

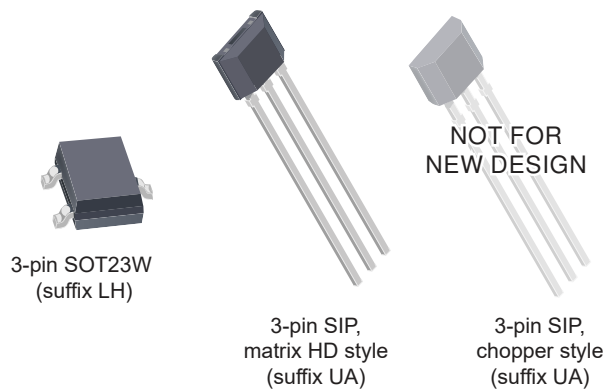
Continuous-Time Bipolar Switch Family

FEATURES AND BENEFITS

- AEC-Q100 automotive qualified
- Continuous-time operation
 - Fast power-on time
 - Low noise
- Stable operation over full operating temperature range
- Reverse-battery protection
- Solid-state reliability
- Factory-programmed at end-of-line for optimum performance
- Robust EMC performance
- High ESD rating
- Regulator stability without a bypass capacitor

PACKAGES:

Not to scale

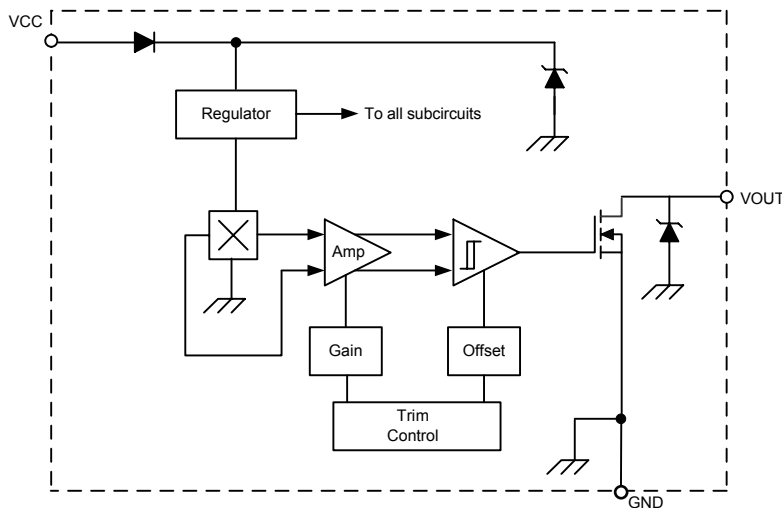


DESCRIPTION

The Allegro™ A1202 and A1203 Hall-effect bipolar switches are next-generation replacements and extension of the popular Allegro A3133 and A3132 bipolar switch product line. Overall, the A120x family, produced with BiCMOS technology, consists of continuous-time devices that feature fast power-on time and low-noise operation. Device programming is performed after packaging, to ensure increased switchpoint accuracy by eliminating offsets that can be induced by package stress. Unique Hall element geometries and low-offset amplifiers help to minimize noise and to reduce the residual offset voltage normally caused by device overmolding, temperature excursions, and thermal stress.

The A120x Hall-effect bipolar switches include the following on a single silicon chip: voltage regulator, Hall-voltage generator, small-signal amplifier, Schmitt trigger, and NMOS output transistor. The integrated voltage regulator permits operation from 3.8 to 24 V. The extensive on-board protection circuitry makes possible a ± 30 V absolute maximum voltage rating for superior protection in automotive and motor commutation applications, without adding external components. All devices in the family are identical, except for magnetic switchpoints.

The small geometries of the BiCMOS process allow these devices to be provided in ultrasmall packages. The package styles available provide magnetically optimized solutions for most applications. Package LH is a SOT23W, a miniature low-profile surface-mount package, while package UA is a three-lead ultramini SIP for through-hole mounting. Each package is lead (Pb) free, with 100% matte-tin-plated leadframes.



