A1220, A1221, A1222, and A1223

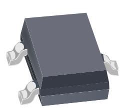
Chopper-Stabilized Precision Hall-Effect Latches

FEATURES AND BENEFITS

- AEC-Q100 automotive qualified
- Quality Managed (QM)
- Symmetrical latch switch points
- Resistant to physical stress
- Superior temperature stability
- Output short-circuit protection
- Operation from unregulated supply down to 3 V
- Reverse-battery protection
- Solid-state reliability
- Small package sizes

PACKAGES:

Not to scale



3-pin SOT23W (suffix LH)

3-pin SIP, matrix HD style (suffix UA)

3-pin SIP, chopper style (suffix UA)

DESCRIPTION

The A1220, A1221, A1222, and A1223 Hall-effect sensor ICs are extremely temperature-stable and stress-resistant devices especially suited for operation over extended temperature ranges to 150°C. Superior high-temperature performance is made possible through dynamic offset cancellation, which reduces the residual offset voltage normally caused by device overmolding, temperature dependencies, and thermal stress. Each device includes on a single silicon chip a voltage regulator, Hall-voltage generator, small-signal amplifier, chopper stabilization, Schmitt trigger, and a short-circuit protected open-drain output to sink up to 25 mA. A south pole of sufficient strength turns the output on. A north pole of sufficient strength is necessary to turn the output off.

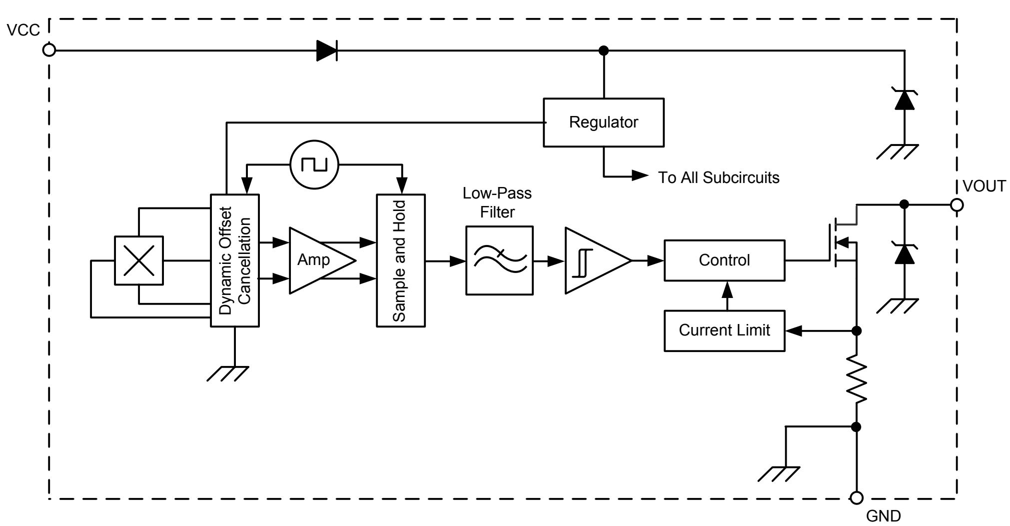
An onboard regulator permits operation with supply voltages of 3 to 24 V. The advantage of operating down to 3 V is that the device can be used in 3 V applications or with additional

Continued on next page...

TYPICAL APPLICATIONS

- Automotive
  - Power closures/actuators
  - Electronic power steering
  - Seat/windows/sunroof motors
  - Trunk/door/liftgate motors
- Industrial motor/encoders
- Commutation/index sensing
- BLDC motors
- Fan motors

FUNCTIONAL BLOCK DIAGRAM



DESCRIPTION (continued)

external resistance in series with the supply pin for greater protection against high voltage transient events.

Two package styles provide magnetically optimized packages for most applications. Package type LH is a modified 3-pin SOT23W surface-mount package, while UA is a three-pin ultra-mini SIP for through-hole mounting. Both packages are lead (Pb) free, with 100% matte-tin-plated leadframes.

