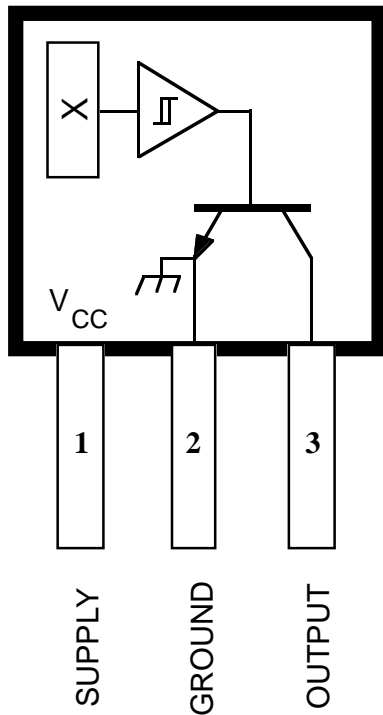


# 3121, 3122, AND 3123

## HALL-EFFECT SWITCHES FOR HIGH-TEMPERATURE OPERATION



Dwg. PH-003A

Pinning is shown viewed from branded side.

### ABSOLUTE MAXIMUM RATINGS at $T_A = +25^\circ\text{C}$

|  |                 |
|--|-----------------|
| Supply Voltage, $V_{CC}$ .....           | 30 V            |
| Reverse Battery Voltage, $V_{RCC}$ ..... | -30 V           |
| Magnetic Flux Density, B .....           | Unlimited       |
| Output OFF Voltage, $V_{OUT}$ .....      | 28 V            |
| Reverse Output Voltage, $V_{OUT}$ .....  | -0.5 V          |
| Continuous Output Current, $I_{OUT}$ ... | 25 mA           |
| Operating Temperature Range, $T_A$       |                 |
| Suffix 'E-' .....                        | -40°C to +85°C  |
| Suffix 'L-' .....                        | -40°C to +150°C |
| Storage Temperature Range,               |                 |
| $T_S$ .....                              | -65°C to +170°C |

These Hall-effect switches are monolithic integrated circuits with tighter magnetic specifications, designed to operate continuously over extended temperatures to +150°C, and are more stable with both temperature and supply voltage changes. The unipolar switching characteristic makes these devices ideal for use with a simple bar or rod magnet. The three basic devices (A3121, A3122, and A3123) are identical except for magnetic switch points.

Each device includes a voltage regulator for operation with supply voltages of 4.5 volts to 24 volts, reverse battery protection diode, quadratic Hall-voltage generator, temperature compensation circuitry, small-signal amplifier, Schmitt trigger, and an open-collector output to sink up to 25 mA. With suitable output pull up, they can be used with bipolar or CMOS logic circuits. The A3121 is an improved replacement for the UGx3113 and UGx3119.

The first character of the part number suffix determines the device operating temperature range. Suffix 'E-' is for the automotive and industrial temperature range of -40°C to +85°C. Suffix 'L-' is for the automotive and military temperature range of -40°C to +150°C. Two package styles provide a magnetically optimized package for most applications. Suffix '-LT' is a miniature SOT89/TO-243AA transistor package for surface-mount applications; suffix '-UA' is a three-lead ultra-mini-SIP.

### FEATURES and BENEFITS

- Superior Temp. Stability for Automotive or Industrial Applications
- 4.5 V to 24 V Operation ... Needs Only An Unregulated Supply
- Open-Collector 25 mA Output ... Compatible with Digital Logic
- Reverse Battery Protection
- Activate with Small, Commercially Available Permanent Magnets
- Solid-State Reliability ... No Moving Parts
- Small Size
- Resistant to Physical Stress

Always order by complete part number, e.g., **A3121EUA**.

