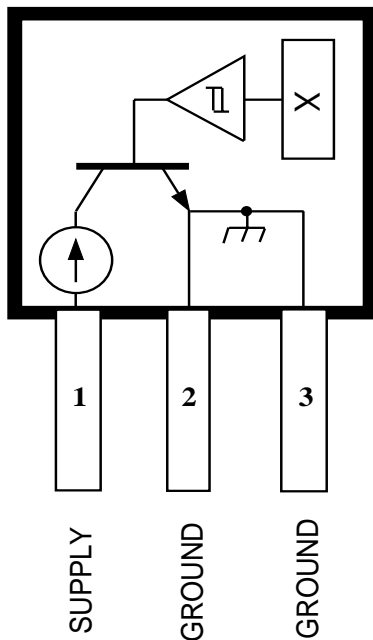


# 3163

## HALL-EFFECT SWITCH FOR 2-WIRE APPLICATIONS

### Suffix 'UA' Pinning (ultra-mini SIP)



Dwg. PH-003-7A

Pinning is shown viewed from branded side.

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

Supply Voltage,  $V_{CC}$  ..... **26.5 V**  
Reverse Battery Voltage,  $V_{RCC}$  .... **-16 V**  
Magnetic Flux Density,  $B$  ..... **Unlimited**  
Package Power Dissipation,  $P_D$  **See Graph**  
Junction Temperature,  $T_J$  ..... **+170°C**  
Operating Temperature Range,  
 $T_A$  ..... **-40°C to +85°C**  
Storage Temperature Range,  
 $T_S$  ..... **-65°C to +170°C**

This Hall-effect switch is a monolithic integrated circuit designed to operate continuously over extended temperatures to  $+85^\circ\text{C}$ . The unipolar switching characteristic makes this device ideal for use with a simple bar or rod magnet. The A3163ELT and A3163EUA are identical except for package.

Each device includes a voltage regulator for operation with supply voltages of 3.5 to 24 volts, reverse-battery protection, quadratic Hall-voltage generator for low offset, temperature compensation circuitry, small-signal amplifier, Schmitt trigger, and a constant-current open-collector output, wired internally for true 2-wire operation. Noise radiation is limited by control of the output-current slew rate.

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 for through-hole mounting; it is also available with lead forming for surface-mount applications (suffix 'UA-TL').

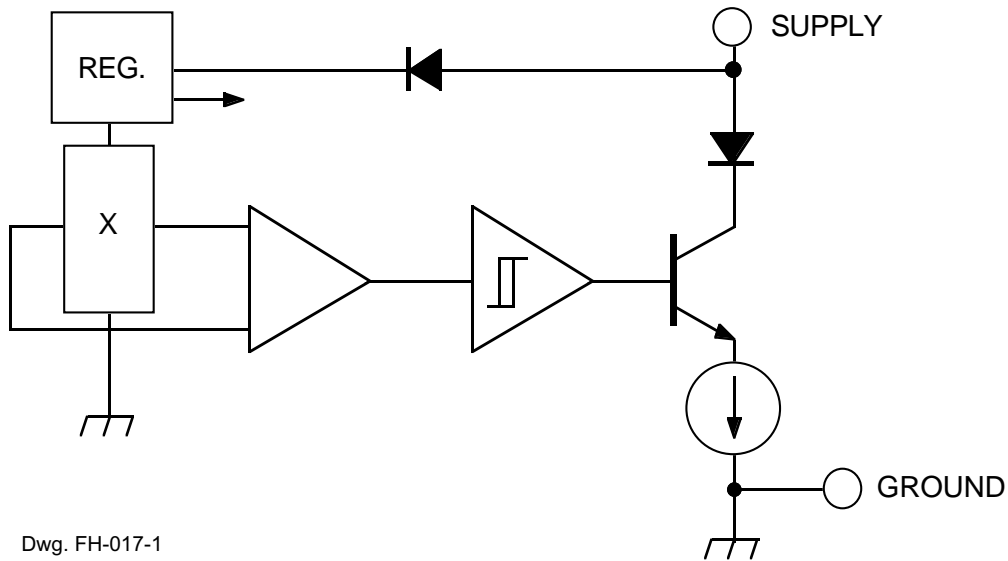
### FEATURES and BENEFITS

- Internal Current Regulator for 2-Wire Operation
- Output Slew Rate Controlled
- 3.5 V to 24 V Operation ... Needs Only An Unregulated Supply
- Reverse Battery Protection
- Excellent Temperature Stability
- Activate with Small, Commercially Available Permanent Magnets
- Small Size
- Solid-State Reliability ... No Moving Parts
- Resistant to Physical Stress

