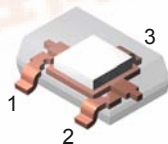


# A1301 and A1302

## Continuous-Time Ratiometric Linear Hall Effect Sensors

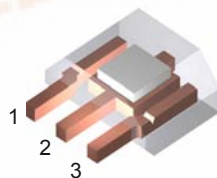
Package LH, 3-pin Surface Mount

1. VCC
2. VOUT
3. GND



Package UA, 3-pin SIP

1. VCC
2. GND
3. VOUT



### ABSOLUTE MAXIMUM RATINGS

Supply Voltage, $V_{CC}$	8 V
Output Voltage, $V_{OUT}$	8 V
Reverse-Supply Voltage, $V_{RCC}$	-0.1 V
Reverse-Output Voltage, $V_{ROUT}$	-0.1 V
Output Sink Current, $I_{OUT}$	10 mA
Operating Temperature	
Ambient, $T_A$ , Range E	-40°C to 85°C
Ambient, $T_A$ , Range K	-40°C to 125°C
Maximum Junction, $T_{J(max)}$	165°C
Storage Temperature, $T_S$	-65°C to 170°C

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°C to 125°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. Each package is available in a lead (Pb) free version (suffix, -T) with 100% matte tin plated lead-frame.

### 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



# A1301 and A1302

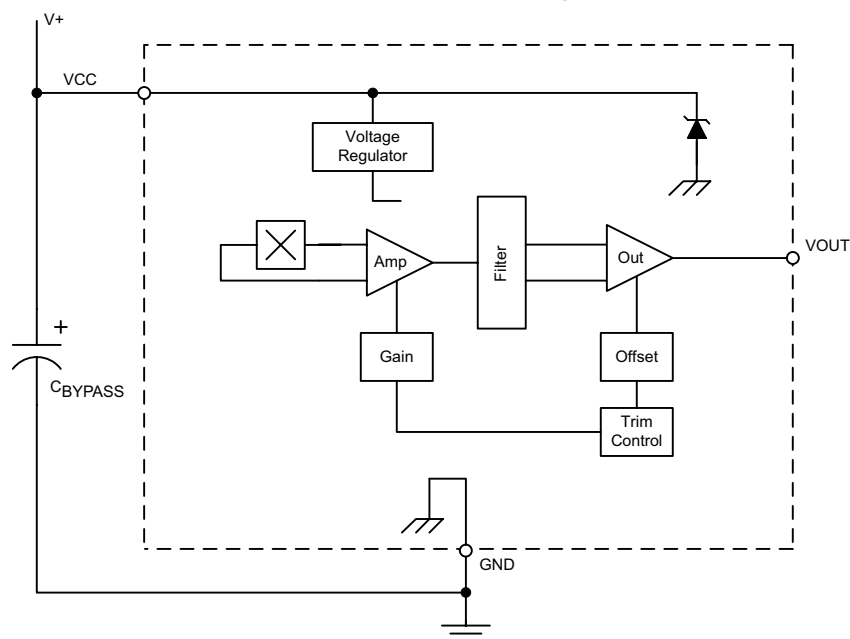
## Continuous-Time Ratiometric Linear Hall Effect Sensors

### Product Selection Guide

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

\*Contact Allegro for additional packing options.

### Functional Block Diagram



### Terminal List

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

# A1301 and A1302

## Continuous-Time Ratiometric Linear Hall Effect Sensors

**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.

# A1301 and A1302

## Continuous-Time Ratiometric Linear Hall Effect Sensors

### 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, however, 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:

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

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:

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

**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:

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

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:

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

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

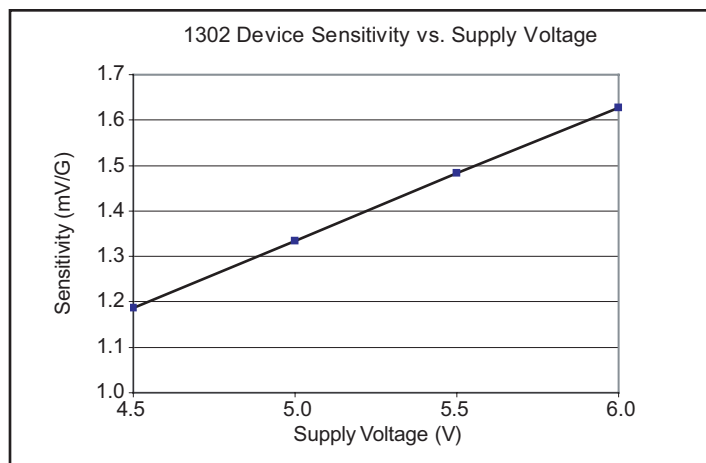
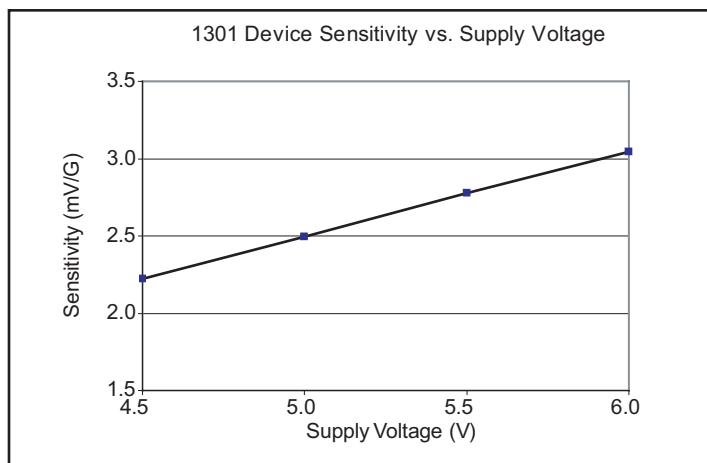
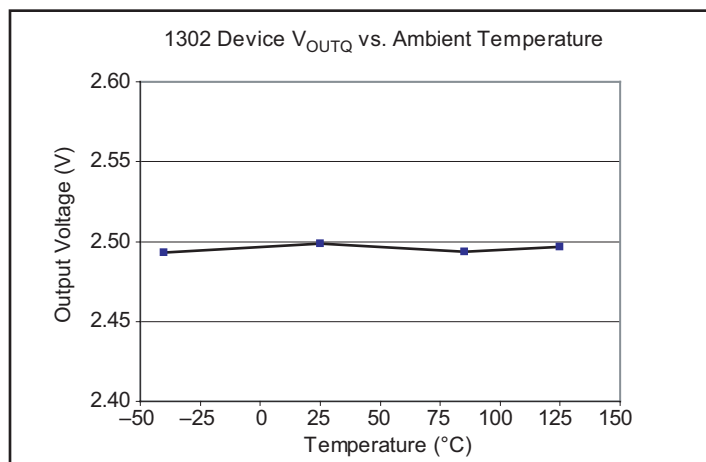
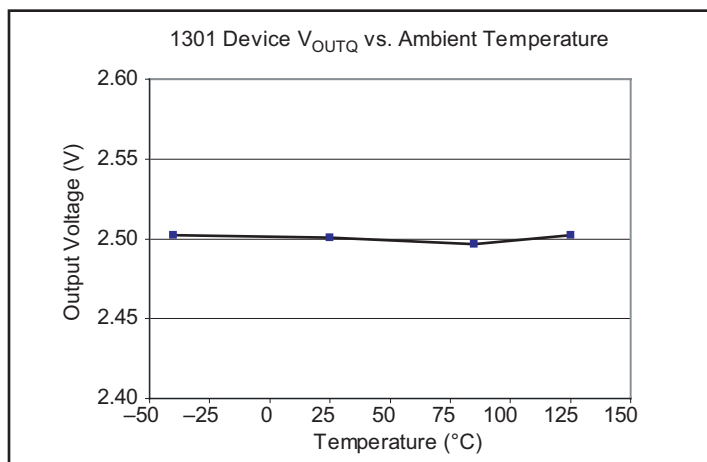
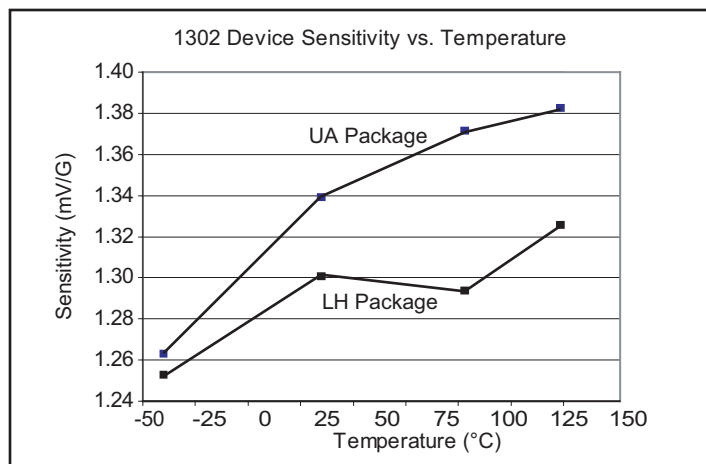
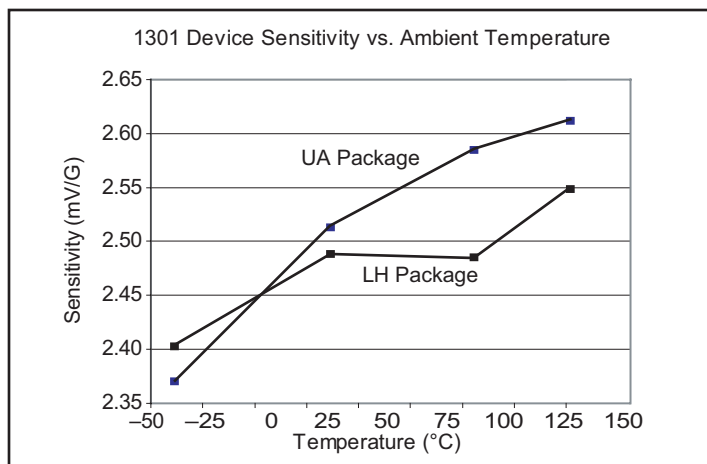
and output symmetry as:

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

# A1301 and A1302

## Continuous-Time Ratiometric Linear Hall Effect Sensors

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

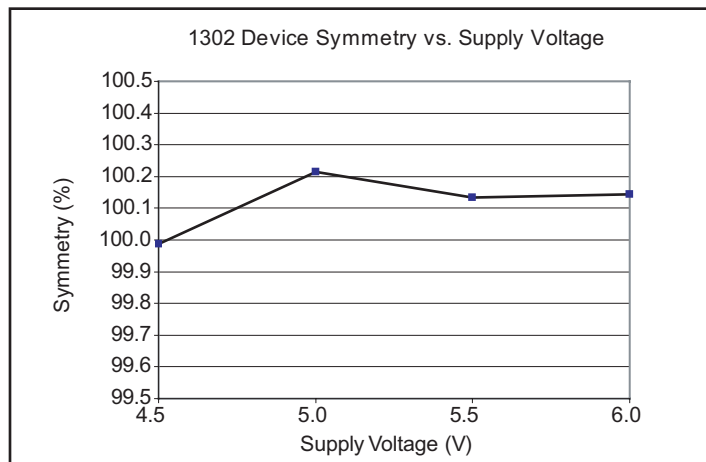
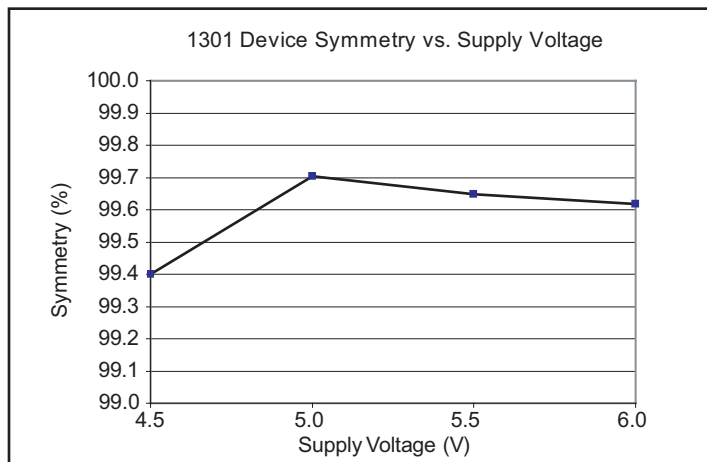
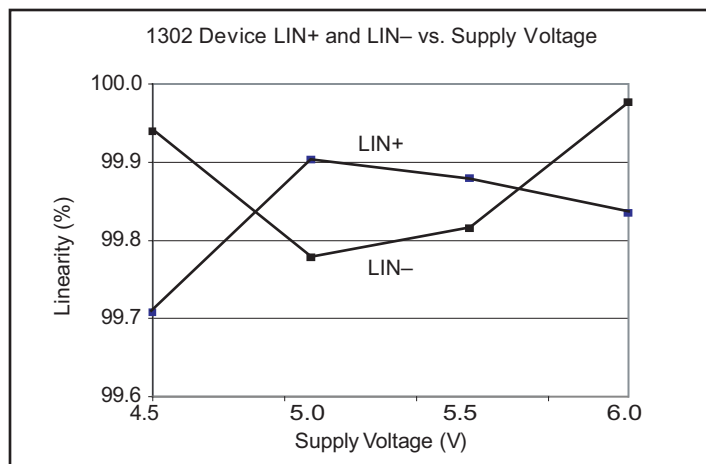
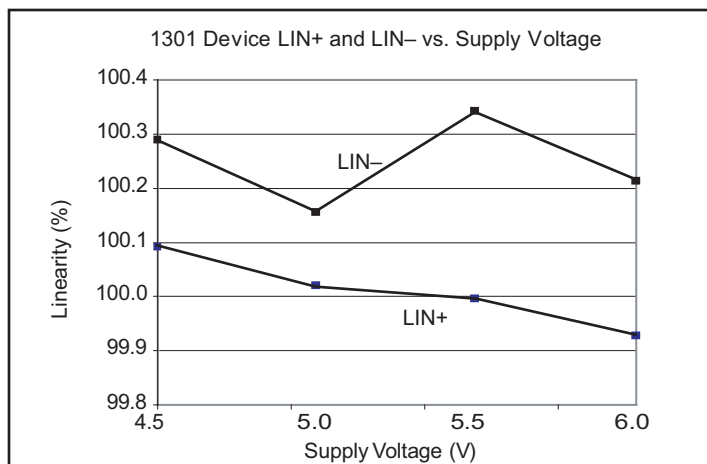
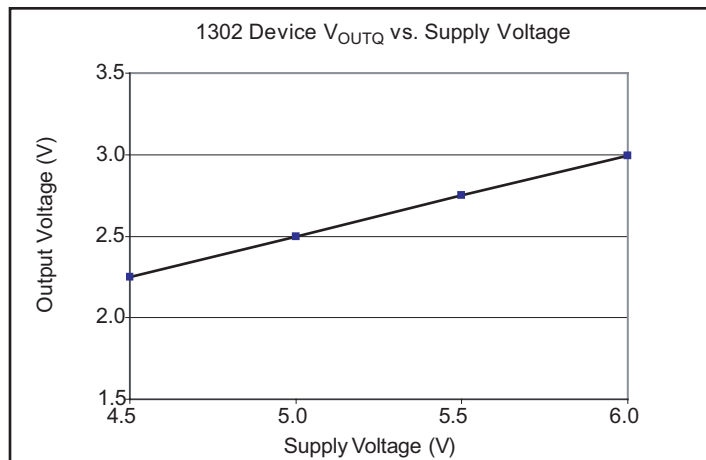
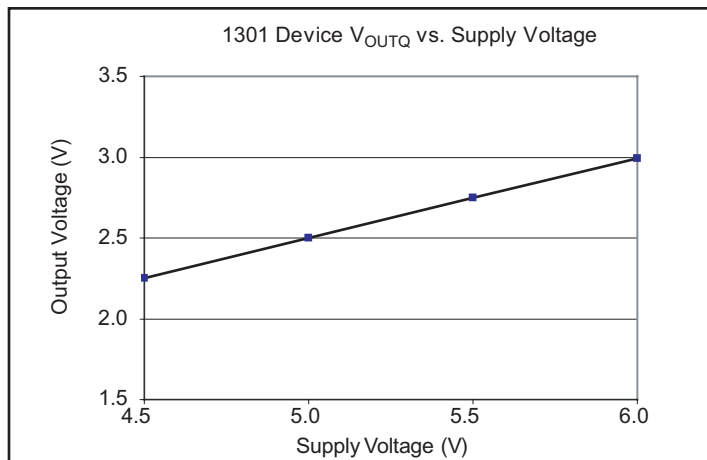


