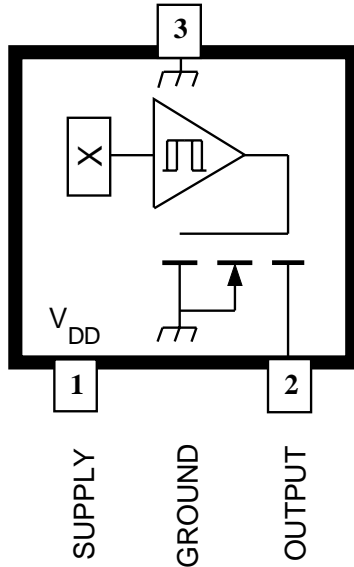


3212

MICROPOWER, ULTRA-SENSITIVE HALL-EFFECT SWITCH

Package Suffix 'LH' Pinning (SOT23W)



Dwg. PH-016-1

Pinning is shown viewed from branded side.

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

Supply Voltage, V_{DD}	5 V
Magnetic Flux Density, B	Unlimited
Output Off Voltage, V_{OUT}	5 V
Output Current, I_{OUT}	1 mA
Junction Temperature, T_J	+170°C
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

Caution: These CMOS devices have input static protection (Class 3) but are still susceptible to damage if exposed to extremely high static electrical charges.

The A3212 integrated circuit is an ultra-sensitive, pole independent Hall-effect switch with a latched digital output. This sensor is especially suited for operation in battery-operated, hand-held equipment such as cellular and cordless telephones, pagers, and palmtop computers. A 2.5 volt to 3.5 volt operation and a unique clocking scheme reduce the average operating power requirements – to less than 15 μW with a 2.75 volt supply.

Unlike other Hall-effect switches, either a north or south pole of sufficient strength will turn the output on; in the absence of a magnetic field, the output is off. The polarity independence and minimal power requirement allow these devices to easily replace reed switches for superior reliability and ease of manufacturing, while eliminating the requirement for signal conditioning.

Improved stability is made possible through chopper stabilization (dynamic offset cancellation), which reduces the residual offset voltage normally caused by device overmolding, temperature dependencies, and thermal stress.

This device includes on a single silicon chip a Hall-voltage generator, small-signal amplifier, chopper stabilization, a latch, and a MOSFET output. Advanced BiCMOS processing is used to take advantage of low-voltage and low-power requirements, component matching, very low input-offset errors, and small component geometries.

Two package styles provide a magnetically optimized package for most applications. Suffix 'LH' is a miniature low-profile surface-mount package while suffix 'UA' is a three-lead ultra-mini-SIP for through-hole or surface mounting.