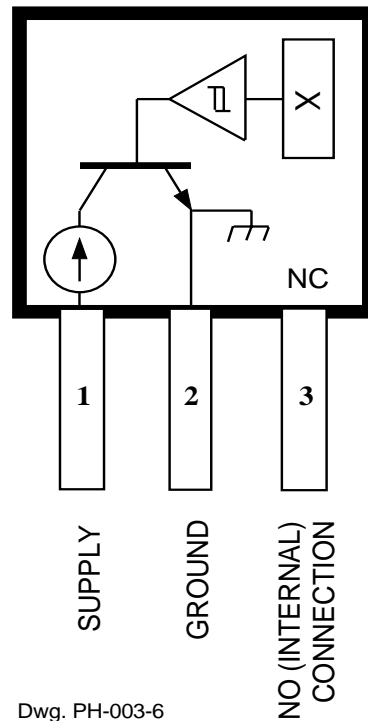
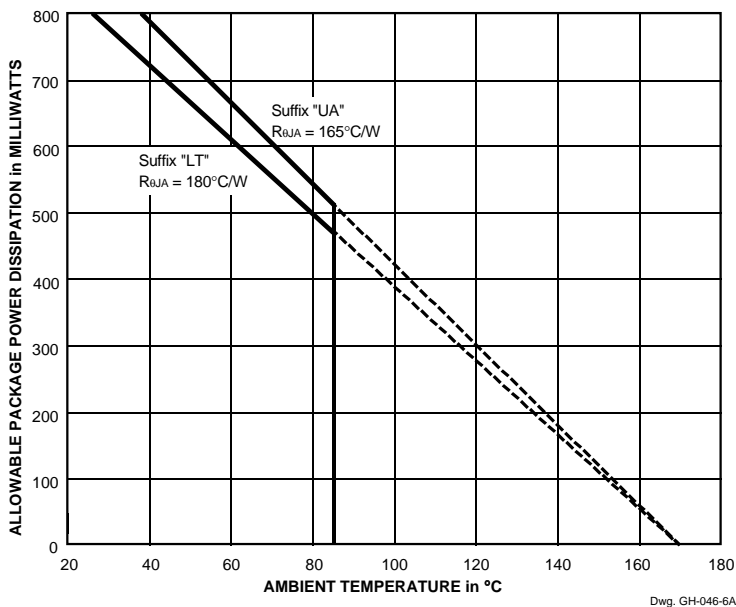
Always order by complete part number, e.g., **A3163ELT**.

# 3163 HALL-EFFECT SWITCH FOR 2-WIRE APPLICATIONS

## FUNCTIONAL BLOCK DIAGRAM



## Suffix 'LT' Pinning (SOT89/TO-243AA)



Pinning is shown viewed from branded side.

**3163**  
**HALL-EFFECT SWITCH**  
**FOR 2-WIRE APPLICATIONS**

**ELECTRICAL CHARACTERISTICS over operating voltage and temperature ranges.**

Characteristic	Symbol	Test Conditions	Limits			
			Min.	Typ.	Max.	Units
Supply Voltage	$V_{CC}$	Operating	3.5	—	24	V
Output Current	$I_{OUT(H)}$	$B > B_{OP}$	12	14	17	mA
	$I_{OUT(L)}$	$B < B_{RP}$	5.0	5.6	6.9	mA
Output Slew Rate	di/dt	$C_L = 20$ pF	—	7.0	20	mA/ $\mu$ s
Output Settling Time	$t_{sd}$	$C_L = 20$ pF	—	—	20	$\mu$ s
Reverse Battery Current	$I_{CCR}$	$V_{RCC} = -16$ V	—	—	-15	mA