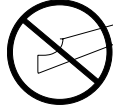
Functional Block Diagram

A1202 and A1203

Continuous-Time Bipolar Switch Family

SELECTION GUIDE

Part Number	Packing [1]	Mounting	Ambient, T_A	B_{RP} (Min)	B_{OP} (Max)
A1202LUA-T [2]	Bulk, 500 pieces/bag	3-pin SIP through hole	-40°C to 150°C	-75	75
A1203EUA-T [2]	Bulk, 500 pieces/bag	3-pin SIP through hole	-40°C to 85°C	-95	95
A1203LLHLT-T	7-in. reel, 3000 pieces/reel	3-pin SOT23W surface mount	-40°C to 150°C		
A1203LLHLX-T	13-in. reel, 10000 pieces/reel	3-pin SOT23W surface mount			
A1203LUA-T [2]	Bulk, 500 pieces/bag	3-pin SIP through hole			



[1] Contact Allegro for additional packing options.

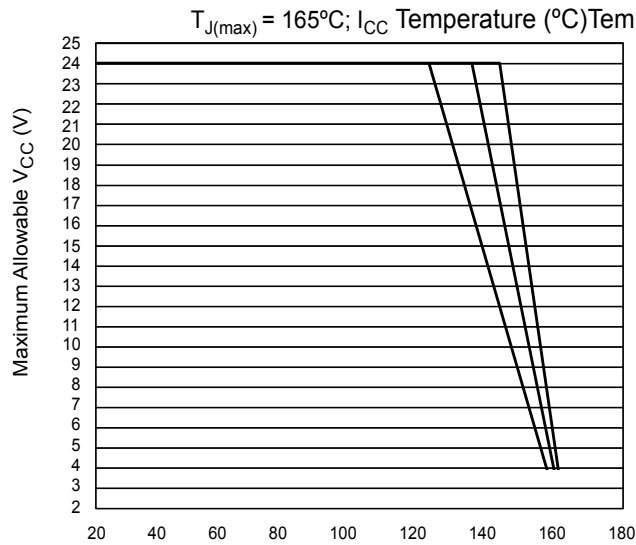
[2] The chopper-style UA package is not for new design; the matrix HD style UA package is recommended for new designs.

OPERATING CHARACTERISTICS: over full operating voltage and ambient temperature ranges,
unless otherwise noted