# 3121, 3122, AND 3123 HALL-EFFECT SWITCHES FOR HIGH-TEMPERATURE OPERATION

## ELECTRICAL CHARACTERISTICS over operating temperature range, at $V_{CC} = 12\text{ V}$ .

| Characteristic            | Symbol         | Test Conditions                             | Limits |      |      |               |
|---------------------------|----------------|---|--------|------|------|---------------|
|                           |                |   | Min.   | Typ. | Max. | Units         |
| Supply Voltage            | $V_{CC}$       | Operating                                   | 4.5    | —    | 24   | V             |
| Output Saturation Voltage | $V_{OUT(SAT)}$ | $I_{OUT} = 20\text{ mA}$ , $B > B_{OP}$     | —      | 140  | 400  | mV            |
| Output Leakage Current    | $I_{OFF}$      | $V_{OUT} = 24\text{ V}$ , $B < B_{RP}$      | —      | <1.0 | 10   | $\mu\text{A}$ |
| Supply Current            | $I_{CC}$       | $B < B_{RP}$ (Output OFF)                   | —      | 4.6  | 9.0  | mA            |
| Output Rise Time          | $t_r$          | $R_L = 820\ \Omega$ , $C_L = 20\ \text{pF}$ | —      | 0.04 | 2.0  | $\mu\text{s}$ |
| Output Fall Time          | $t_f$          | $R_L = 820\ \Omega$ , $C_L = 20\ \text{pF}$ | —      | 0.18 | 2.0  | $\mu\text{s}$ |

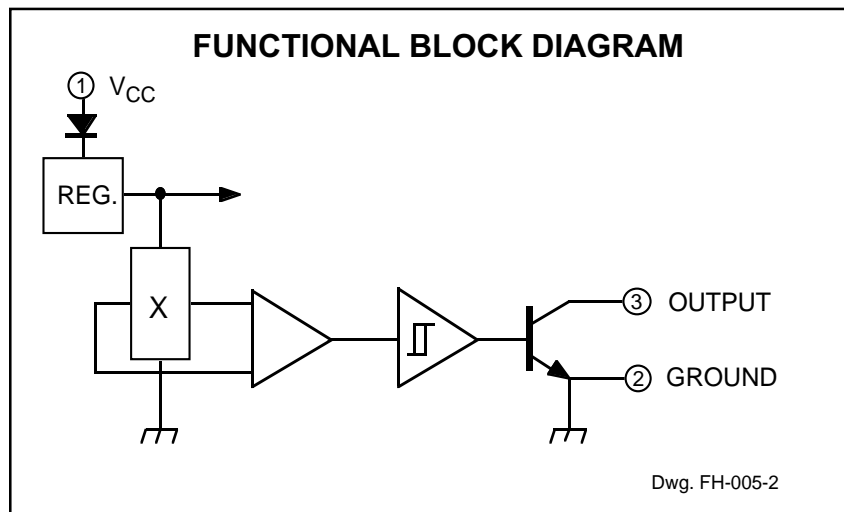
## MAGNETIC CHARACTERISTICS in gauss over operating supply voltage range.

| Characteristic                        | Part Numbers* |      |      |       |      |      |       |      |      |
|---------------------------------------|---------------|------|------|-------|------|------|-------|------|------|
|                                       | A3121         |      |      | A3122 |      |      | A3123 |      |      |
|                                       | Min.          | Typ. | Max. | Min.  | Typ. | Max. | Min.  | Typ. | Max. |
| $B_{OP}$ at $T_A = 25^\circ\text{C}$  | 250           | 350  | 450  | 280   | 340  | 400  | 250   | 345  | 440  |
| over operating temp. range            | 220           | 350  | 500  | 260   | 340  | 430  | 230   | 345  | 470  |
| $B_{RP}$ at $T_A = 25^\circ\text{C}$  | 125           | 245  | 380  | 140   | 235  | 330  | 180   | 240  | 300  |
| over operating temp. range            | 80            | 245  | 410  | 120   | 235  | 360  | 160   | 240  | 330  |
| $B_{hys}$ at $T_A = 25^\circ\text{C}$ | 70            | 105  | 140  | 70    | 105  | 140  | 70    | 105  | 140  |
| over operating temp. range            | 60            | 105  | 150  | 70    | 105  | 140  | 70    | 105  | 140  |

NOTES: Typical values are at  $T_A = +25^\circ\text{C}$  and  $V_{CC} = 12\text{ V}$ .