**MAGNETIC CHARACTERISTICS over operating supply voltage and temperature ranges.**

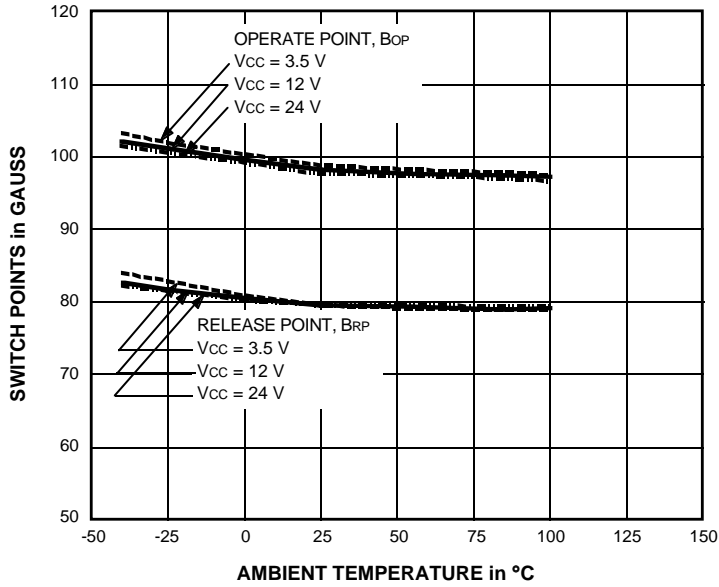
Characteristic	Symbol	Limits			
		Min.	Typ.	Max.	Units
Operate Point (output turns on)	$B_{OP}$	—	98	160	G
Release Point (output turns off)	$B_{RP}$	30	79	—	G
Hysteresis ( $B_{OP} - B_{RP}$ )	$B_{hys}$	5.0	19	40	G

NOTES: 1. Typical Data is at  $T_A = +25^\circ\text{C}$  and  $V_{CC} = 12$  V and is for design information only.  
2. 1 gauss (G) is exactly equal to 0.1 millitesla (mT).