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ABSOLUTE MAXIMUM RATINGS

Characteristic	Symbol	Notes	Rating	Units
Forward Supply Voltage [1]	V_{CC}		26.5	V
Reverse Supply Voltage [1]	V_{RCC}		–30	V
Output Off Voltage [1]	V_{OUT}		26	V
Continuous Output Current	I_{OUT}		25	mA
Reverse Output Current	I_{ROUT}		–50	mA
Operating Ambient Temperature	T_A	Range E	–40 to 85	°C
		Range L	–40 to 150	°C
Maximum Junction Temperature	T_J(max)		165	°C
		For 500 hours	175	°C
Storage Temperature	T_{stg}		–65 to 170	°C

[1]

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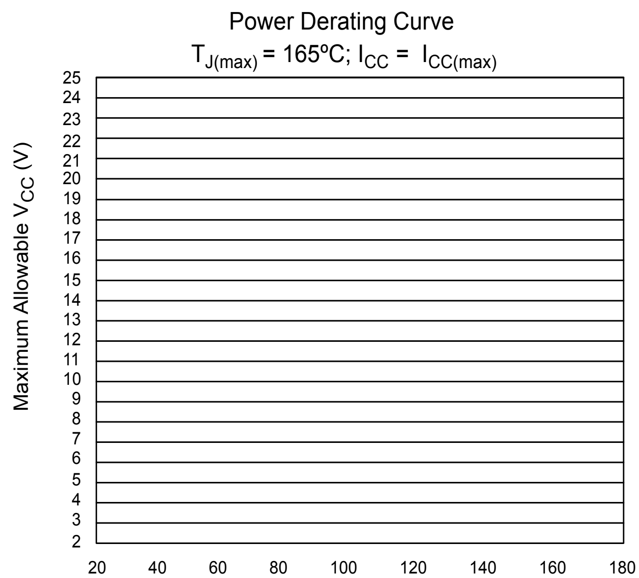
THERMAL CHARACTERISTICS: May require derating at maximum conditions; see application information

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



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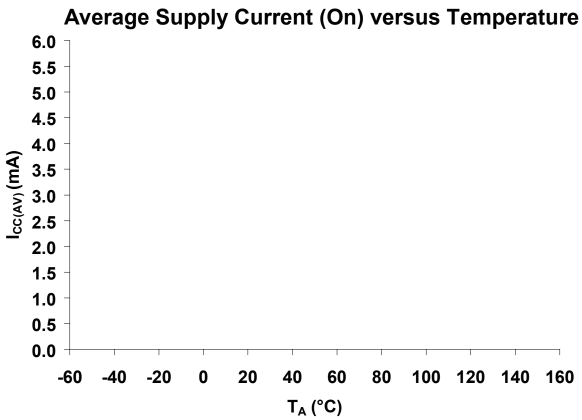

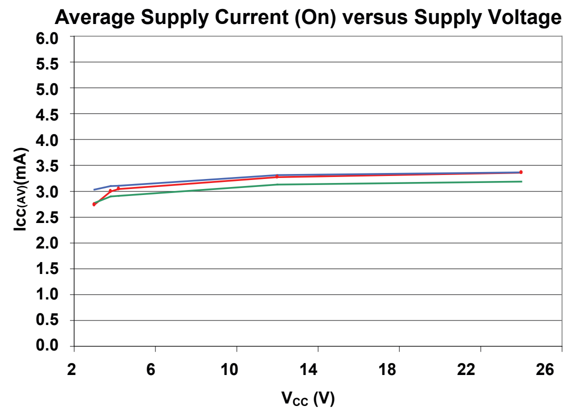

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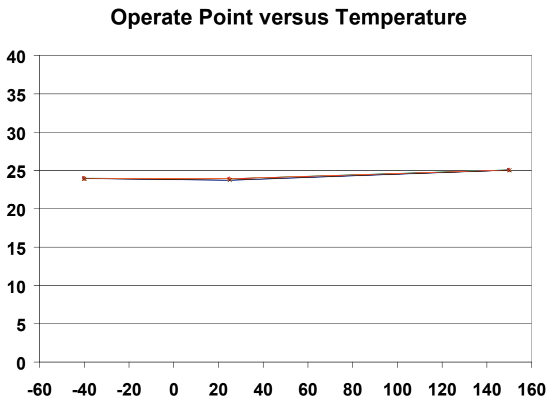
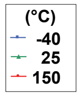
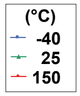
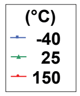




T_A (°C)026T0.553 0 T(0)T.18 T(2)T8640.329 0 T(Tm(t)T(3)T0.553 8(0)T-0.55329 02450 T(1)T0.3 02.18 T5)T-0.553 -0.553 5253 564.4572 cm0 00