$B_{OP}$  = operate point (output turns ON);  $B_{RP}$  = release point (output turns OFF);  $B_{hys}$  = hysteresis ( $B_{OP} - B_{RP}$ ).

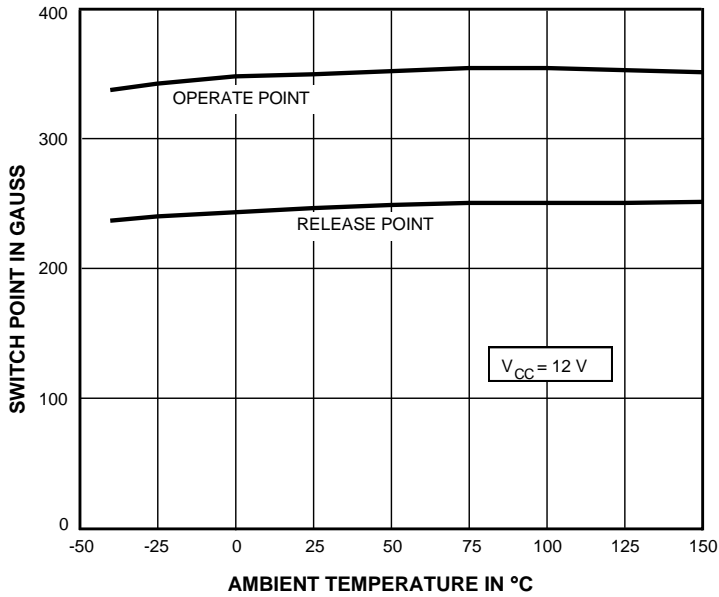
\*Complete part number includes a suffix to identify operating temperature range (E- or L-) and package type (-LT or -UA).