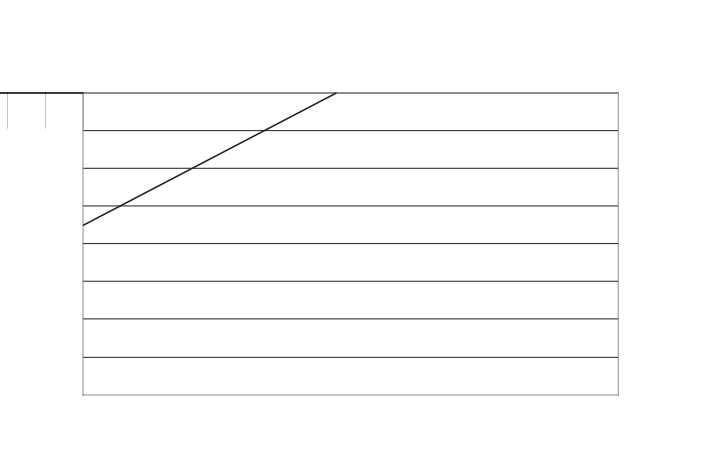
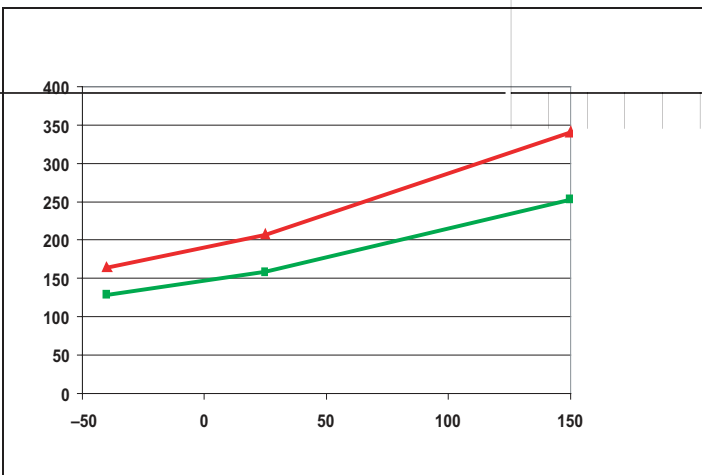
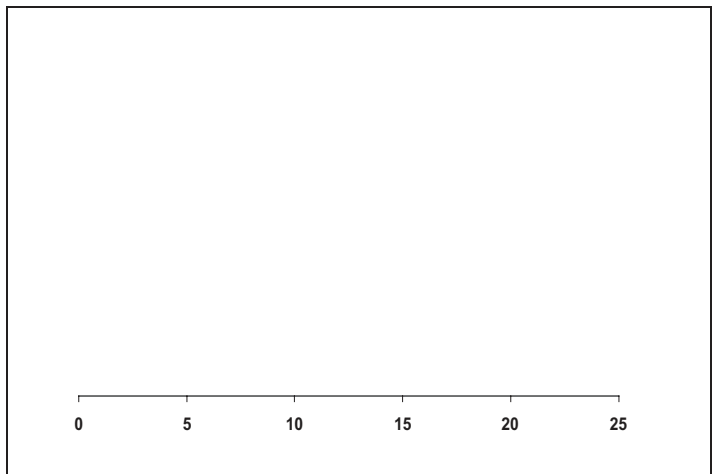
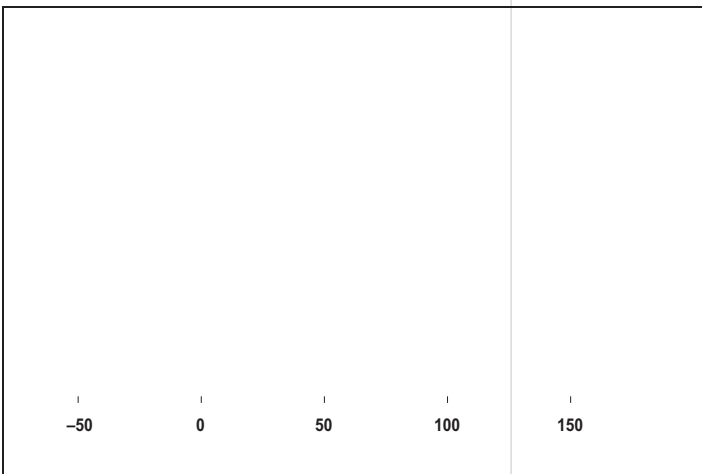
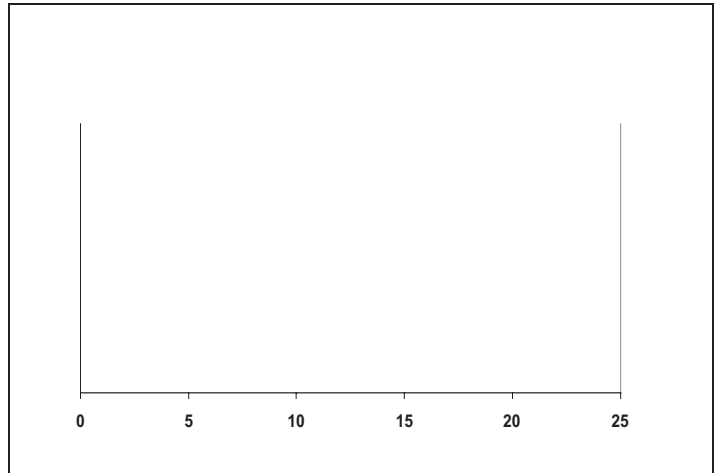
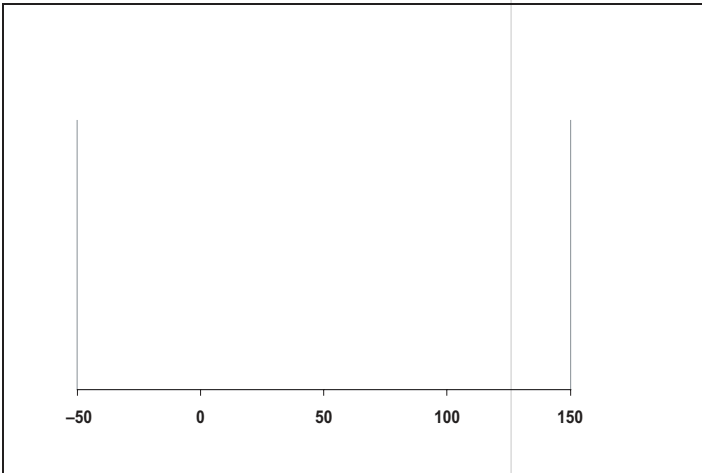
Characteristic	Symbol	Test Conditions	Min.	Typ.	Max.	Units
ELECTRICAL CHARACTERISTICS						