FEATURES

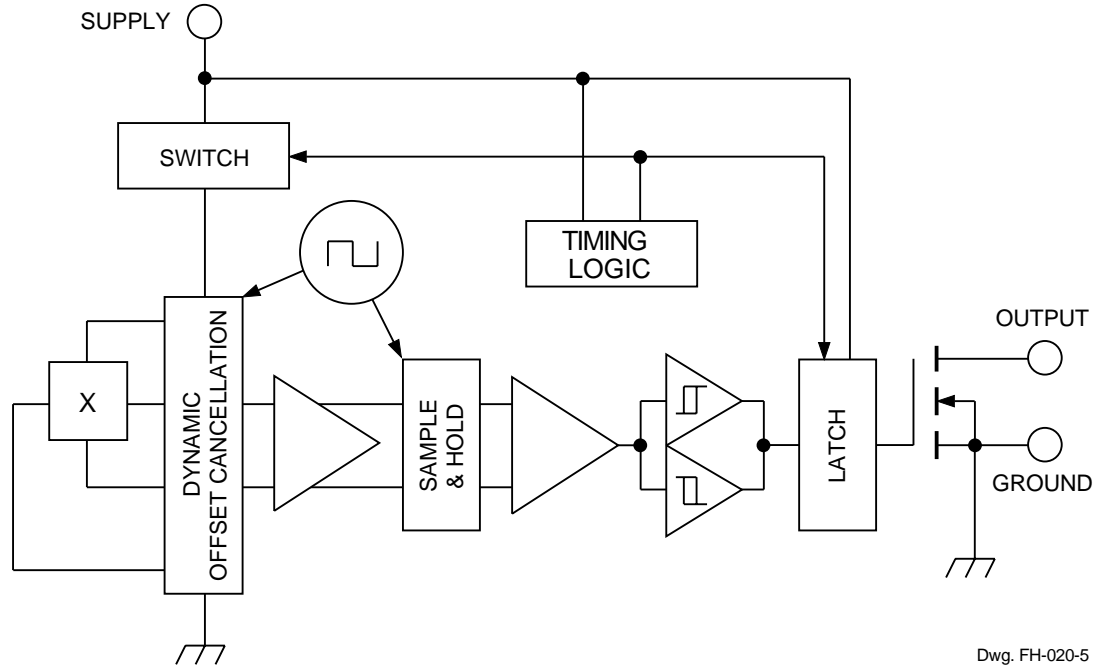
- Micropower Operation
- Operation With North or South Pole
- 2.5 V to 3.5 V Battery Operation
- Chopper Stabilized
 - Superior Temperature Stability
 - Extremely Low Switch-Point Drift
 - Insensitive to Physical Stress
- ESD Protected to 5 kV
- Solid-State Reliability
- Small Size
- Easily Manufacturable With Magnet Pole Independence

Always order by complete part number: the prefix 'A' + the basic four-digit part number + the suffix 'E' or 'L' to indicate operating temperature range + a suffix to indicate package style, e.g., **A3212ELH** .

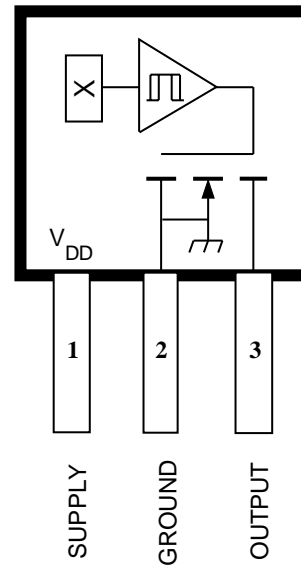
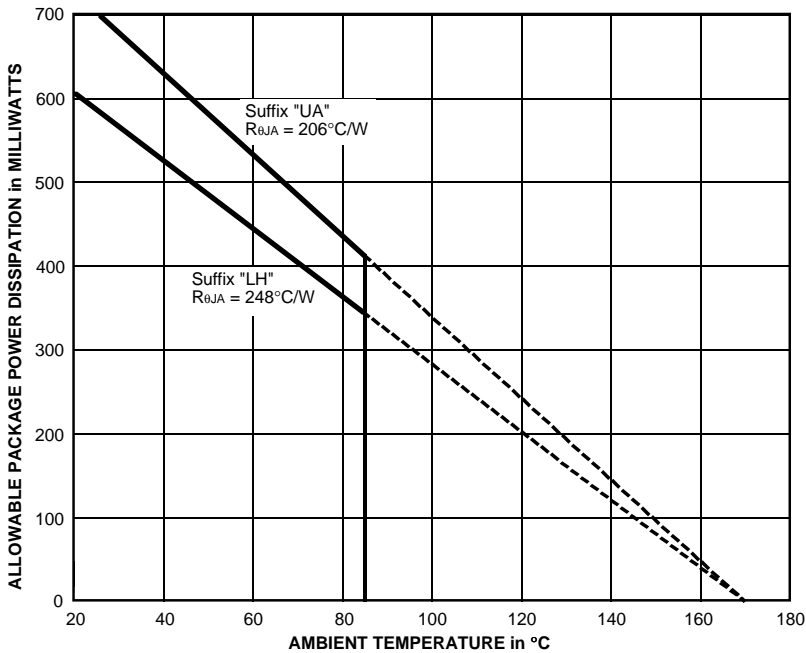


3212 MICROPOWER, ULTRA-SENSITIVE HALL-EFFECT SWITCHES

FUNCTIONAL BLOCK DIAGRAM



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



Pinning is shown viewed from branded side.