# 3121, 3122, AND 3123 HALL-EFFECT SWITCHES FOR HIGH-TEMPERATURE OPERATION

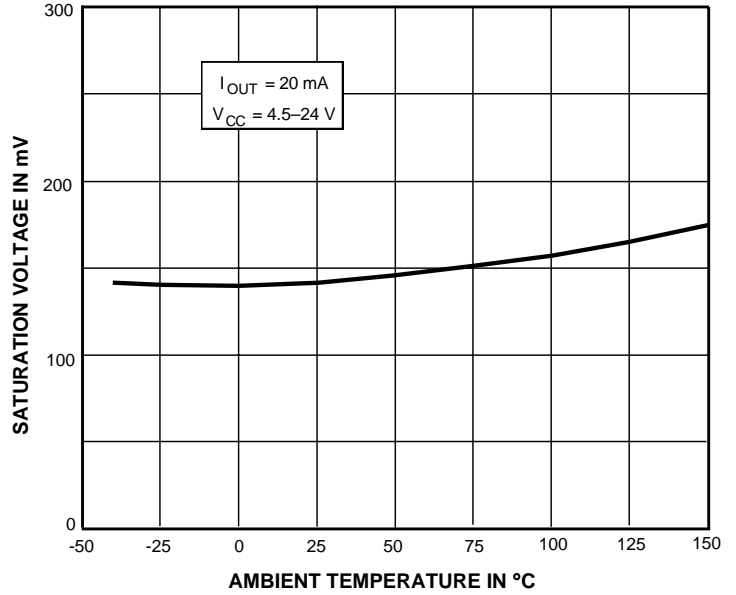
## TYPICAL OPERATING CHARACTERISTICS

**SWITCH POINTS**



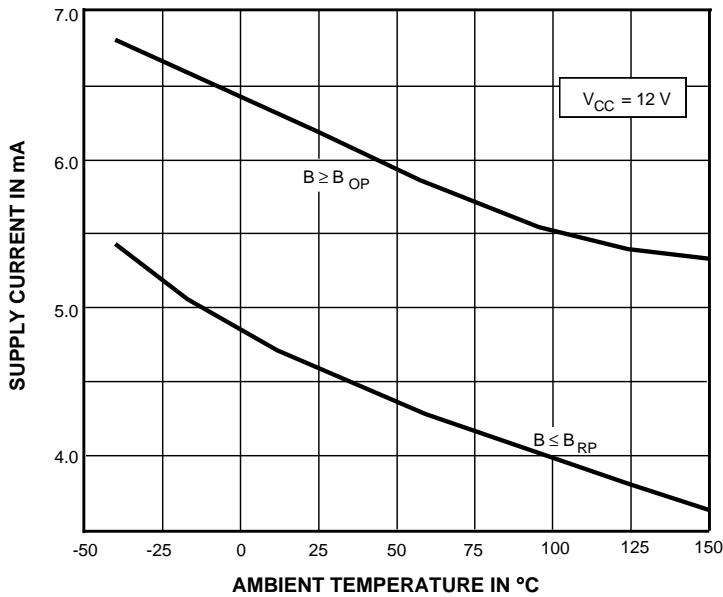
Dwg. GH-038

**OUTPUT SATURATION VOLTAGE**



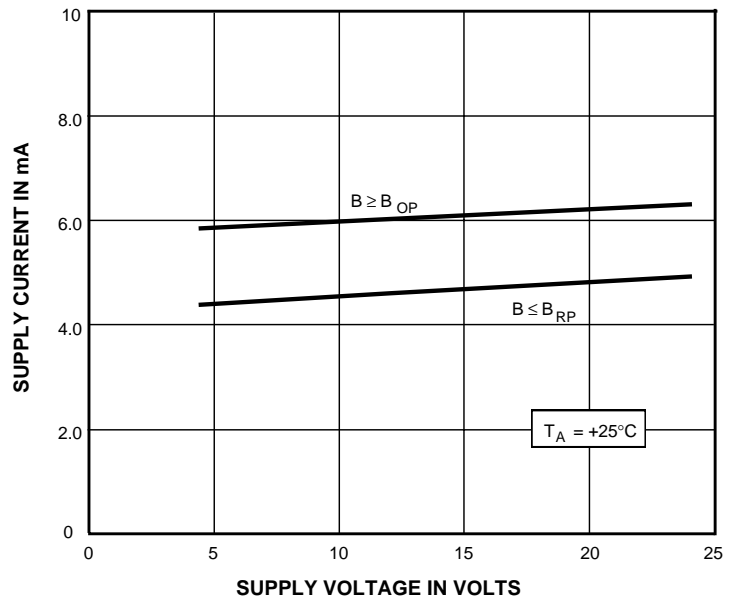
Dwg. GH-040

**SUPPLY CURRENT**



Dwg. GH-039

**SUPPLY CURRENT**



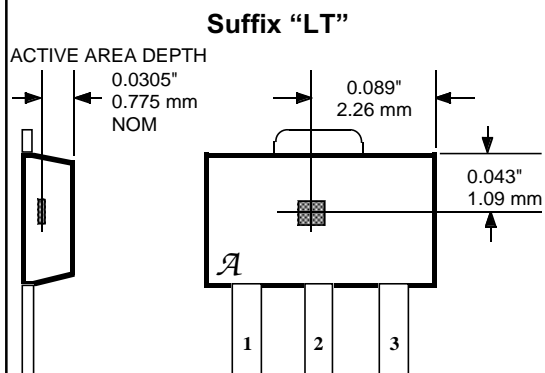
Dwg. GH-041

\* Complete part number includes a suffix denoting operating temperature range (E- or L-) and package type (-LT or -UA).

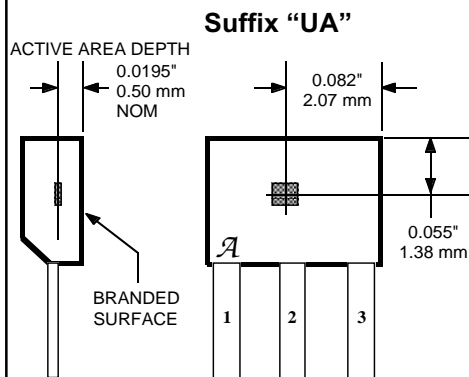
# 3121, 3122, AND 3123 HALL-EFFECT SWITCHES FOR HIGH-TEMPERATURE OPERATION

## SENSOR LOCATIONS

(±0.005" [0.13 mm] die placement)