# 3163 HALL-EFFECT SWITCH FOR 2-WIRE APPLICATIONS

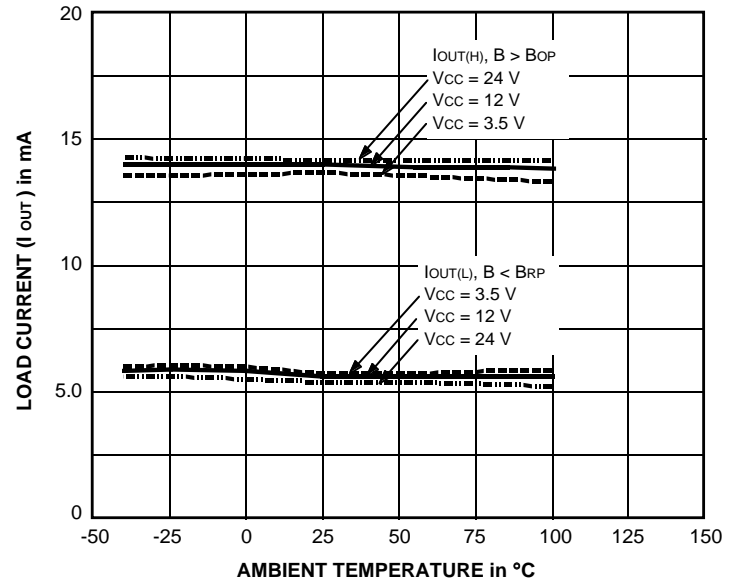
## TYPICAL OPERATING CHARACTERISTICS

SWITCH POINTS



Dwg. GH-044-5

LOAD CURRENT



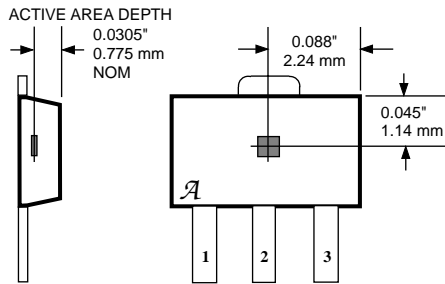
Dwg. GH-028-10

# 3163 HALL-EFFECT SWITCH FOR 2-WIRE APPLICATIONS

## SENSOR LOCATIONS

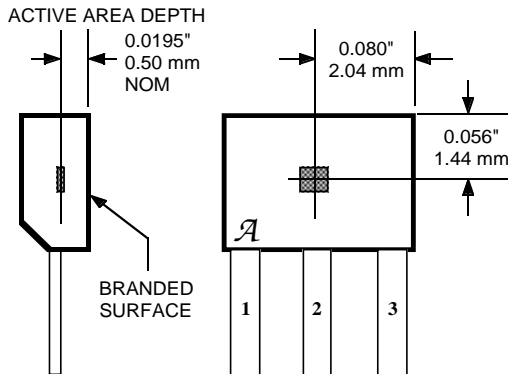
( $\pm 0.005$ " [0.13 mm] die placement)

### Suffix "LT"



Dwg. MH-008-8A

### Suffix "UA"

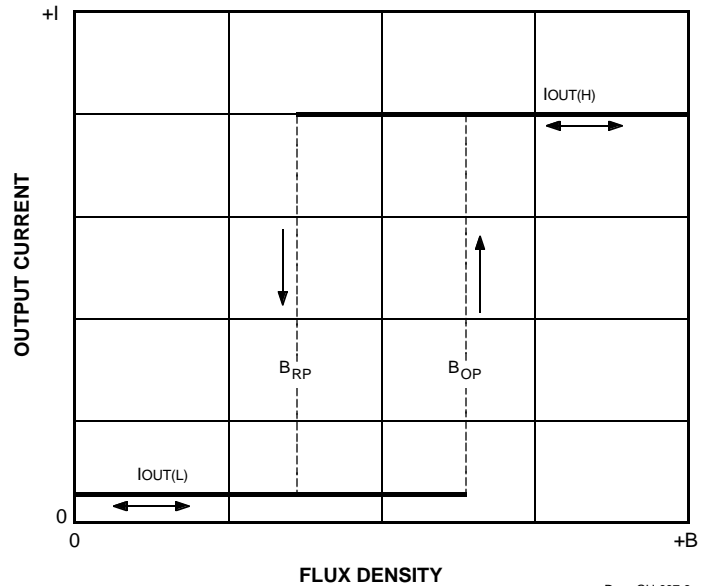


Dwg. MH-011-9B

## FUNCTIONAL DESCRIPTION

**Operation.** The output of these devices turns on when a magnetic field (south pole) perpendicular to the Hall sensor exceeds the operate point threshold ( $B_{OP}$ ). After turn on, the output will source current ( $I_{OUT(H)}$ ) equal to the device operating current plus a current source. When the magnetic field is decreased (south pole) below the release point ( $B_{RP}$ ), the output will source current ( $I_{OUT(L)}$ ) equal to the Hall-effect sensor operating current with the current source turned off. The difference in the magnetic operate and release points is the hysteresis ( $B_{hys}$ ) of the device. The hysteresis allows clean switching of the output even in the presence of external mechanical vibration or electrical noise.

Powering up in the absence of a magnetic field (less than  $B_{OP}$  and higher than  $B_{RP}$ ) will allow an indeterminate output state. The correct state is warranted after the first excursion beyond  $B_{OP}$  or  $B_{RP}$ .



Dwg. GH-007-8

# 3163

## HALL-EFFECT SWITCH FOR 2-WIRE APPLICATIONS

### APPLICATIONS INFORMATION

**External Components.** It is strongly recommended that an external bypass capacitor be connected (in close proximity to the Hall sensor) between the supply and ground of the device.