T518 0-C





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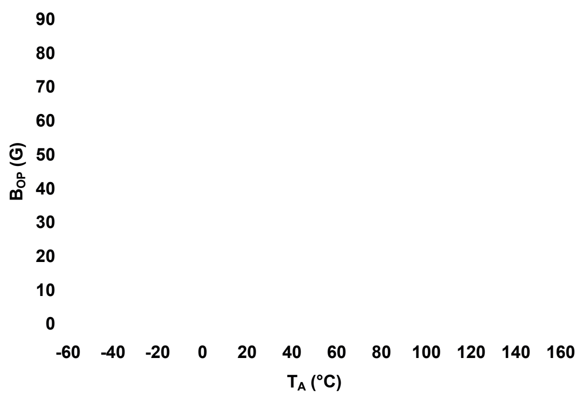
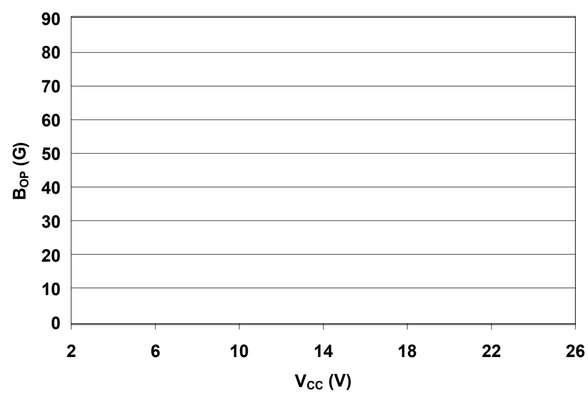
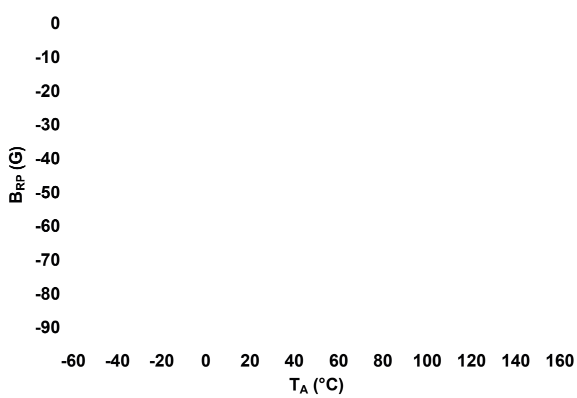
Operate Point versus Temperature