Dwg. MH-008-2D



Dwg. MH-011-2D

## OPERATION

The output of these devices (pin 3) switches low when the magnetic field at the Hall sensor exceeds the operate point threshold ( $B_{OP}$ ). At this point, the output voltage is  $V_{OUT(SAT)}$ . When the magnetic field is reduced to below the release point threshold ( $B_{RP}$ ), the device output goes high. The difference in the magnetic operate and release points is called 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.

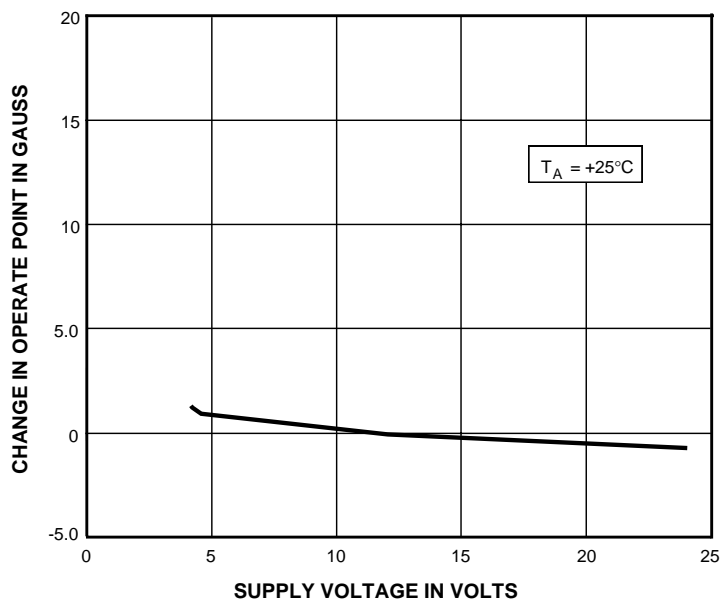
## APPLICATIONS INFORMATION

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

- *Hall-Effect IC Applications Guide*, Application Note 27701;
- *Hall-Effect Devices: Soldering, Gluing, Potting, Encapsulating, and Lead Forming*, Application Note 27703.1;
- *Soldering of Through-Hole Hall-Sensor Devices*, Application Note 27703; and
- *Soldering of Surface-Mount Hall-Sensor Devices*, Application Note 27703.2.

All are provided in *Allegro Electronic Data Book*, AMS-702. or at [www.allegromicro.com](http://www.allegromicro.com)

## CHANGE IN OPERATE POINT

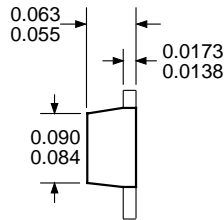
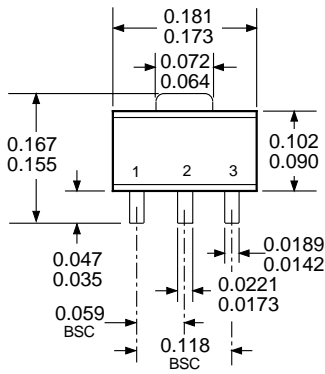


Dwg. GH-042

# 3121, 3122, AND 3123 HALL-EFFECT SWITCHES FOR HIGH-TEMPERATURE OPERATION

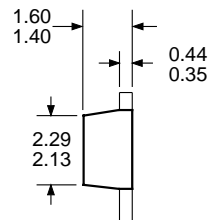
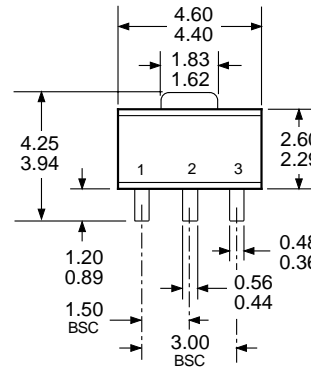
## PACKAGE DESIGNATOR 'LT' (SOT89/TO-243AA)