**Power Derating.** Due to the internal device power dissipation, the junction temperature ( $T_J$ ) will be higher than the ambient temperature ( $T_A$ ). To ensure that the absolute maximum junction temperature is not exceeded, the following equations should be applied:

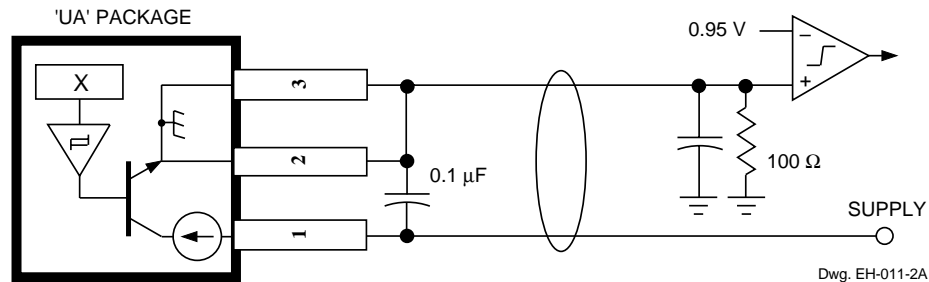
$$T_J = T_A + (P_D \times R_{\theta JA})$$

where  $P_D$  is the maximum supply power

$$I_{OUT(H)} \times V_{CC}$$

and  $R_{\theta JA}$  is the package thermal resistance. The specified limit for  $I_{OUT(H)}$  should be used to ensure a margin of safety.

**Magnets.** The simplest form of magnet that will operate this device is a ring magnet. Other methods of operation, such as linear magnets, are possible.



### TYPICAL APPLICATION

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;
- *Soldering of Surface-Mount Hall-Sensor Devices*, Application Note 27703.2; and
- *Two-Wire Hall-Effect Sensors*, Application Note 27704.

All are provided in *Allegro Electronic Data Book*, AMS-702 or at

[www.allegromicro.com](http://www.allegromicro.com)

**3163**  
**HALL-EFFECT SWITCH**  
**FOR 2-WIRE APPLICATIONS**

**CRITERIA FOR DEVICE QUALIFICATION**

All Allegro sensors are subjected to stringent qualification requirements prior to being released to production. To become qualified, except for the destructive ESD tests, no failures are permitted.

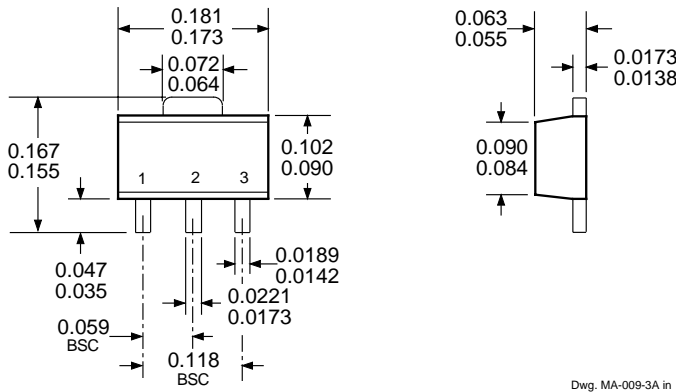
Qualification Test	Test Method and Test Conditions	Test Length	Samples	Comments
Biased Humidity (HAST)	$T_A = 130^{\circ}\text{C}$ , RH = 85%	50 hrs	77	$V_{CC} = V_{OUT} = 5\text{ V}$
High-Temperature Operating Life (HTOL)	JESD22-A108, $T_A = 150^{\circ}\text{C}$ , $T_J \leq 165^{\circ}\text{C}$	408 hrs	77	$V_{CC} = 24\text{ V}$ , $V_{OUT} = 20\text{ V}$
Accelerated HTOL	$T_A = 175^{\circ}\text{C}$ , $T_J = 190^{\circ}\text{C}$	504 hrs	77	$V_{CC} = 24\text{ V}$ , $V_{OUT} = 20\text{ V}$
Autoclave, Unbiased	JESD22-A102, Condition C, $T_A = 121^{\circ}\text{C}$ , 15 psig	96 hrs	77	
High-Temperature (Bake) Storage Life	MIL-STD-883, Method 1008, $T_A = 170^{\circ}\text{C}$	1000 hrs	77	
Temperature Cycle	MIL-STD-883, Method 1010, $-65^{\circ}\text{C}$ to $+150^{\circ}\text{C}$	500 cycles	77	
Latch-Up	—	Pre/Post Reading	6	
Electro-Thermally Induced Gate Leakage	—	Pre/Post Reading	6	
ESD, Human Body Model	CDF-AEC-Q100-002	Pre/Post Reading	3 per test	Test to failure, All leads > 4 kV
ESD, Machine Model	JESD22-A115	Pre/Post Reading	3 per test	Test to failure, All leads >700 V
Electrical Distributions	Per Specification	—	30	