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MICROPOWER,
ULTRA-SENSITIVE
HALL-EFFECT SWITCHES

ELECTRICAL CHARACTERISTICS over operating voltage and temperature range (unless otherwise specified).

Characteristic	Symbol	Test Conditions	Limits			
			Min.	Typ.	Max.	Units
Supply Voltage Range	V_{DD}	Operating ¹	2.5	2.75	3.5	V
Output Leakage Current	I_{OFF}	$V_{OUT} = 3.5\text{ V}$, $B_{RPN} < B < B_{RPS}$	–	<1.0	1.0	μA
Output On Voltage	V_{OUT}	$I_{OUT} = 1\text{ mA}$, $V_{DD} = 2.75\text{ V}$	–	100	300	mV
Awake Time	t_{awake}		–	45	90	μs
Period	t_{period}		–	45	90	ms
Duty Cycle	d.c.		–	0.1	–	%
Chopping Frequency	f_C		–	340	–	kHz
Supply Current	$I_{DD(EN)}$	Chip awake (enabled)	–	–	2.0	mA
	$I_{DD(DIS)}$	Chip asleep (disabled)	–	–	8.0	μA
	$I_{DD(AVG)}$	$V_{DD} = 2.75\text{ V}$	–	5.1	10	μA
		$V_{DD} = 3.5\text{ V}$	–	6.7	10	μA

- NOTES: 1. Operate and release points will vary with supply voltage.
 2. B_{OPx} = operate point (output turns on); B_{RPx} = release point (output turns off).
 3. Typical Data is at $T_A = +25^\circ\text{C}$ and $V_{DD} = 2.75\text{ V}$ and is for design information only.

MAGNETIC CHARACTERISTICS over operating voltage and temperature range (unless otherwise specified).

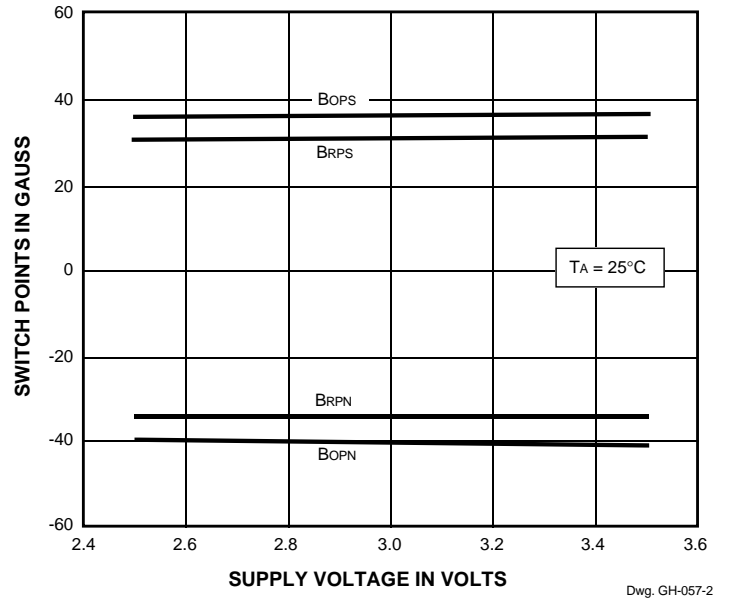
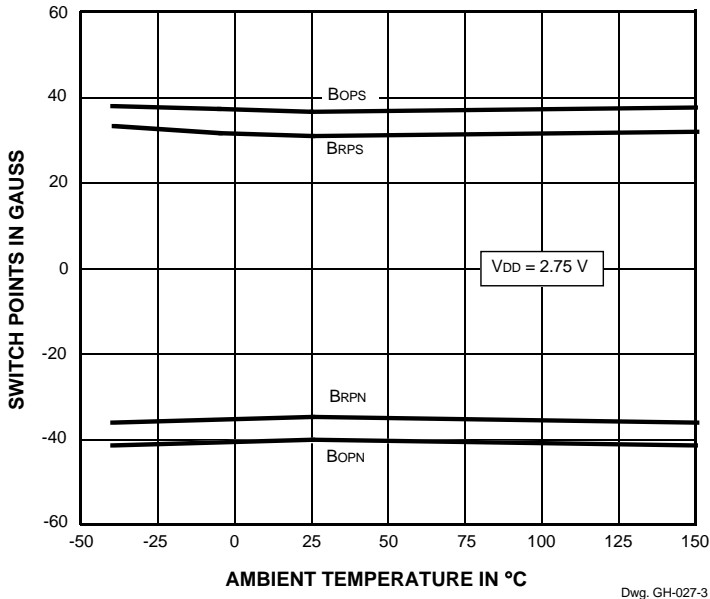
Characteristic	Symbol	Test Conditions	Limits			
			Min.	Typ.	Max.	Units
Operate Points	B_{OPS}	South pole to branded side	–	37	55	G
	B_{OPN}	North pole to branded side	-55	-40	–	G
Release Points	B_{RPS}	South pole to branded side	10	31	–	G
	B_{RPN}	North pole to branded side	–	-34	-10	G
Hysteresis	B_{hys}	$ B_{OPx} - B_{RPx} $	–	5.9	–	G