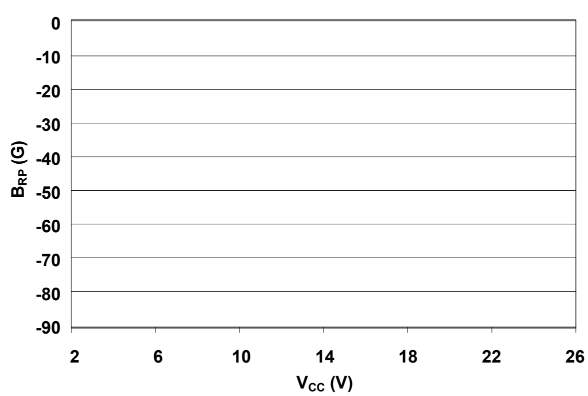
Operate Point versus Supply Voltage



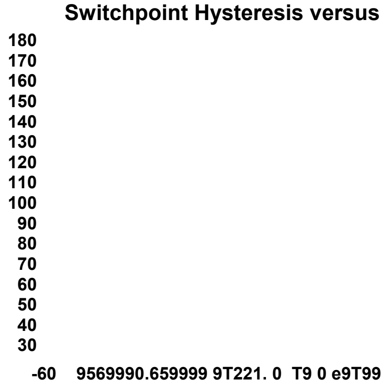
Release Point versus Temperature



Release Point versus Supply Voltage



Switchpoint Hysteresis versus Temperature



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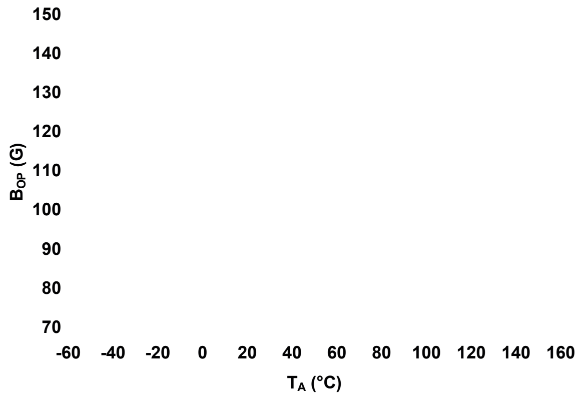
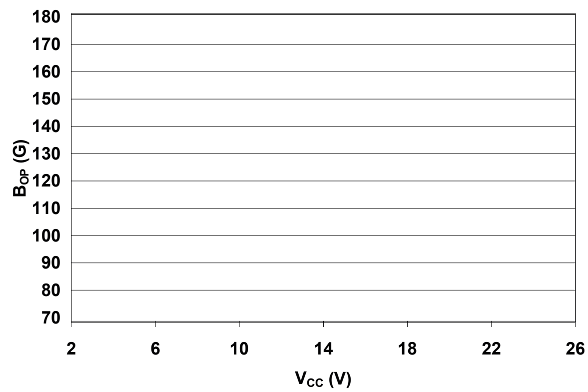
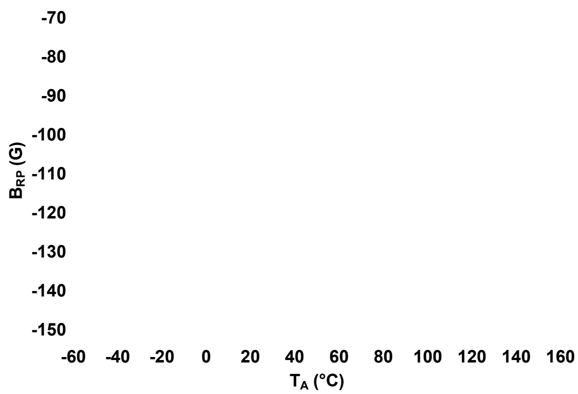
Operate Point versus Temperature



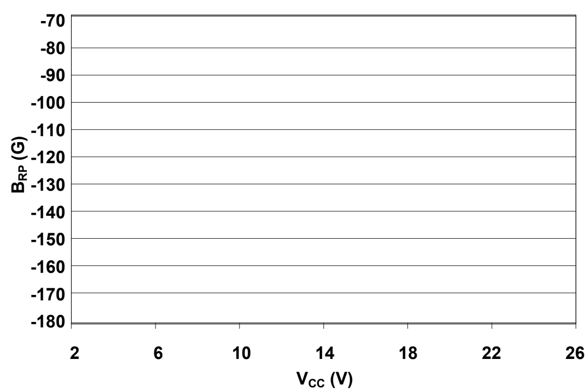
Operate Point versus Supply Voltage



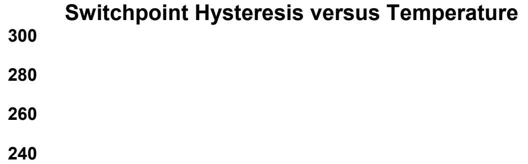
Release Point versus Temperature



Release Point versus Supply Voltage



Switchpoint Hysteresis versus Temperature



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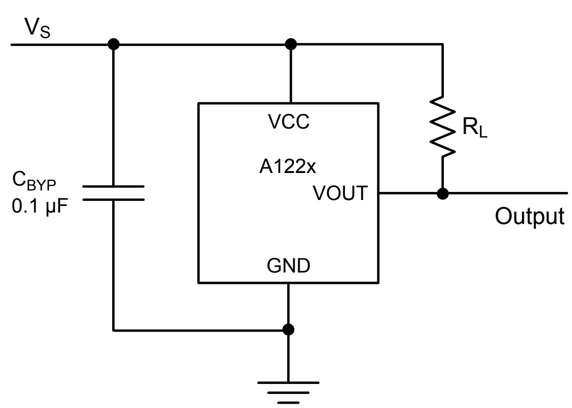
OPERATION

The output of these devices switches low (turns on) when a magnetic field perpendicular to the Hall element exceeds the operate point threshold, B_{OP} (see panel A of figure 1). After turn-on, the output voltage is $V_{OUT(SAT)}$. The output transistor is capable of sinking current up to the short circuit current limit, I_{OM}, which is a minimum of 30 mA. When the magnetic field is reduced below the release point, B_{RP}, the device output goes high (turns off). The difference in the magnetic operate and release points is the hysteresis, B_{HYS}, of the device. This built-in hysteresis allows clean switching of the output even in the presence of external mechanical vibration and electrical noise.