# 3163

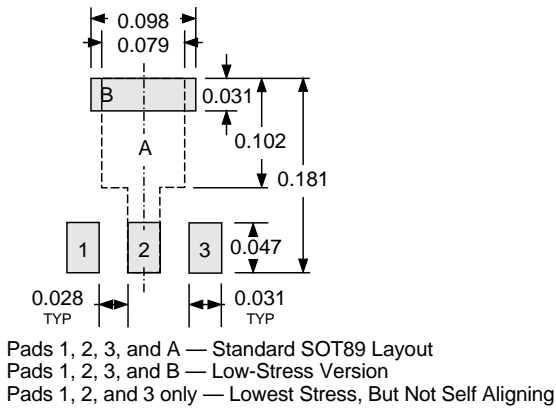
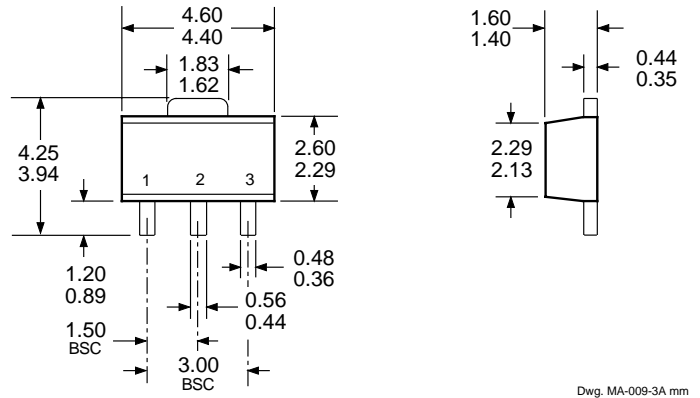
## HALL-EFFECT SWITCH FOR 2-WIRE APPLICATIONS

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

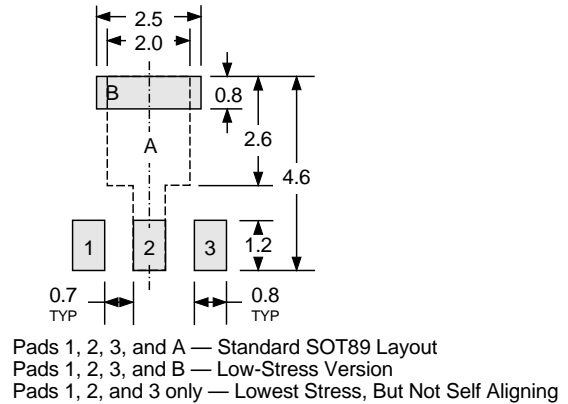
Dimensions in Inches  
(for reference only)



Dimensions in Millimeters  
(controlling dimensions)