- NOTES: 1. As used here, negative flux densities are defined as less than zero (algebraic convention) and -50 G is less than +10 G.
 2. Typical Data is at $T_A = +25^\circ\text{C}$ and $V_{DD} = 2.75\text{ V}$ and is for design information only.

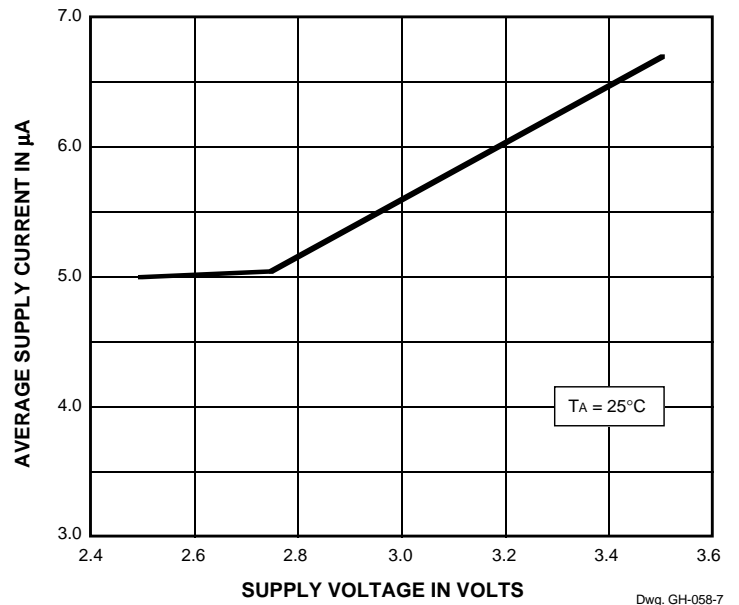
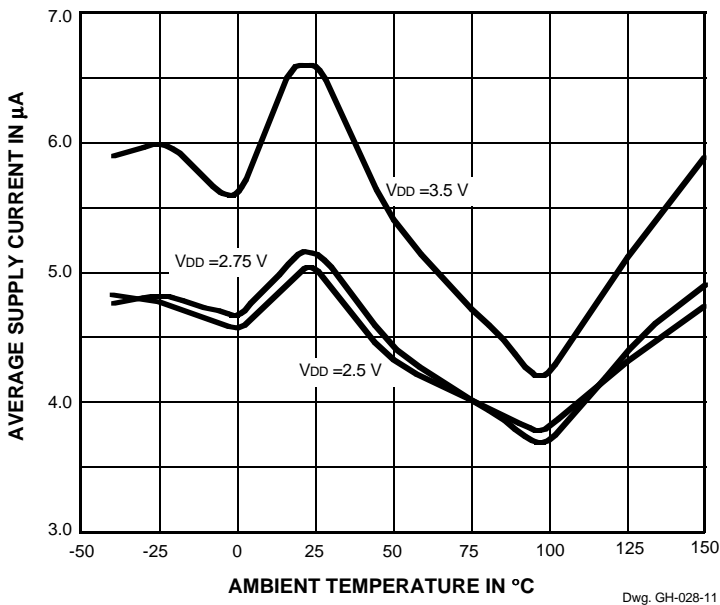
3212
MICROPOWER,
ULTRA-SENSITIVE
HALL-EFFECT SWITCHES

