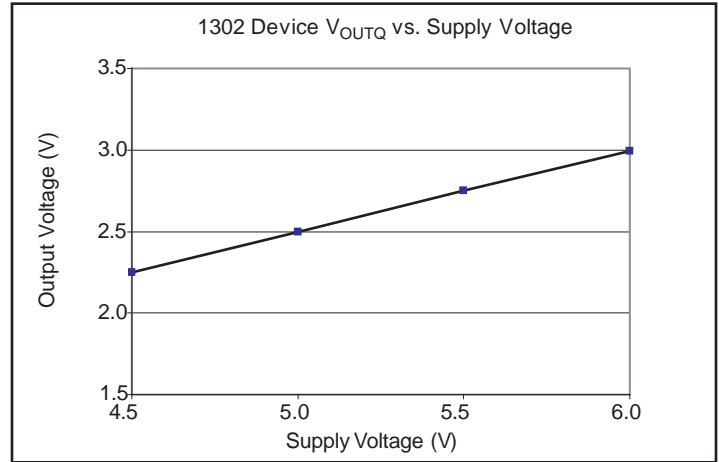
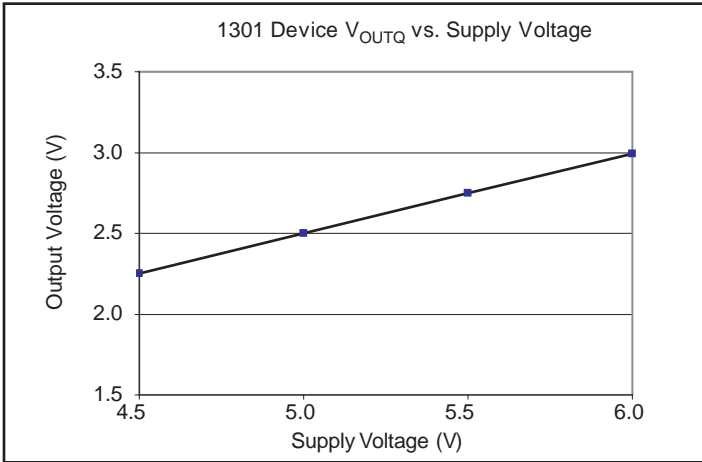
$$Sym = \frac{V_{OUT(+B)} - V_{OUTQ}}{V_{OUTQ} - V_{OUT(-B)}} \times 100\% \quad (8)$$

