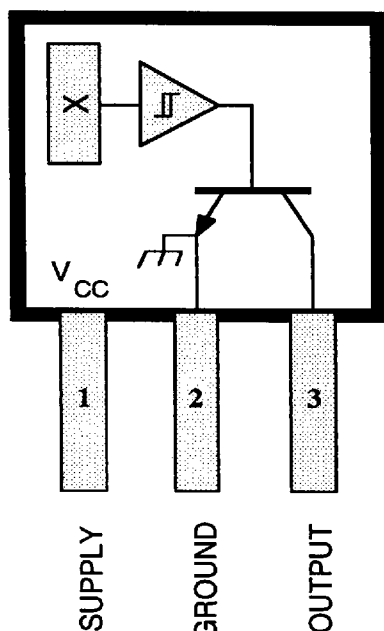


## **HALL-EFFECT LATCHES FOR HIGH-TEMPERATURE OPERATION**



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, $V_{OUT}$ .....	30 V
Reverse Output Voltage, $V_{OUT}$ .....	-0.5 V
Continuous Output Current, $I_{OUT}$ .....	25 mA
Operating Temperature Range, $T_A$	
Suffix 'S-' .....	-20°C to +85°C
Suffix 'E-' .....	-40°C to +85°C
Suffix 'K-' .....	-40°C to +125°C
Suffix 'L-' .....	-40°C to +150°C
Storage Temperature Range,	
$T_S$ .....	-65°C to +170°C

These Hall-effect latches are extremely temperature-stable and stress-resistant sensors especially suited for operation over extended temperature ranges to  $+150^\circ\text{C}$ . Superior high-temperature performance is made possible through a novel Schmitt trigger circuit that maintains operate and release point symmetry by compensating for temperature changes in the Hall element. Additionally, internal compensation provides magnetic switch points that become more sensitive with temperature, hence offsetting the usual degradation of the magnetic field with temperature. The symmetry capability makes these devices ideal for use in pulse-counting applications where duty cycle is an important parameter. The five basic devices (3185 through 3189) are identical except for magnetic switch points.

Each device includes on a single silicon chip a voltage regulator, quadratic Hall-voltage generator, temperature compensation circuit, signal amplifier, Schmitt trigger, and a buffered open-collector output to sink up to 25 mA. The on-board regulator permits operation with supply voltages of 3.8 to 24 volts.

The first character of the part number suffix determines the device operating temperature range; suffix 'S-' is for  $-20^\circ\text{C}$  to  $+85^\circ\text{C}$ , 'E-' is for  $-40^\circ\text{C}$  to  $+85^\circ\text{C}$ , 'K-' is  $-40^\circ\text{C}$  to  $+125^\circ\text{C}$ , and 'L-' is  $-40^\circ\text{C}$  to  $+150^\circ\text{C}$ . Four package styles provide a magnetically optimized package for most applications. Suffix '-LL' is a long-leaded version of suffix '-LT', a miniature SOT-89/TO-243AA transistor package for surface-mount applications; suffix '-U' is a three-lead plastic mini-SIP while suffix '-UA' is a three-lead ultra-mini-SIP.