TYPICAL OPERATING CHARACTERISTICS

SWITCH POINTS



SUPPLY CURRENT



3212
MICROPOWER,
ULTRA-SENSITIVE
HALL-EFFECT SWITCHES

CRITERIA FOR DEVICE QUALIFICATION

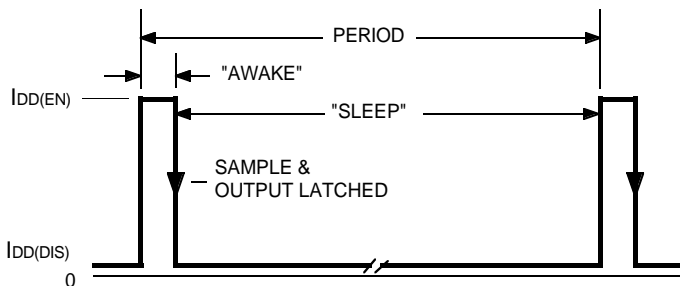
All Allegro sensors are subjected to stringent qualification requirements prior to being released to production. To become qualified, except for the destructive ESD tests, no failures are permitted.

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	$V_{DD} = V_{OUT} = 3\text{ V}$
High-Temperature Operating Life (HTOL)	JESD22-A108, $T_A = 150^{\circ}\text{C}$, $T_J \leq 165^{\circ}\text{C}$	408 hrs	77	$V_{DD} = V_{OUT} = 3\text{ V}$
Accelerated HTOL	$T_A = 175^{\circ}\text{C}$, $T_J \leq 190^{\circ}\text{C}$	504 hrs	77	$V_{DD} = V_{OUT} = 3\text{ V}$
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°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 > 5 kV
ESD, Machine Model	JESD22-A115	Pre/Post Reading	3 per test	Test to failure, All leads > 350 V
Electrical Distributions	Per Specification	—	30	

3212 MICROPOWER, ULTRA-SENSITIVE HALL-EFFECT SWITCHES

FUNCTIONAL DESCRIPTION

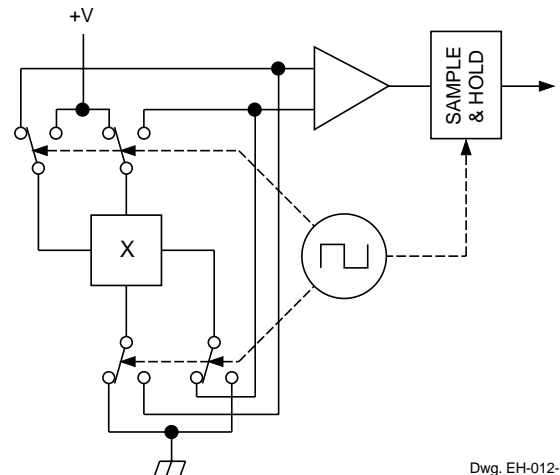
Low Average Power. Internal timing circuitry activates the sensor for 45 μ s and deactivates it for the remainder of the period (45 ms). A short "awake" time allows for stabilization prior to the sensor sampling and data latching on the falling edge of the timing pulse. The output during the "sleep" time is latched in the last sampled state. The supply current is not affected by the output state.