**Dimensions in Inches**  
(for reference only)

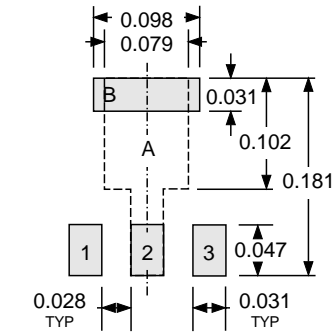


Dwg. MA-009-3A in

**Dimensions in Millimeters**  
(controlling dimensions)

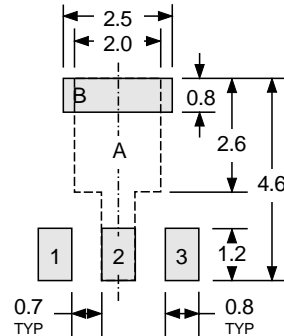


Dwg. MA-009-3A mm



Pads 1, 2, 3, and A — Standard SOT89 Layout  
Pads 1, 2, 3, and B — Low-Stress Version  
Pads 1, 2, and 3 only — Lowest Stress, But Not Self Aligning

Dwg. MA-012-3 in



Pads 1, 2, 3, and A — Standard SOT89 Layout  
Pads 1, 2, 3, and B — Low-Stress Version  
Pads 1, 2, and 3 only — Lowest Stress, But Not Self Aligning

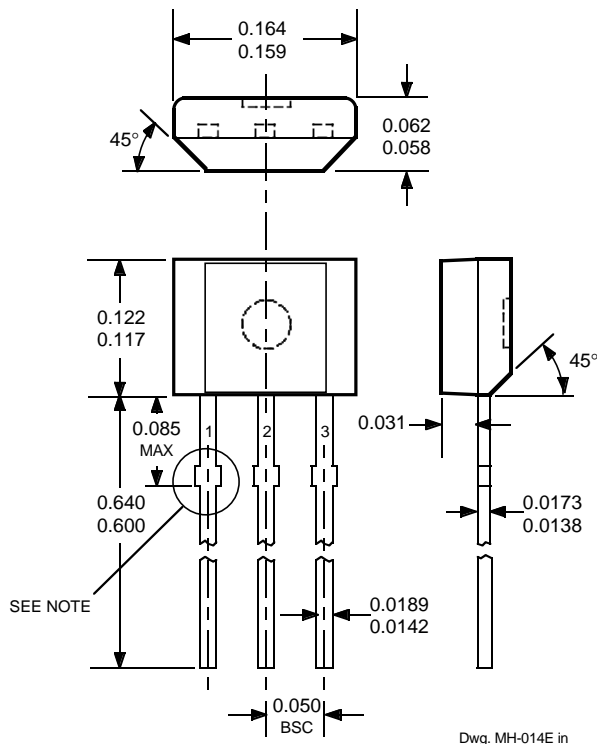
Dwg. MA-012-3 mm

- NOTES:
1. Exact body and lead configuration at vendor's option within limits shown.
  2. Supplied in bulk pack (500 pieces per bag) or add "TR" to part number for tape and reel.
  3. Only low-temperature ( $\leq 240^{\circ}\text{C}$ ) reflow-soldering techniques are recommended for SOT89 devices.