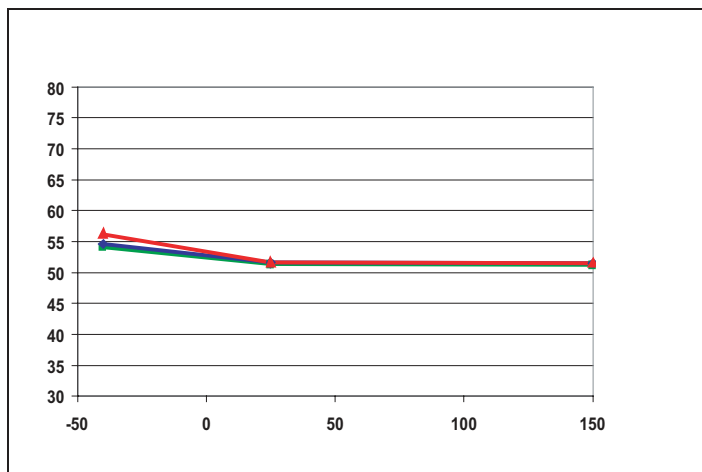
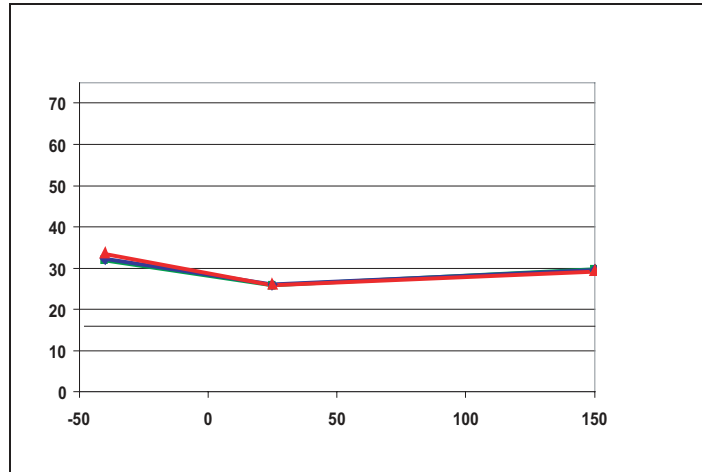
THERMAL CHARACTERISTICS: May require derating at maximum conditions; see application information