**Typical Characteristics  
(30 pieces, 3 fabrication lots)**

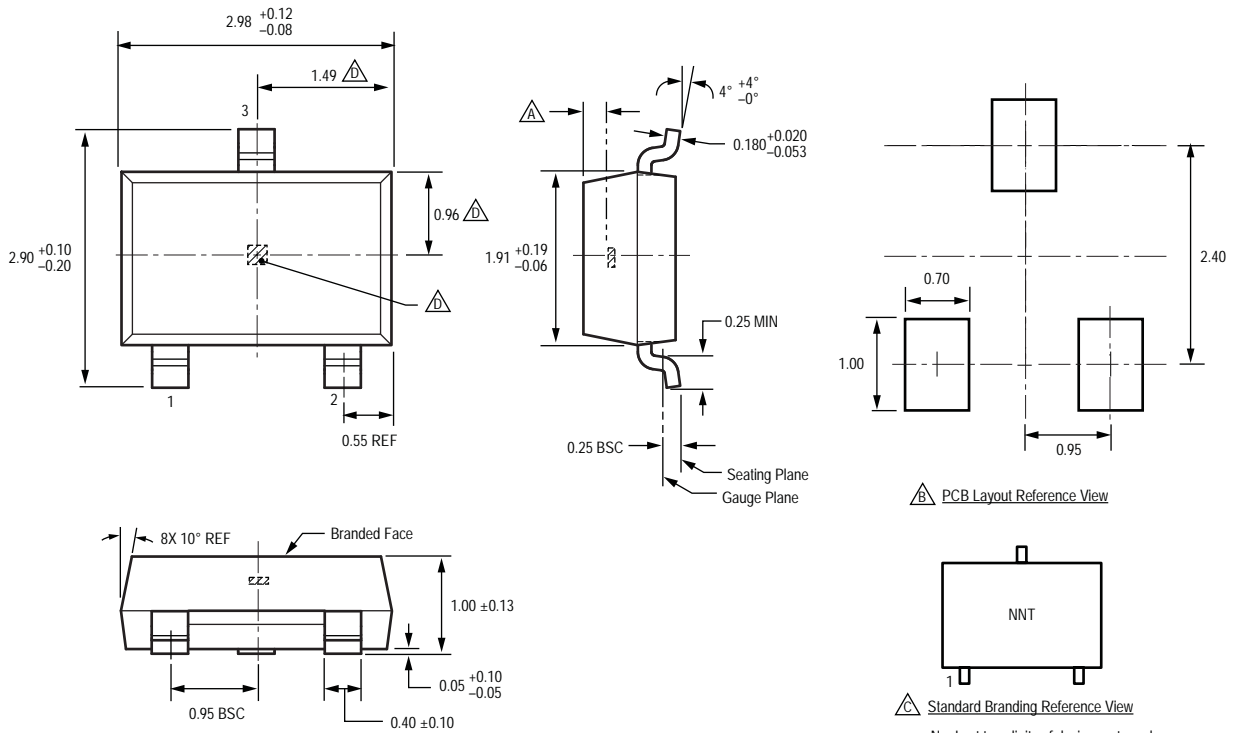


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Typical Characteristics, continued  
(30 pieces, 3 fabrication lots)



**Package LH, 3-Pin; (SOT-23W)**



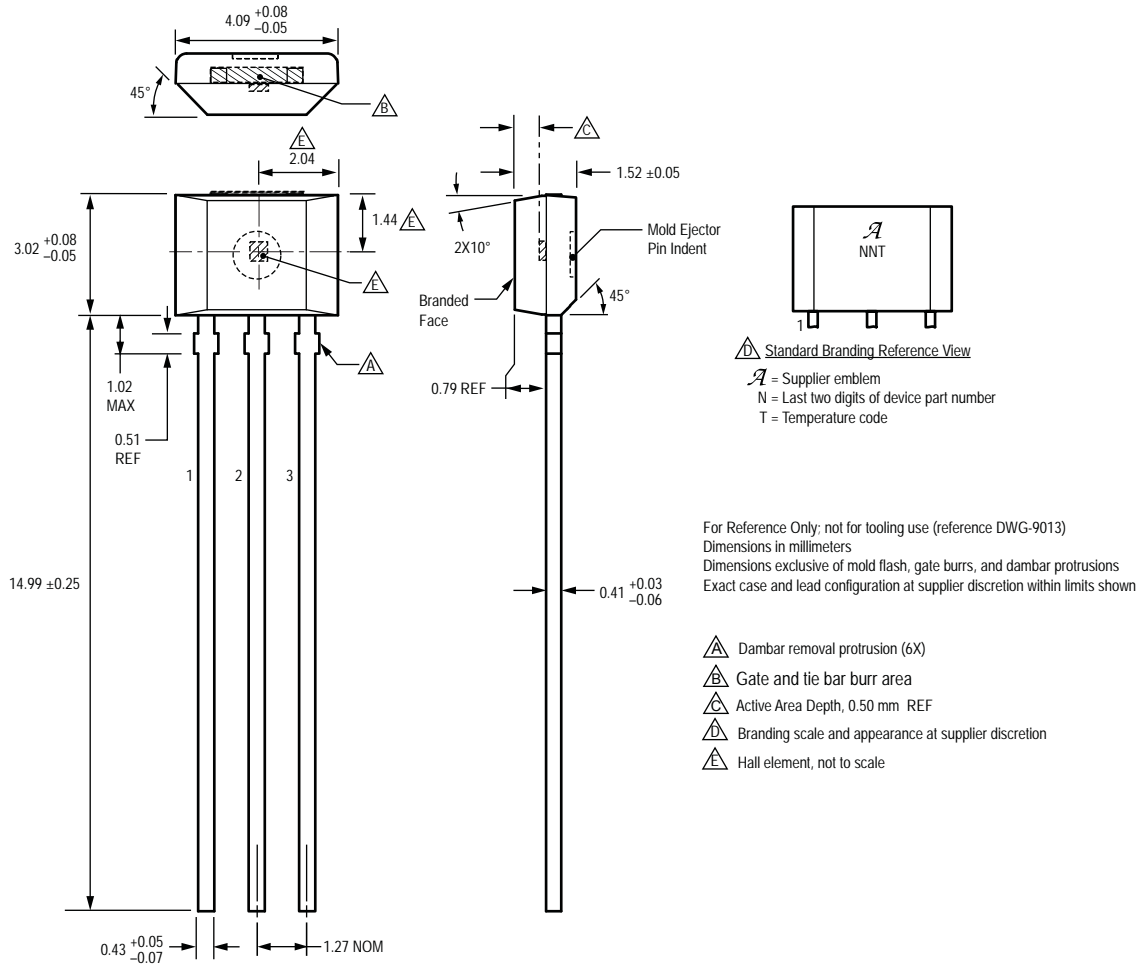
For Reference Only; not for tooling use (reference dwg. 802840)  
 Dimensions in millimeters  
 Dimensions exclusive of mold flash, gate burrs, and dambar protrusions  
 Exact case and lead configuration at supplier discretion within limits shown