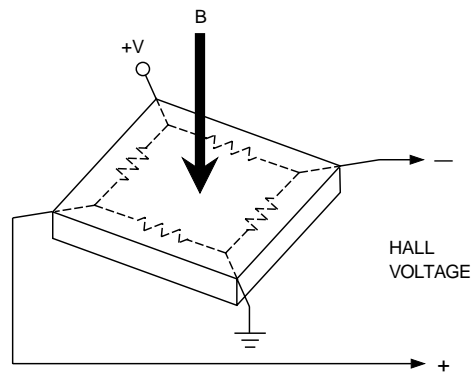
Dwg. WH-017-2

Chopper-Stabilized Technique. The Hall element can be considered as a resistor array similar to a Wheatstone bridge. A large portion of the offset is a result of the mismatching of these resistors. These devices use a proprietary dynamic offset cancellation technique, with an internal high-frequency clock to reduce the residual offset voltage of the Hall element that is normally caused by device overmolding, temperature dependencies, and thermal stress. The chopper-stabilizing technique cancels the mismatching of the resistor circuit by changing the direction of the current flowing through the Hall plate using CMOS switches and Hall voltage measurement taps, while maintaining the Hall-voltage signal that is induced by the external magnetic flux. The signal is then captured by a sample-and-hold circuit and further processed using low-offset bipolar circuitry. This technique produces devices that have an extremely stable quiescent Hall output voltage, are immune to thermal stress, and have precise recoverability after temperature cycling. A relatively high sampling frequency is used for faster signal processing capability can be processed.

More detailed descriptions of the circuit operation can be found in: Technical Paper STP 97-10, *Monolithic Magnetic Hall Sensor Using Dynamic Quadrature Offset Cancellation* and Technical Paper STP 99-1, *Chopper-Stabilized Amplifiers With A Track-and-Hold Signal Demodulator*.



Dwg. EH-012-1

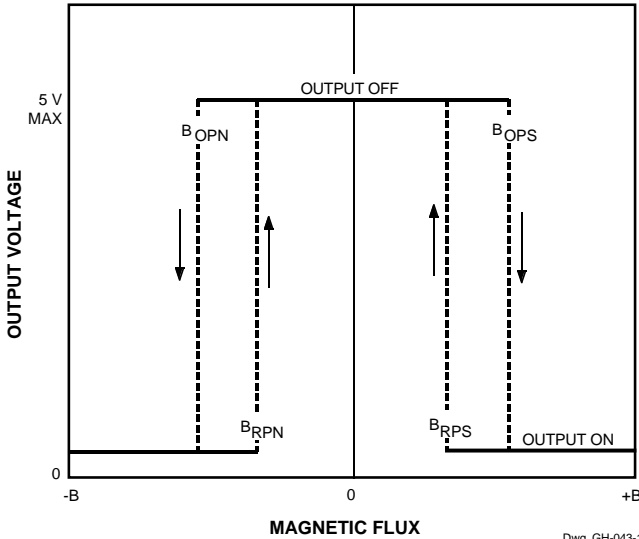


Dwg. AH-011-2

Operation. The output of this device switches low (turns on) when a magnetic field perpendicular to the Hall sensor exceeds the operate point B_{OPS} (or is less than B_{OPN}). After turn-on, the output is capable of sinking up to 1 mA and the output voltage is $V_{OUT(ON)}$. When the magnetic field is reduced below the release point B_{RPS} (or increased above B_{RPN}), the device output switches 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.

As used here, negative flux densities are defined as less than zero (algebraic convention) and -50 G is less than +10 G.