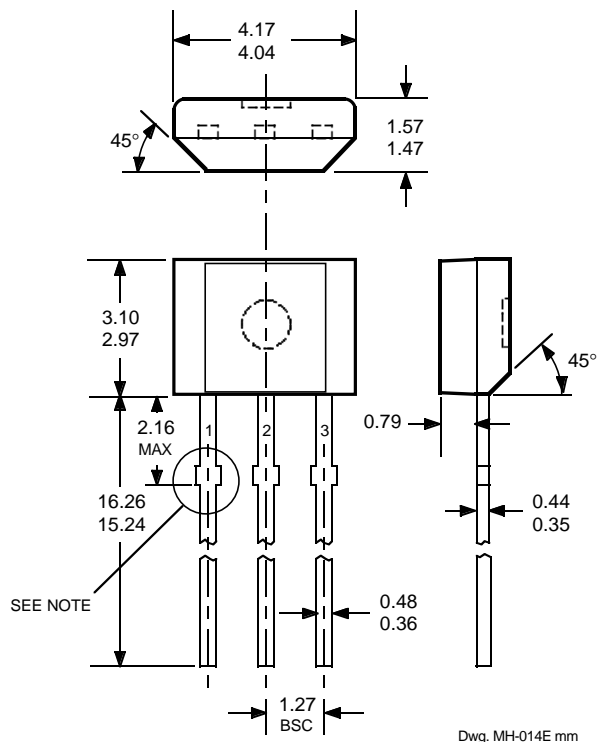
# 3121, 3122, AND 3123 HALL-EFFECT SWITCHES FOR HIGH-TEMPERATURE OPERATION

## PACKAGE DESIGNATOR 'UA'

Dimensions in Inches  
(controlling dimensions)

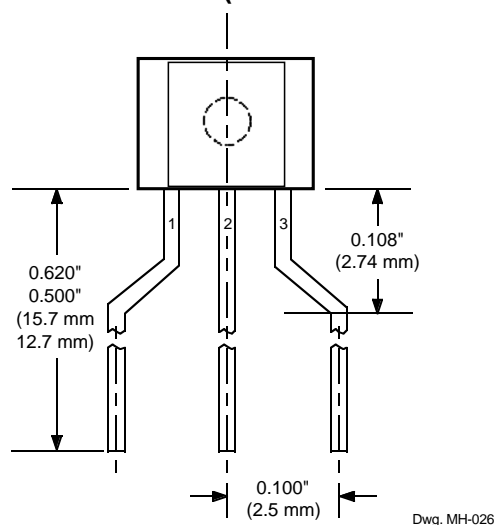


Dimensions in Millimeters  
(for reference only)



- NOTES:
1. Tolerances on package height and width represent allowable mold offsets. Dimensions given are measured at the widest point (parting line).
  2. Exact body and lead configuration at vendor's option within limits shown.
  3. Height does not include mold gate flash.
  4. Recommended minimum PWB hole diameter to clear transition area is 0.035" (0.89 mm).
  5. Where no tolerance is specified, dimension is nominal.
  6. Supplied in bulk pack (500 pieces per bag).

## Radial Lead Form (order A312xxUA-LC)



NOTE: Lead-form dimensions are the nominals produced on the forming equipment. No dimensional tolerance is implied or guaranteed for bulk packaging (500 pieces per bag).