### **FEATURES**

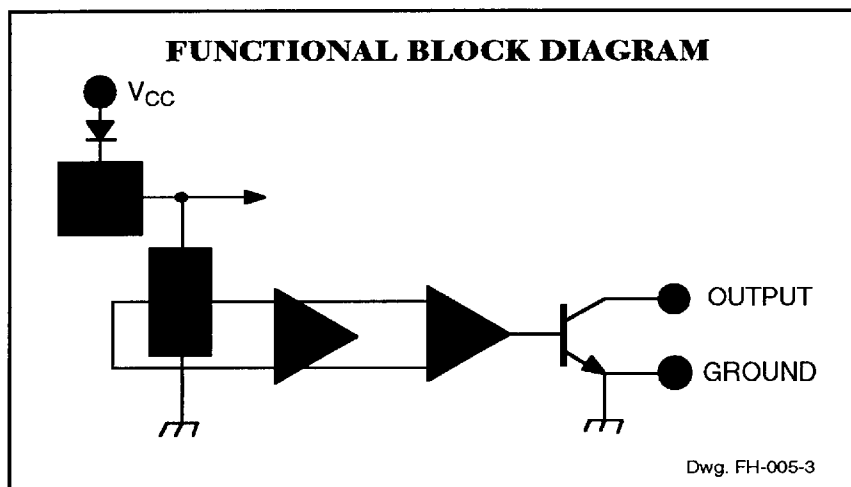
- Symmetrical Switch Points
- Superior Temperature Stability
- Operation From Unregulated Supply
- Open-Collector 25 mA Output
- Reverse Battery Protection
- Activate With Small, Commercially Available Permanent Magnets
- Solid-State Reliability
- Small Size
- Resistant to Physical Stress

Always order by complete part number: the prefix 'A' + the basic four-digit part number + a suffix to indicate operating temperature range + a suffix to indicate package style, e.g., **A3185SLL**.

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# 3185 THRU 3189 HALL-EFFECT LATCHES 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	3.8	—	24	V
Output Saturation Voltage	$V_{OUT(SAT)}$	$I_{OUT} = 20\text{ mA}$ , $B > B_{OP}$	—	175	400	mV
Output Leakage Current	$I_{OFF}$	$V_{OUT} = 24\text{ V}$ , $B < B_{RP}$	—	0.05	5.0	$\mu\text{A}$
Supply Current	$I_{CC}$	$B < B_{RP}$ (Output OFF)	—	4.75	8.0	mA
		$B > B_{OP}$ (Output ON)	—	5.7	—	mA
Output Rise Time	$t_r$	$R_L = 820\ \Omega$ , $C_L = 20\text{ pF}$	—	100	—	ns
Output Fall Time	$t_f$	$R_L = 820\ \Omega$ , $C_L = 20\text{ pF}$	—	100	—	ns

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

Characteristic	Part Numbers*									
	A3185		A3186		A3187		A3188		A3189	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
$B_{OP}$ at $T_A = 25^\circ\text{C}$	170	270	70	330	50	150	100	180	50	230
over operating temp. range	140	300	30	350	50	175	80	200	50	250
$B_{RP}$ at $T_A = 25^\circ\text{C}$	-270	-170	-330	-70	-150	-50	-180	-100	-230	-50
over operating temp. range	-300	-140	-350	-30	-175	-50	-200	-80	-250	-50
$B_{hys}$ at $T_A = 25^\circ\text{C}$	340	540	140	660	100	300	200	360	100	460
over operating temp. range	280	600	100	700	100	350	160	400	100	500

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

As used here, negative flux densities are defined as less than zero (algebraic convention).

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



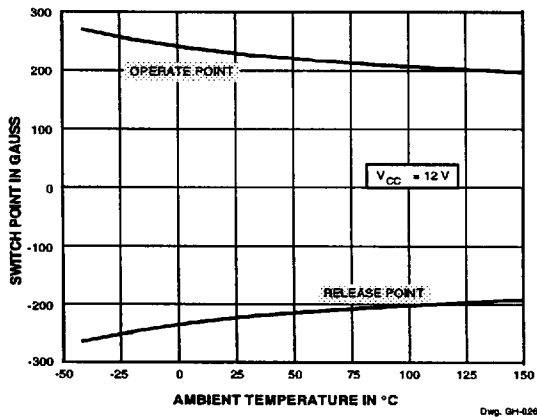
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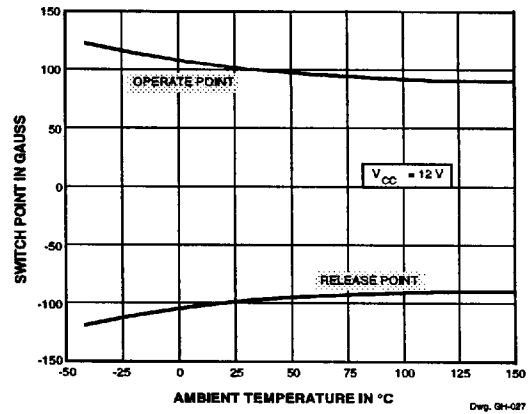
# 3185 THRU 3189 HALL-EFFECT LATCHES FOR HIGH-TEMPERATURE OPERATION