Characteristic	Symbol	Test Conditions	Value	Units
Package Thermal Resistance	$R_{\theta JA}$	Package LH, 1-layer PCB with copper limited to solder pads	228	$^{\circ}\text{C}/\text{W}$
		Package LH, 2-layer PCB with 0.463 in ² of copper area each side connected by thermal vias	110	$^{\circ}\text{C}/\text{W}$
		Package UA, 1-layer PCB with copper limited to solder pads	165	$^{\circ}\text{C}/\text{W}$



CHARACTERISTIC DATA





FUNCTIONAL DESCRIPTION

Bipolar Device Switching

The devices of the A120x family provide highly sensitive switching for applications using magnetic fields of alternating polarities, such as ring magnets. There are three switching modes for bipolar devices, referred to as *latch*, *unipolar switch*, and *negative switch*. Mode is determined by the switchpoint characteristics of the individual device. The characteristic hysteresis, B_{HYS} , of the device, is the difference in the relative magnetic strength and polarity of the switchpoints of the device. (Note that, in the following descriptions, a negative magnetic value indicates a north polarity field, and a positive magnetic value indicates a south polarity field. For a given value of magnetic strength, B_X , the values $-B_X$ and B_X indicate two fields of equal strength, but opposite polarity. $B = 0$ indicates the absence of a magnetic field.)

Bipolar devices typically behave as latches. In this mode, magnetic fields of opposite polarity and equivalent strengths are needed to switch the output. When the magnetic fields are removed ($B \rightarrow 0$) the device remains in the same state until a magnetic field of the opposite polarity and of sufficient strength causes it to switch. The hysteresis of latch mode behavior is shown in panel A of Figure 1.

In contrast to latching, when a device exhibits unipolar switching, it only responds to a south magnetic field. The field must be of sufficient strength, $> B_{OP}$, for the device to operate. When the

field is reduced beyond the B_{RP} level, the device switches back to the high state, as shown in panel B of Figure 1. Devices exhibiting negative switch behavior operate in a similar but opposite manner. A north polarity field of sufficient strength, $> B_{RP}$, (more north than B_{RP}) is required for operation, although the result is that V_{OUT} switches high, as shown in panel C of Figure 1.

reduced to below the release point threshold, B_{RP} , the device output, V_{OUT} , goes high. The values of the magnetic parameters are specified in the Magnetic Characteristics table, on page 3. Note that, as shown in Figure 1, these switchpoints can lie in either north or south polarity ranges.

The A120x family is designed to attain a small hysteresis, and thereby provide more sensitive switching. Although this means that true latching behavior cannot be guaranteed in all cases, proper switching can be ensured by use of both south and north magnetic fields, as in a ring magnet. The hysteresis of the A120x family allows clean switching of the output, even in the presence of external mechanical vibration and electrical noise.

Bipolar devices adopt an indeterminate output state when powered-on in the absence of a magnetic field or in a field that lies within the hysteresis band of the device.

For more information on bipolar switches, refer to Application Note 27705, *Understanding Bipolar Hall Effect Sensor ICs*.

Continuous-Time Benefits

Continuous-time devices, such as the A120x family, offer the fastest available power-on settling time and frequency response. Due to offsets generated during the IC packaging process, continuous-time devices typically require programming after packaging to tighten magnetic parameter distributions. In contrast, chopper-stabilized switches employ an offset cancellation technique on the chip that eliminates these offsets without the need for after-packaging programming. The tradeoff is a longer settling time and reduced frequency response as a result of the chopper-stabilization offset cancellation algorithm.

The choice between continuous-time and chopper-stabilized designs is solely determined by the application. Battery management is an example where continuous-time is often required. In these applications, V_{CC} is chopped with a very small duty cycle in order to conserve power (refer to Figure 4). The duty cycle is controlled by the power-on time, t_{PO} , of the device. Because continuous-time devices have the shorter power-on time, they are the clear choice for such applications.