Dwg. MA-012-3 in



Dwg. MA-012-3 mm

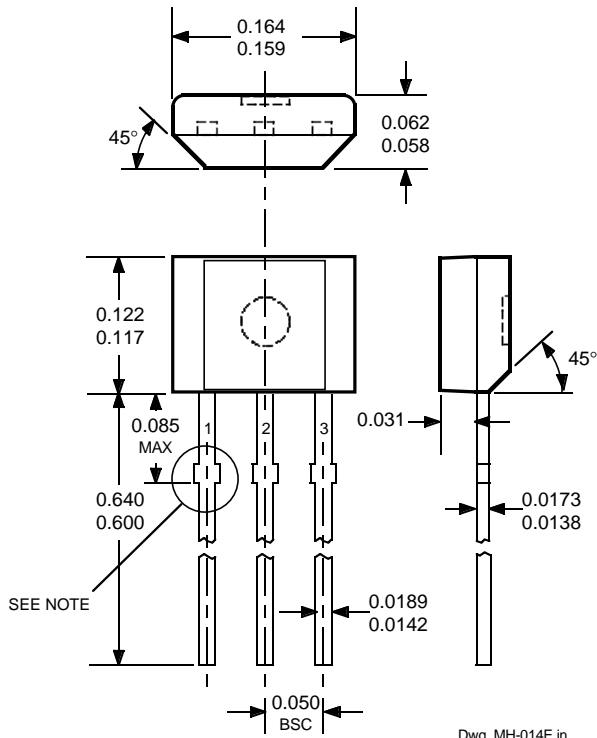
- NOTES:
- Exact body and lead configuration at vendor's option within limits shown.
  - Supplied in bulk pack (500 pieces per bag) or add "TR" to part number for tape and reel.
  - Only low-temperature ( $\leq 240^{\circ}\text{C}$ ) reflow-soldering techniques are recommended for SOT89 devices.



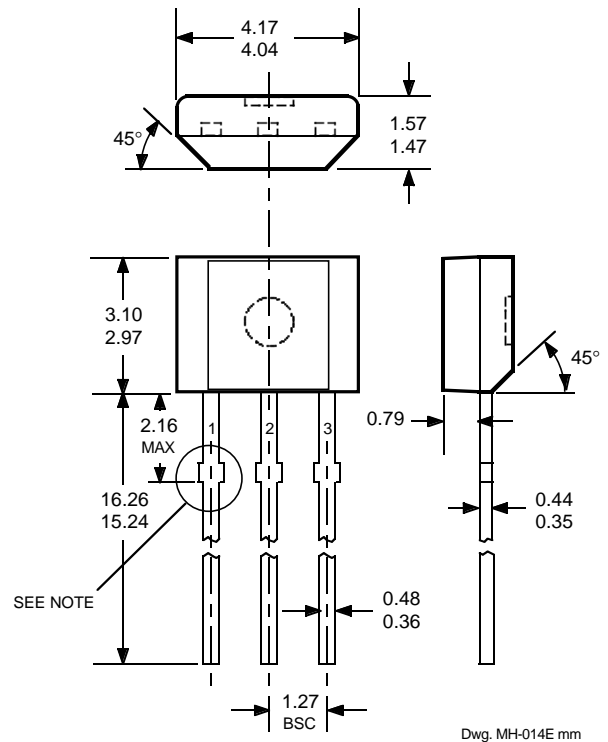
# 3163 HALL-EFFECT SWITCH FOR 2-WIRE APPLICATIONS

## PACKAGE DESIGNATOR 'UA'

**Dimensions in Inches**  
(controlling dimensions)

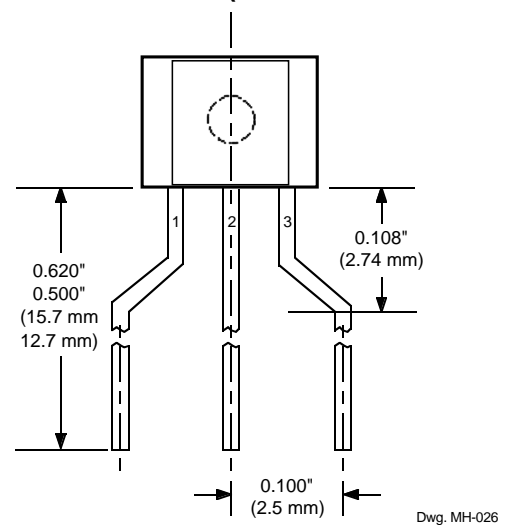


**Dimensions in Millimeters**  
(for reference only)



- 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 A3163xUA-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).

**3163**  
**HALL-EFFECT SWITCH**  
**FOR 2-WIRE APPLICATIONS**

*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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