## TYPICAL OPERATING CHARACTERISTICS

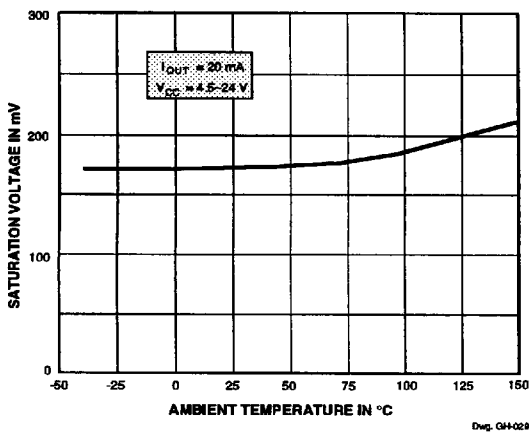
### A3185° SWITCH POINTS



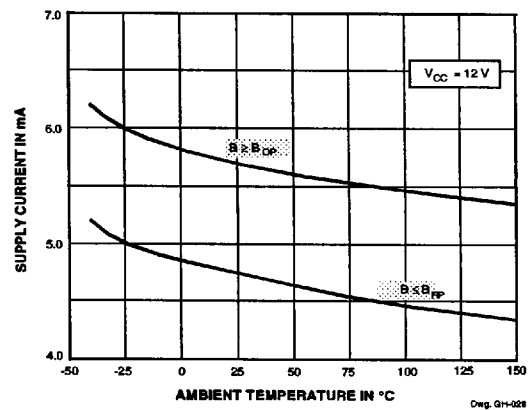
### A3187° SWITCH POINTS



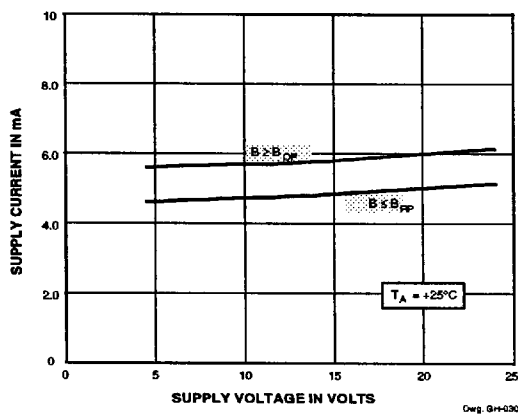
### OUTPUT SATURATION VOLTAGE



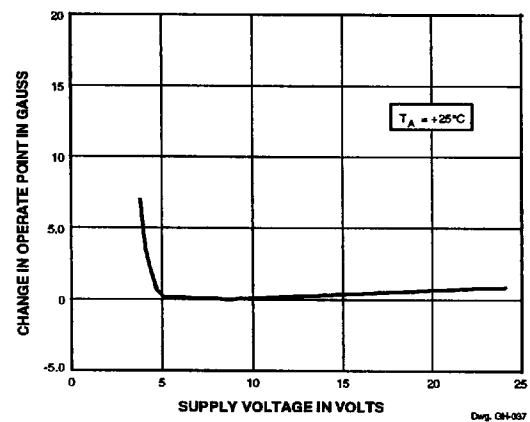
### SUPPLY CURRENT



### SUPPLY CURRENT



### OPERATE POINT



\* Complete part number includes a suffix denoting operating temperature range (E, K, L, or S) and package type (LL, LT, U, or UA).