- Active Area Depth, 0.28 mm REF
- Reference land pattern layout  
All pads a minimum of 0.20 mm from all adjacent pads; adjust as necessary to meet application process requirements and PCB layout tolerances
- Branding scale and appearance at supplier discretion
- Hall element, not to scale

N = Last two digits of device part number  
 T = Temperature code

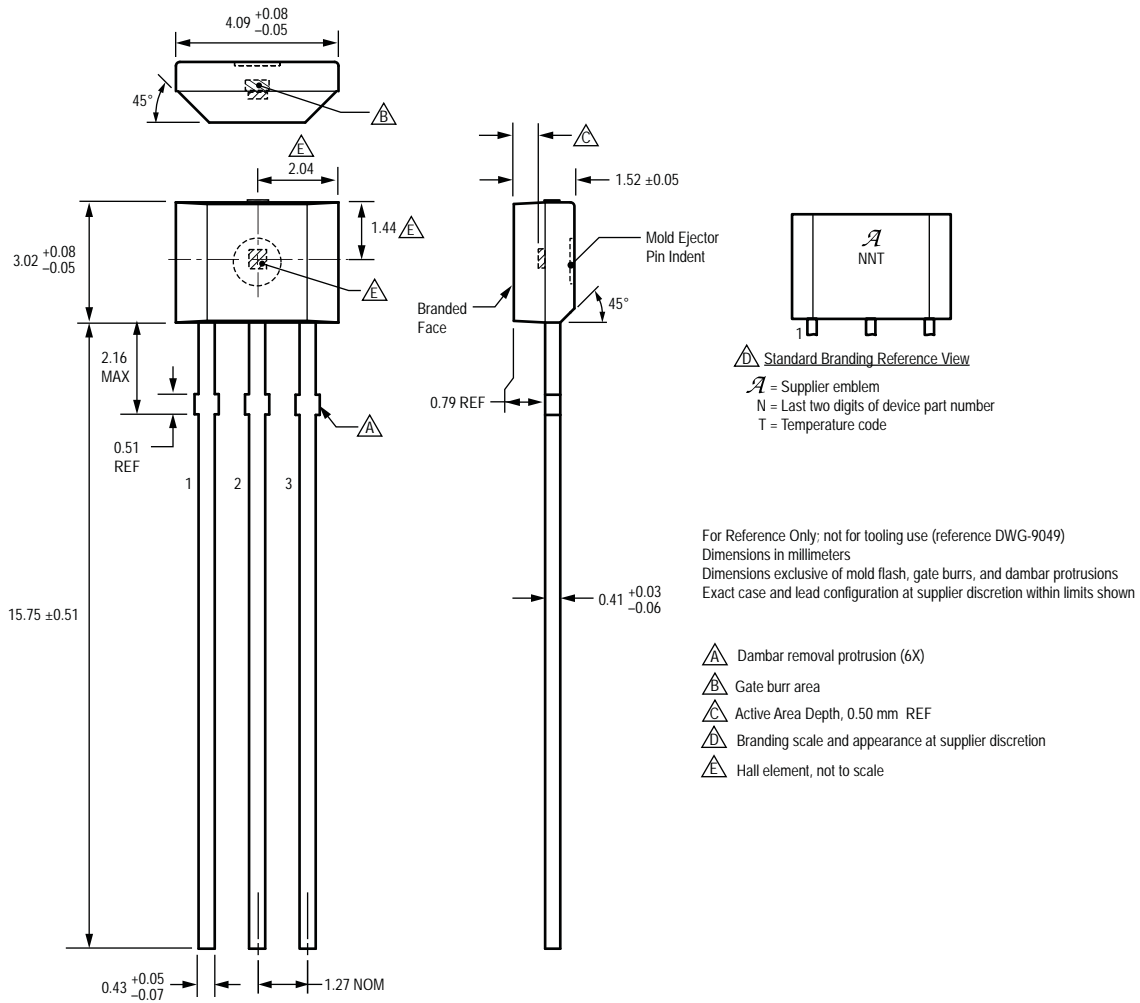


**Package UA, 3-Pin SIP**  
Matrix Leadframe



Please note that there are changes to the existing UA package drawing pending.  
 Please contact the Allegro Marketing department for additional information.

**Package UA, 3-Pin SIP  
Conventional Leadframe**



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The products described herein are manufactured under one or more of the following U.S. patents: 5,045,920; 5,264,783; 5,442,283; 5,389,889; 5,581,179; 5,517,112; 5,619,137; 5,621,319; 5,650,719; 5,686,894; 5,694,038; 5,729,130; 5,917,320; and other patents pending.

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