For more information on the chopper stabilization technique, refer to Technical Paper STP 97-10, *Monolithic Magnetic Hall Sensing Using Dynamic Quadrature Offset Cancellation* and Technical Paper STP 99-1, *Chopper-Stabilized Amplifiers with a Track-and-Hold Signal Demodulator*.

Additional Application Information

Extensive applications information for Hall-effect devices is available in:

- *Hall-Effect IC Applications Guide*, Application Note 27701
- *Hall-Effect Devices: Gluing, Potting, Encapsulating, Lead Welding and Lead Forming*, Application Note 27703.1
- *Soldering Methods for Allegro's Products – SMT and Through-Hole*, Application Note 26009

All are provided on Allegro website, www.allegromicro.com.

POWER DERATING

Power Derating

The device must be operated below the maximum junction temperature of the device, $T_{J(max)}$. Under certain combinations of peak conditions, reliable operation may require derating supplied power or improving the heat dissipation properties of the application. This section presents a procedure for correlating factors affecting operating T_J . (Thermal data is also available on the Allegro MicroSystems Web site.)

The Package Thermal Resistance, $R_{\theta JA}$, is a figure of merit summarizing the ability of the application and the device to dissipate heat from the junction (die), through all paths to the ambient air. Its primary component is the Effective Thermal Conductivity, K , of the printed circuit board, including adjacent devices and traces. Radiation from the die through the device case, $R_{\theta JC}$, is relatively small component of $R_{\theta JA}$. Ambient air temperature, T_A , and air motion are significant external factors, damped by overmolding.

The effect of varying power levels (Power Dissipation, P_D), can be estimated. The following formulas represent the fundamental relationships used to estimate T_J , at P_D .