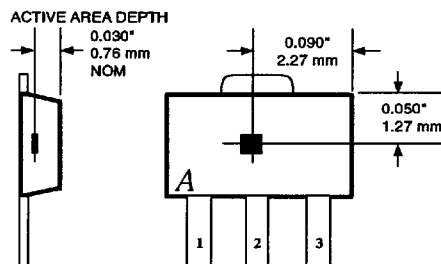
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# 3185 THRU 3189 HALL-EFFECT LATCHES FOR HIGH-TEMPERATURE OPERATION

## SENSOR LOCATIONS

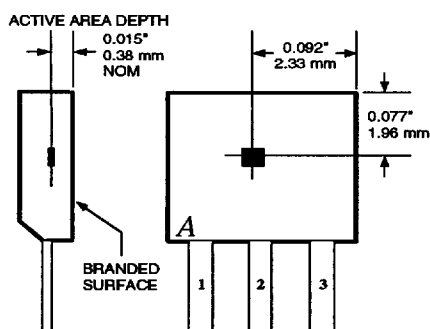
( $\pm 0.005$ " [0.13 mm] die placement)

### Package Designators "LL" and "LT"



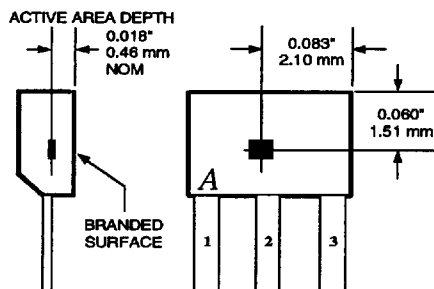
Dwg. MH-008-4B

### Package Designator "U"



Dwg. MH-002-7B

### Package Designators "UA" and "UA-TL"



Dwg. MH-011-4B

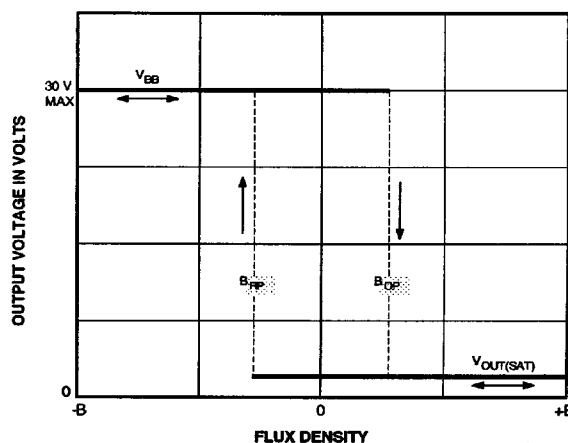
Although sensor location is accurate to three sigma for a particular design, product improvements may result in small changes to sensor location.

## OPERATION

In operation, the output transistor is OFF until the strength of the magnetic field perpendicular to the surface of the chip exceeds the threshold or operate point ( $B_{OP}$ ). When the field strength exceeds  $B_{OP}$ , the output transistor switches ON and is capable of sinking 25 mA of current.

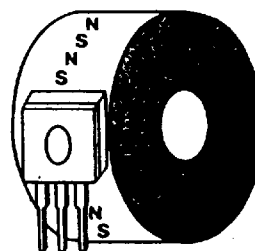
The output transistor switches OFF when magnetic field reversal results in a magnetic flux density below the OFF threshold ( $B_{RP}$ ). This is illustrated in the transfer characteristics graph (A3187\* shown).

Note that the device latches; that is, a south pole of sufficient strength will turn the device ON. Removal of the south pole will leave the device ON. The presence of a north pole of sufficient strength is required to turn the device OFF.



Dwg. G1-034-1

The simplest form of magnet that will operate these devices is a ring magnet, as shown below. Other methods of operation are possible.