**3121, 3122, AND 3123  
HALL-EFFECT SWITCHES  
FOR HIGH-TEMPERATURE  
OPERATION**

**HALL-EFFECT SENSORS**

| UNIPOlar HALL-EFFECT DIGITAL SWITCHES             |  |                                       |                         |             |            |   |
|---|--|---------------------------------------|-------------------------|-------------|------------|---|
| Partial Part Number                               | Operate Point (G)<br>Over Oper. Voltage & Temp.  | Release Point (G)<br>Voltage & Temp.  | Hysteresis (G)<br>Range | Oper. Temp. | Packages   | Replaces and Comments                               |
| A3121x  | 220 to 500                                       | 80 to 410                             | 60 to 150               | E, L        | LT, UA     | 3019, 3113, 3119                                    |
| A3122x  | 260 to 430                                       | 120 to 360                            | 70 to 140               | E, L        | LT, UA     |   |
| A3123x  | 230 to 470                                       | 160 to 330                            | 70 to 140               | E, L        | LT, UA     |   |
| A3141x  | 30 to 175  | 10 to 145                             | 20 to 80                | E, L        | LT, UA     | 3040, 3140  |
| A3142x  | 115 to 245                                       | 60 to 190                             | 30 to 80                | E, L        | LT, UA     |   |
| A3143x  | 205 to 355                                       | 150 to 300                            | 30 to 80                | E, L        | LT, UA     |   |
| A3144x  | 35 to 450  | 25 to 430                             | >20                     | E, L        | LT, UA     | 3020, 3120  |
| A3161E  | <160 (Typ 130)                                   | >30 (Typ 110)                         | 5 to 80                 | E           | LT, UA     | 2-wire operation                                    |
| A3163E  | <160 (Typ 98)                                    | >30 (Typ 79)                          | 5 to 40                 | E           | LT, UA     | 2-wire  |
| A3240x  | <50 (Typ 35)                                     | >5 (Typ 25)                           | Typ 10                  | E, L        | LH, LT, UA | chopper stabilized                                  |
| A3250x  | <50 to >350                                      | —                                     | 5 to 35                 | J, L        | UA         | programmable, chopper stabilized                    |
| A3251x  | <50 to >350                                      | —                                     | 5 to 35                 | J, L        | UA         | programmable, chopper stabilized                    |
| A3361E  | <125   | >40                                   | 5 to 30                 | E           | LH, LT, UA | 2-wire, chopper stabilized,<br>output normally high |
| A3362E  | <125   | >40                                   | 5 to 30                 | E           | LH, LT, UA | 2-wire, chopper stabilized,<br>output normally low  |
| MICROPOWER OMNIPOLAR HALL-EFFECT DIGITAL SWITCHES |  |                                       |                         |             |            |   |
| Partial Part Number                               | Operate Points (G)<br>Over Oper. Voltage & Temp. | Release Points (G)<br>Voltage & Temp. | Hysteresis (G)<br>Range | Oper. Temp. | Packages   | Average Supply Current (µA)                         |
| A3209E  | >-60, <60  | <-5, >5                               | Typ 7.7                 | E           | LH, UA     | <425 (Typ 145)                                      |
| A3210E  | >-60, <60  | <-5, >5                               | Typ 7.7                 | E           | LH, UA     | <60 (Typ 8.8)                                       |
| A3212E  | >-55, <55  | <-10, >10                             | Typ. 8                  | E           | LH, UA     | <10 (Typ 4.2)                                       |
| BIPOLAR HALL-EFFECT DIGITAL SWITCHES              |  |                                       |                         |             |            |   |
| Partial Part Number                               | Operate Point (G)<br>Over Oper. Voltage & Temp.  | Release Point (G)<br>Voltage & Temp.  | Hysteresis (G)<br>Range | Oper. Temp. | Packages   | Replaces and Comments                               |
| UGx3132   | <95 (Typ 32)                                     | >-95 (Typ -20)                        | >30 (Typ 52)            | K, L, S     | LT, UA     | 3030, 3130, 3131                                    |
| UGx3133   | <75 (Typ 32)                                     | >-75 (Typ -20)                        | >30 (Typ 52)            | K, L, S     | LT, UA     |   |
| UGx3134   | -40 to 50  | -50 to 40                             | 5 to 55                 | E, L        | LT, UA     |   |
| A3260x  | <30 (Typ 10)                                     | >-30 (Typ -10)                        | Typ 20                  | E, L        | LH, LT, UA | 2 wire, chopper stabilized                          |

Notes: 1) Typical data is at  $T_A = +25^\circ\text{C}$  and nominal operating voltage.  
 2) "x" = Operating Temperature Range [suffix letter or (prefix)]: S (UGN) =  $-20^\circ\text{C}$  to  $+85^\circ\text{C}$ , E =  $-40^\circ\text{C}$  to  $+85^\circ\text{C}$ , J =  $-40^\circ\text{C}$  to  $+115^\circ\text{C}$ , K (UGS) =  $-40^\circ\text{C}$  to  $+125^\circ\text{C}$ , L (UGL) =  $-40^\circ\text{C}$  to  $+150^\circ\text{C}$ .

**3121, 3122, AND 3123  
HALL-EFFECT SWITCHES  
FOR HIGH-TEMPERATURE  
OPERATION**

*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.*

*Allegro MicroSystems, Inc. reserves the right to make, from time to time, such departures from the detail specifications as may be required to permit improvements in the performance, reliability, or manufacturability of its products. Before placing an order, the user is cautioned to verify that the information being relied upon is current.*

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