Removal of the magnetic field will leave the device output latched on if the last crossed switch point is B_{OP}, or latched off if the last crossed switch point is B



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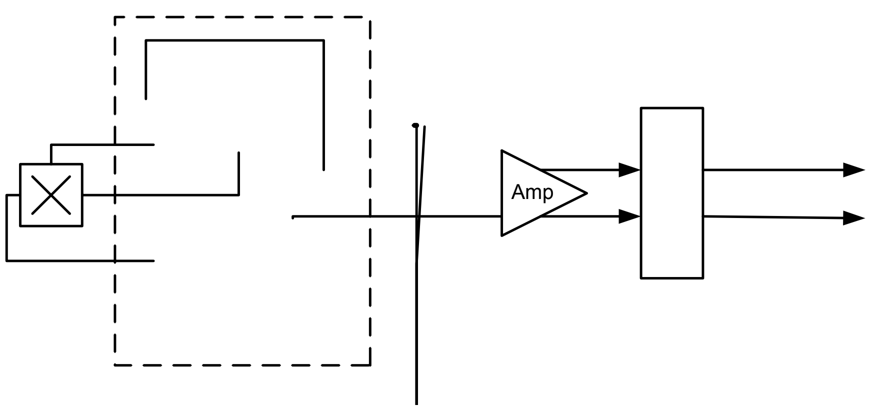

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POWER DERATING

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 website.)

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.

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

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

$$T_J = T$$

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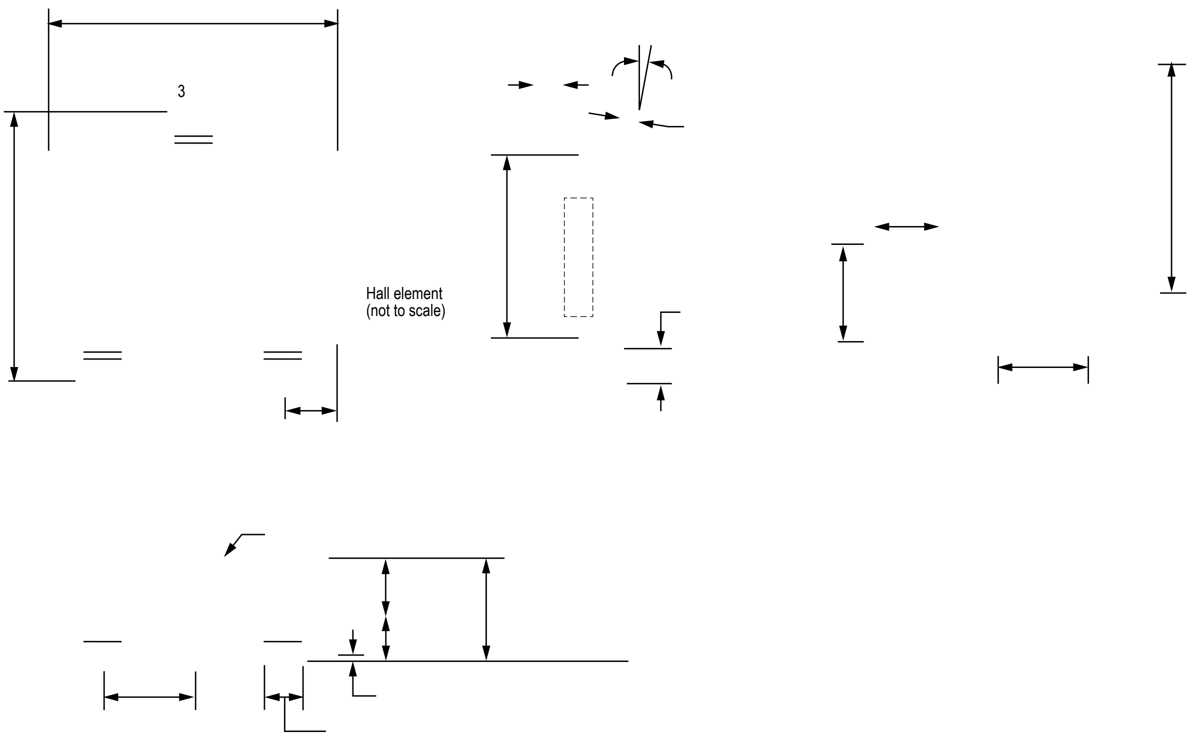