Dwg. A-11,899

## APPLICATIONS INFORMATION

Extensive applications information on magnets and Hall-effect sensors is also available in the *Allegro Integrated and Discrete Semiconductors Data Book* or *Application Note 27701*.



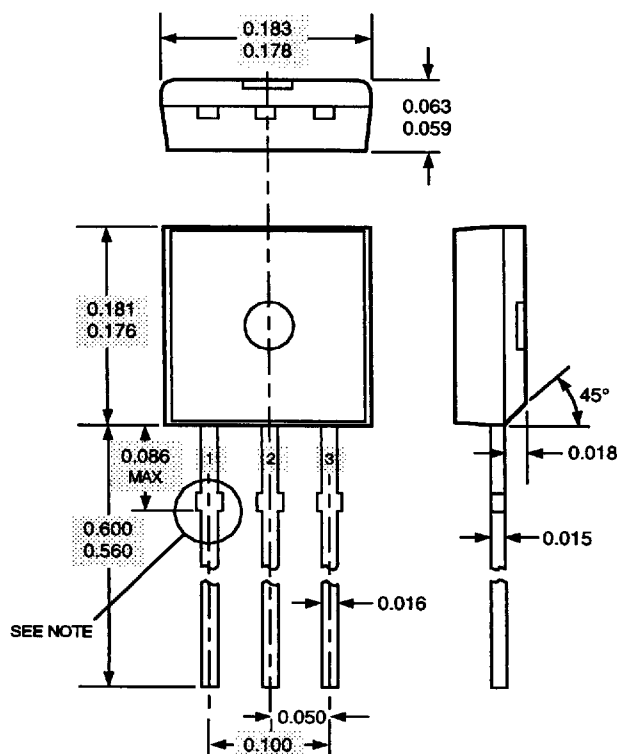
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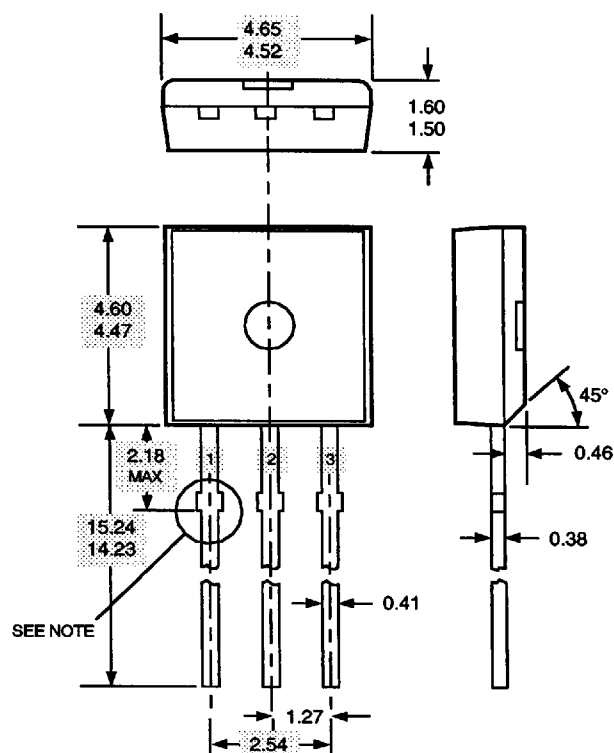
## PACKAGE DESIGNATOR 'U'

Dimensions in Inches  
(controlling dimensions)



Dwg. MH-003D in

Dimensions in Millimeters  
(for reference only)