$$P_D = V_{IN} \times I_{IN} \quad (1)$$

$$\Delta T = P_D \times R_{\theta JA} \quad (2)$$

$$T_J$$

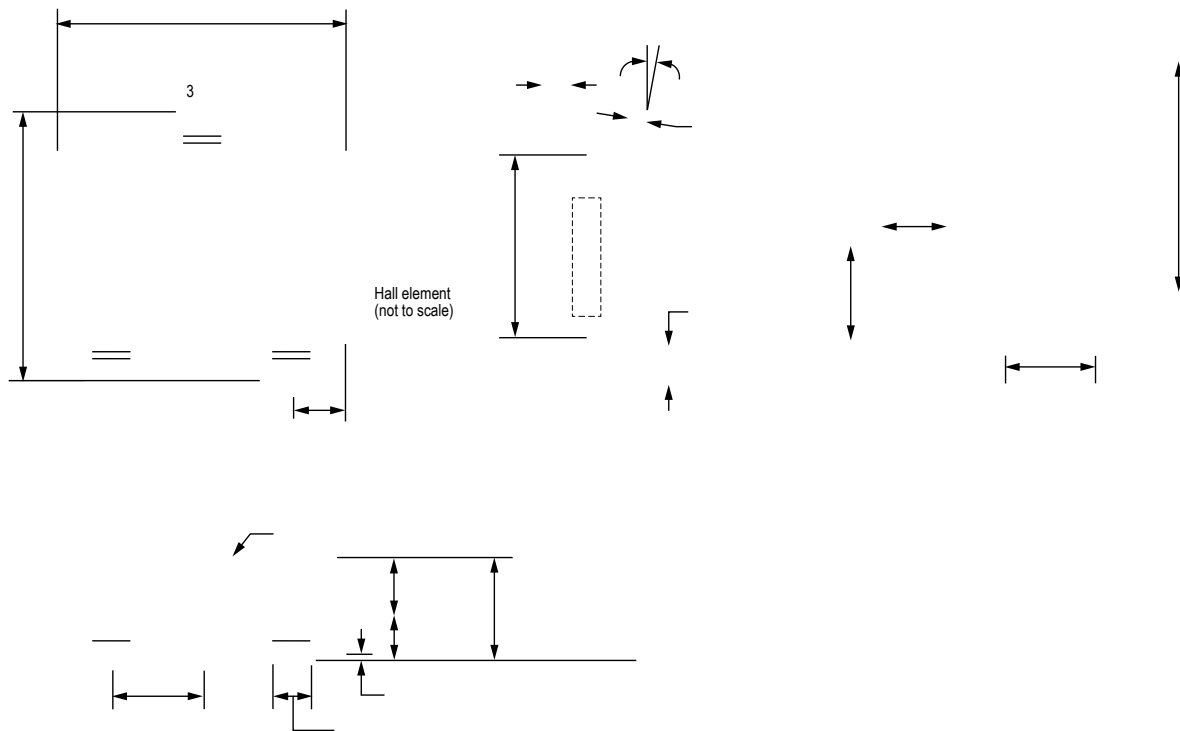


Figure 3: Package LH, 3-Pin (SOT-23W)