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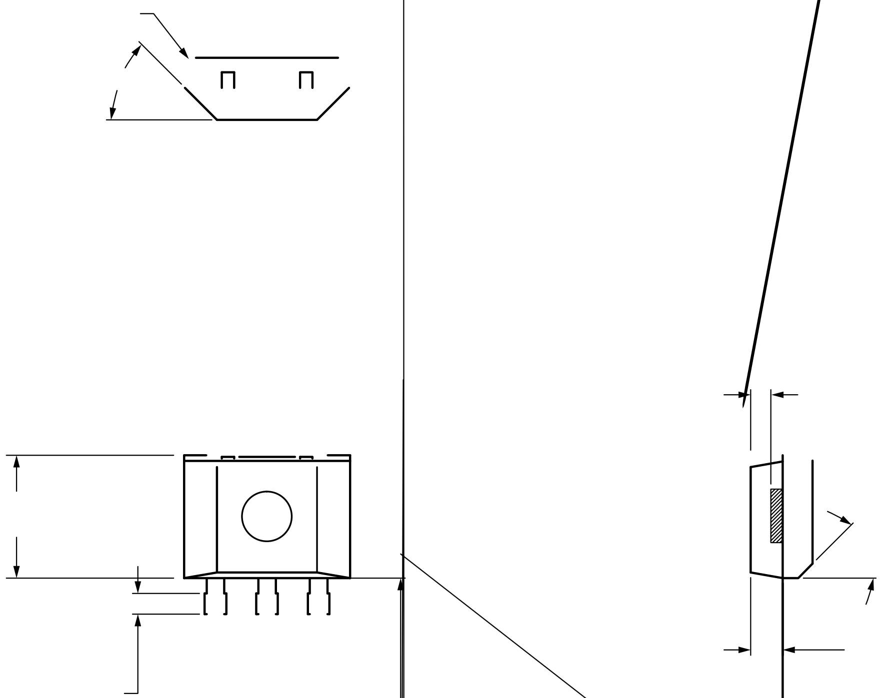
Package UA, 3-Pin SIP, Matrix HD Style



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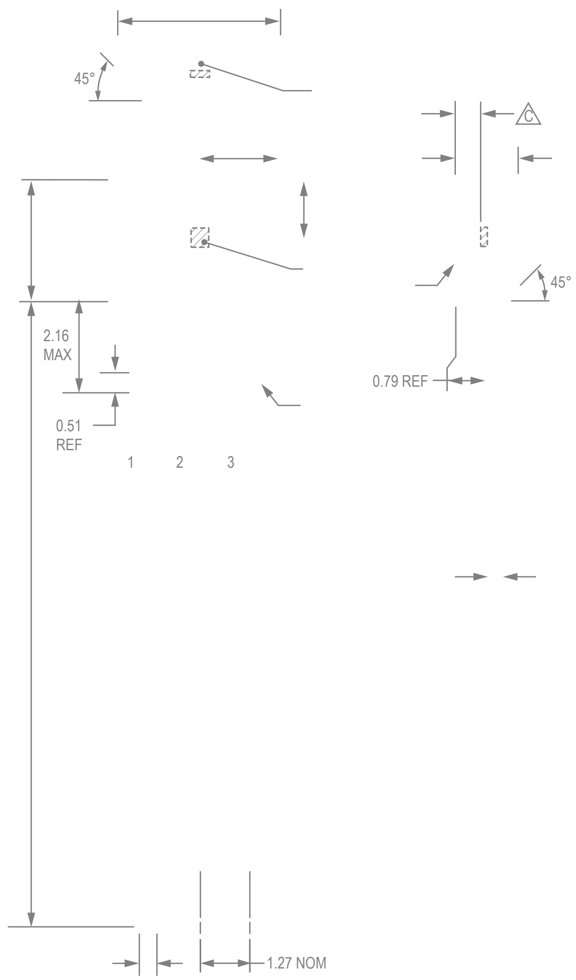
Package UA, 3-Pin SIP, Chopper Style



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Revision History

Number	Date	Description
15	September 16, 2013	Update UA package drawing
16	September 21, 2015	Added AEC-Q100 qualification under Features and Benefits
17	January 12, 2016	Updated Reverse Supply Current test conditions in Electrical Characteristics table
18	October 20, 2016	Chopper-style UA package designated as not for new design
19	September 22, 2017	

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