Dwg. MH-003D mm

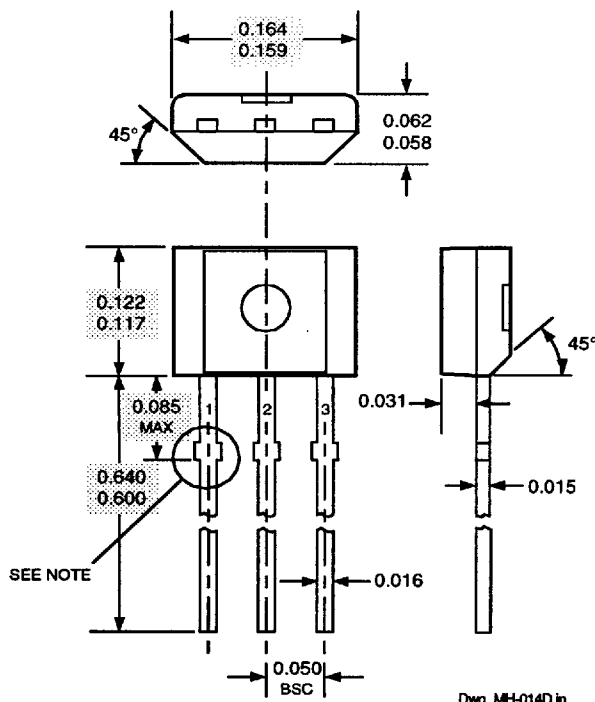
- NOTES:
1. Tolerances on package height and width represent allowable mold offsets. Dimensions given are measured at the widest point (parting line).
  2. Exact body and lead configuration at vendor's option within limits shown.
  3. Height does not include mold gate flash.
  4. Recommended minimum PWB hole diameter to clear transition area is 0.035" (0.89 mm).
  5. Where no tolerance is specified, dimension is nominal.
  6. Minimum lead length was 0.500" (12.70 mm). If existing product to the original specifications is not acceptable, contact sales office before ordering.

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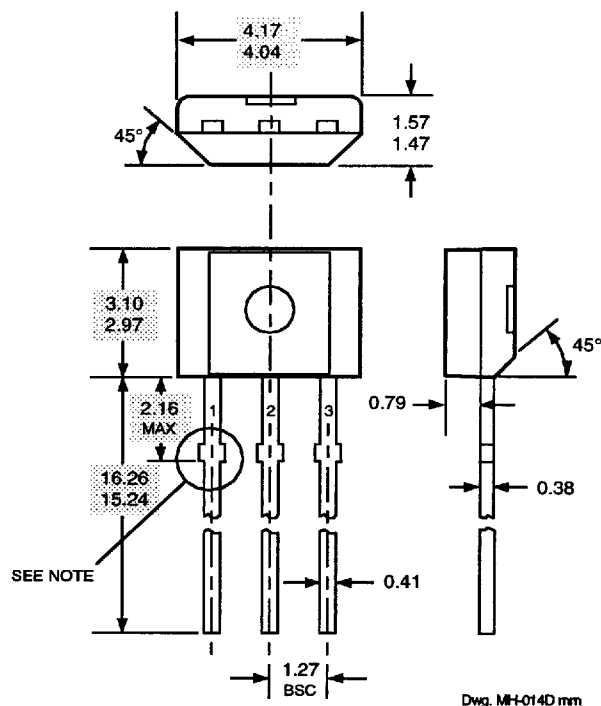
# 3185 THRU 3189 HALL-EFFECT LATCHES FOR HIGH-TEMPERATURE OPERATION

## PACKAGE DESIGNATOR 'UA'

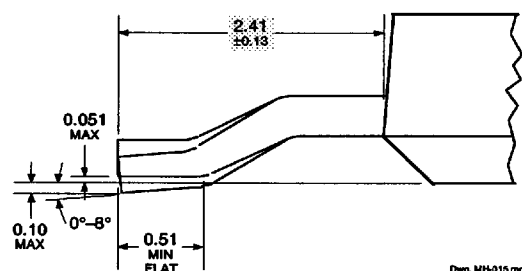
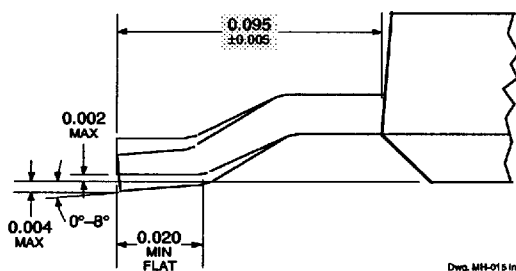
Dimensions in Inches  
(controlling dimensions)



Dimensions in Millimeters  
(for reference only)



## Surface-Mount Lead Form (Suffix -TL)



- 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.