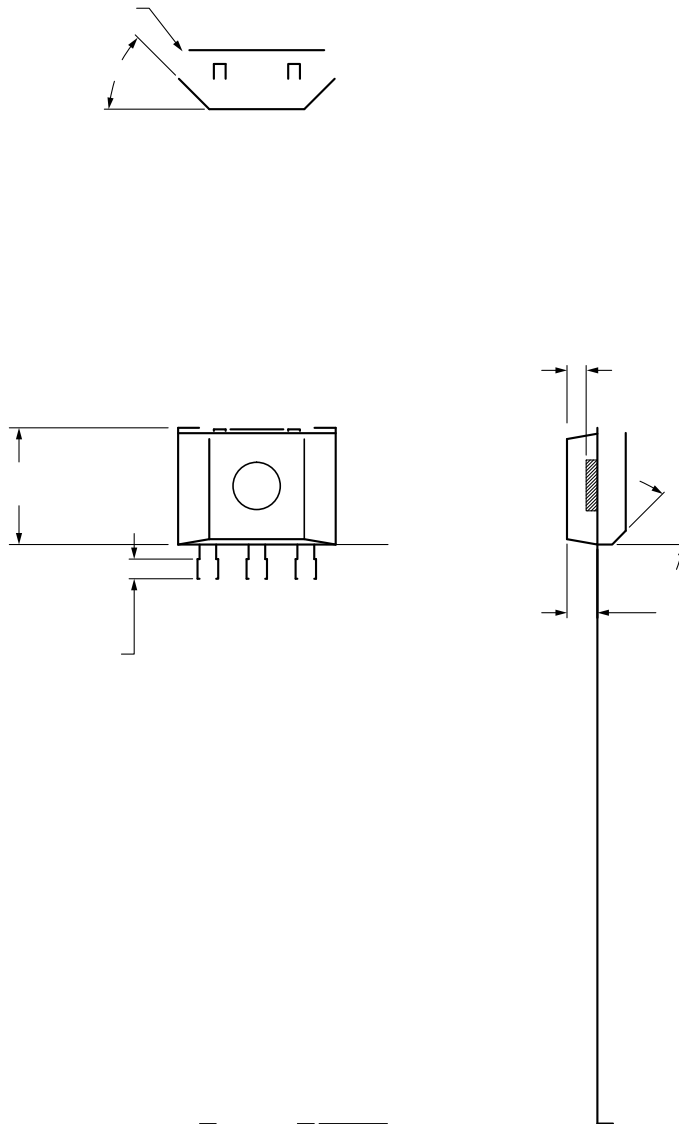


Figure 4: Package UA, 3-Pin SIP, Matrix Style

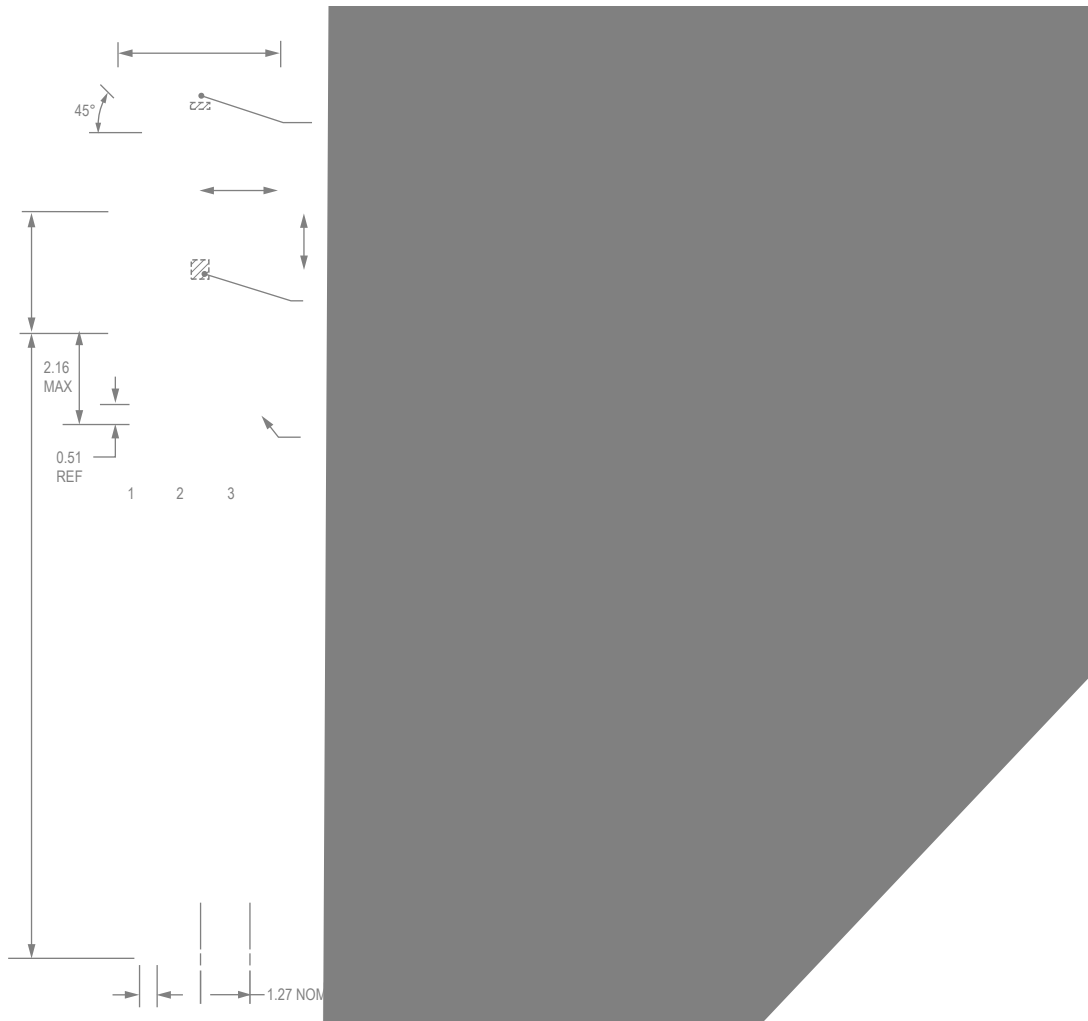


Figure 5: Package UA, 3-Pin SIP, Chopper Style

Revision History

Number	Date	Description
17	May 24, 2012	Update LH package branding
18	January 1, 2015	Added LX option to Selection Guide
19	September 22, 2015	Corrected LH package Active Area Depth value; added AEC-Q100 qualification under Features and Benefits
20	November 4, 2016	Chopper-style UA package designated as not for new design
21	January 29, 2018	Updated matrix-style UA package drawing
22	June 19, 2018	Corrected matrix-style UA package drawing
23	July 2, 2019	Minor editorial updates
24	July 21, 2022	Updated package drawings (pages 12-13)

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