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# A1301 and A1302

## Continuous-Time Ratiometric Linear Hall Effect Sensors

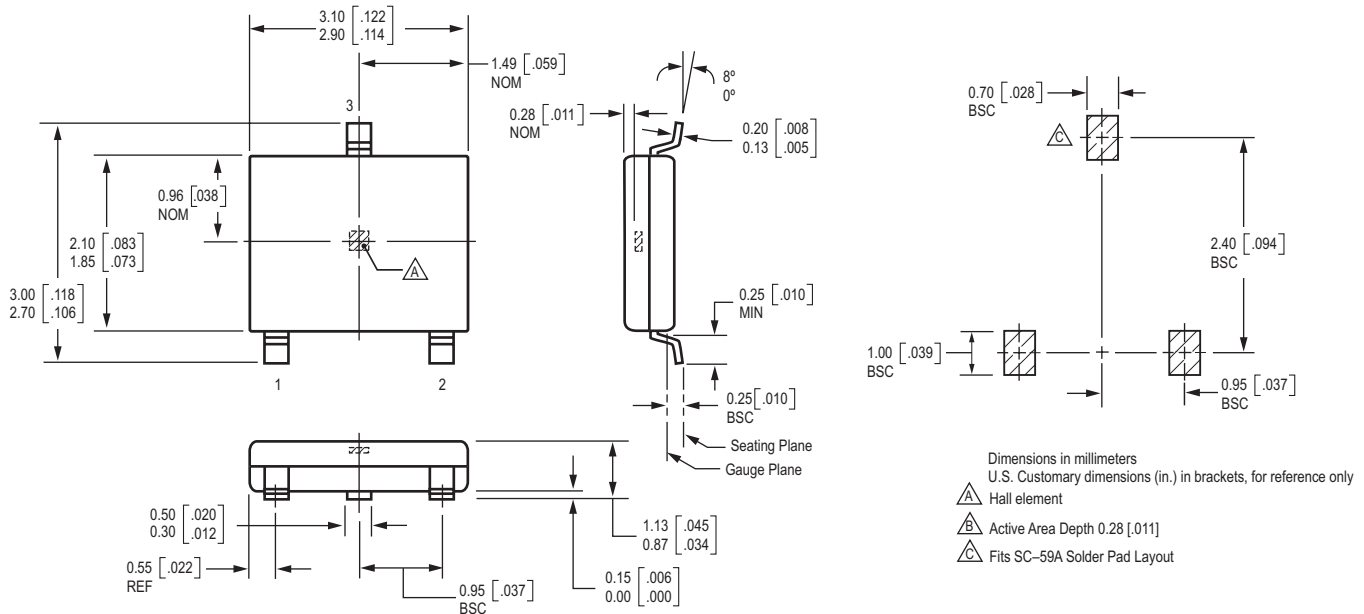
### Typical Characteristics, continued (30 pieces, 3 fabrication lots)



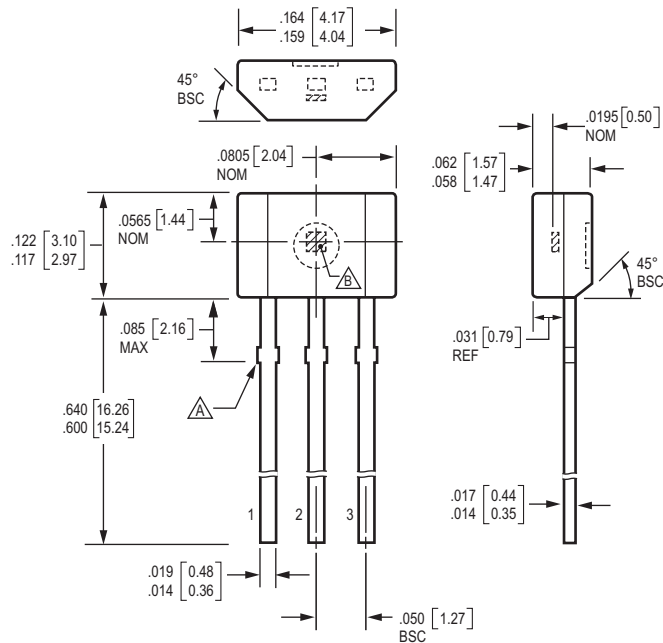
# A1301 and A1302

## Continuous-Time Ratiometric Linear Hall Effect Sensors

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



### Package UA, 3-Pin; (TO-92)



# A1301 and A1302

## Continuous-Time Ratiometric Linear Hall Effect Sensors

*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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