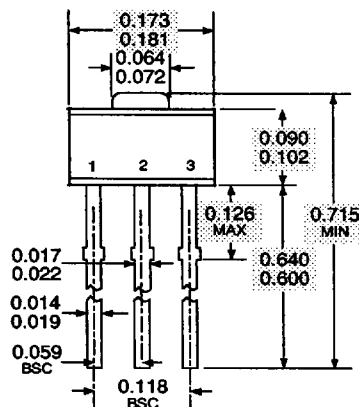
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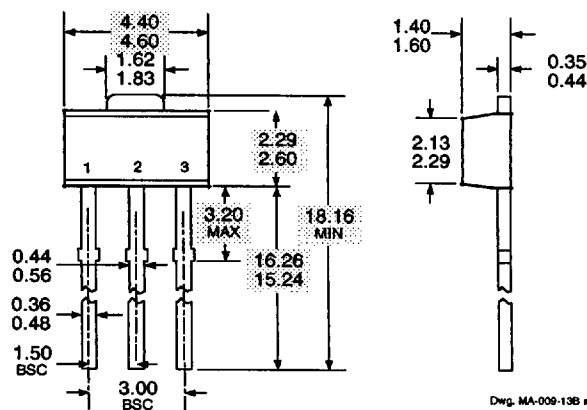
## PACKAGE DESIGNATOR 'LL' (Package 'LT' with long leads)

Dimensions in Inches  
(for reference only)



Dwg. MA-009-13B in

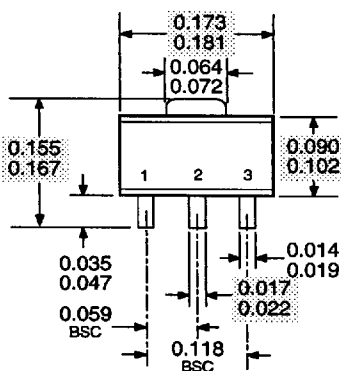
Dimensions in Millimeters  
(controlling dimensions)



Dwg. MA-009-13B mm

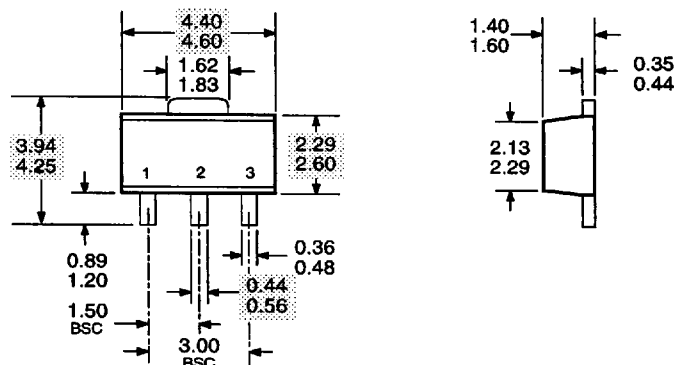
## PACKAGE DESIGNATOR 'LT' (SOT-89/TO-243AA)

Dimensions in Inches  
(for reference only)



Dwg. MA-009-3 in

Dimensions in Millimeters  
(controlling dimensions)



Dwg. MA-009-3 mm

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*The information included herein is believed to be accurate and reliable. However, Allegro MicroSystems, Inc. assumes no responsibility for its use; nor for any infringements of patents or other rights of third parties which may result from its use.*

NOTE: Exact body and lead configuration at vendor's option within limits shown.

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# 3185 THRU 3189 HALL-EFFECT LATCHES FOR HIGH-TEMPERATURE OPERATION

## HALL-EFFECT SENSORS SELECTION GUIDE

Partial Part Number	Avail. Oper. Temp.	Operate Limits Over Temp.			Function†	Notes
		BOP max	BRP min	Bhys min		
3046	E/L	+200	-200	15	Gear-Tooth Sensor	1
3054	K/S	+300	+5	5.0	Unipolar Multiplex	
3056	E/L	+225	-225	15	Gear-Tooth Sensor	
3058	E/L	+300	-300	150	Gear-Tooth Sensor	
3059	K/S	+100	-100	20	AC Gear-Tooth Sensor	
3060	K/S	+35	-35	10	AC Gear-Tooth Sensor	
3121	E/L	+500	+80	60	Unipolar Switch	2, 3
3122	E/L	+430	+120	70	Unipolar Switch	
3123	E/L	+470	+160	70	Unipolar Switch	
3132	K/L/S	+95	-95	30	Bipolar Switch	
3133	K/L/S	+75	-75	30	Bipolar Switch	
3134	E/L	+50	-40	10	Bipolar Switch	
3141	E/L	+175	+10	20	Unipolar Switch	
3142	E/L	+245	+60	30	Unipolar Switch	
3143	E/L	+355	+150	30	Unipolar Switch	
3144	E/L	+450	+25	20	Unipolar Switch	
3161	E	+160	+30	5.0	2-Wire Unipolar Switch	
3175	S	+180	-180	80	Bipolar Latch	
3177	S	+150	-150	50	Bipolar Latch	
3185	E/L	+300	-300	280	Bipolar Latch	
3186	E/L	+350	-350	100	Bipolar Latch	
3187	E/L	+175	-175	100	Bipolar Latch	
3188	E/L	+200	-200	160	Bipolar Latch	
3189	E/L	+250	-250	100	Bipolar Latch	
3195	E/L	+200	-200	110	Bipolar Latch	3
3197	L	+200	-200	110	Bipolar Latch	
3235	S	+200	+15	15	Unipolar Switch	4
		-200	-15	15	Unipolar Switch	
3275	S	+250	-250	100	Bipolar Latch	5
3421	E/L	+300	-300	240	Direction Detection	
3422	E/L	+85	-85	10	Direction Detection	3, 5, 6
3503	S	Typ. 1.3 mV/G		—	Linear Sensor	
3507	E/L	Typ. 2.5 mV/G		—	Linear Sensor	
3508	S	Typ. 2.5 mV/G		—	Linear Sensor	
3515	E/L	Typ. 5.0 mV/G		—	Linear Sensor	
3516	E/L	Typ. 2.5 mV/G		—	Linear Sensor	
3517	L/S	Typ. 5.0 mV/G		—	Linear Sensor	
3518	L/S	Typ. 2.5 mV/G		—	Linear Sensor	
3625	S	+150	-150	200*	900 mA Bipolar Latch	3, 5, 6
3626	S	+150	-150	200*	400 mA Bipolar Latch	
5140	E	+240	+25	20	300 mA Unipolar Switch	3, 6
5275	S	+250	-250	100	300 mA Bipolar Latch	

### Operating Temperature Ranges:

C = 0°C to +70°C, S = -20°C to +85°C, E = -40°C to +85°C, K = -40°C to +125°C, L = -40°C to +150°C

Notes 1. Multiplexed two-wire sensor; after proper address, power/signal bus current indicates magnetic field condition.

2. Active pull down.

3. Protected.

4. Output 1 switches on south pole, output 2 switches on north pole for 2-phase, bifilar-wound, unipolar-driven brushless dc motor control.

5. Complementary outputs for 2-phase bifilar-wound, unipolar-driven brushless dc motor control.

6. Power driver output.

\* Typical.

† Latches will not switch on removal of magnetic field; bipolar switches may switch on removal of field but require field reversal for reliable operation over operating temperature range.



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