3212 MICROPOWER, ULTRA-SENSITIVE HALL-EFFECT SWITCHES

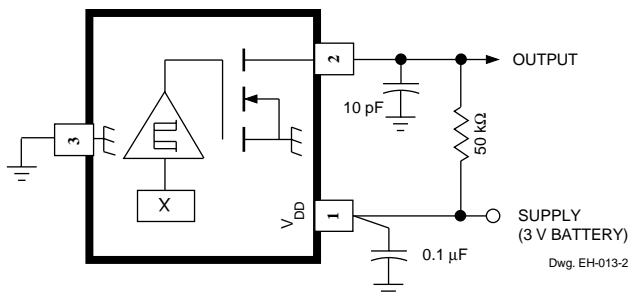


Applications. Allegro's pole-independent sensing technique allows for operation with either a north pole or south pole magnet orientation, enhancing the manufacturability of the device. The state-of-the-art technology provides the same output polarity for either pole face.

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 to reduce both external noise and noise generated by the chopper-stabilization technique. This is especially true due to the relatively high impedance of battery supplies.

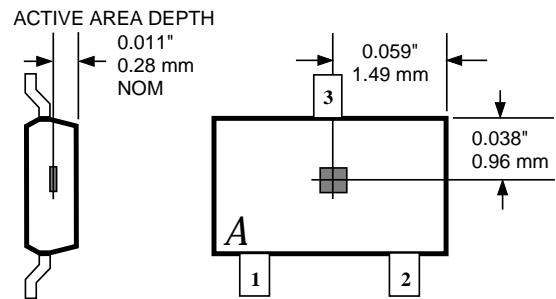
The simplest form of magnet that will operate these devices is a bar magnet with either pole near the branded surface of the device. Many other methods of operation are possible. Extensive applications information on magnets and Hall-effect sensors is also available in the *Allegro Electronic Data Book* AMS-702 or *Application Note 27701*, or at

www.allegromicro.com

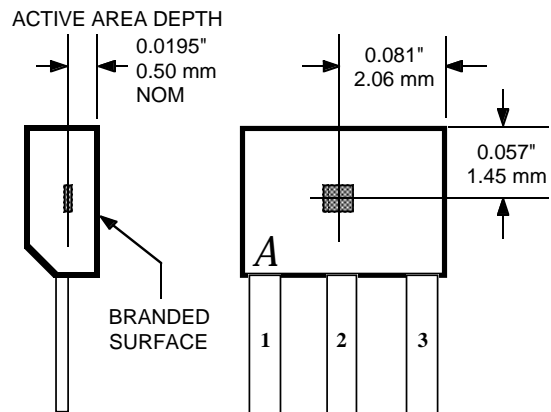


SENSOR LOCATIONS (±0.005" [0.13 mm] die placement)

Package Designator 'LH'



Package Designators 'UA', 'UA-LC', and 'UA-TL'



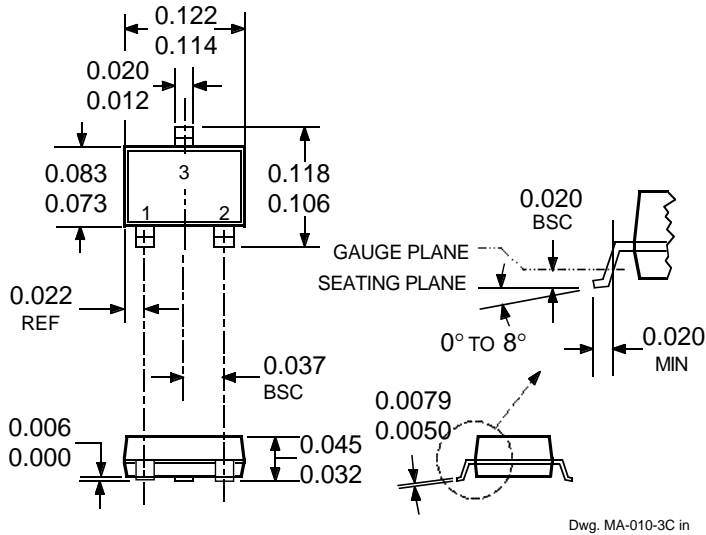
Although sensor location is accurate to three sigma for a particular design, product improvements may result in small changes to sensor location.

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MICROPOWER,
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PACKAGE DESIGNATOR 'LH'

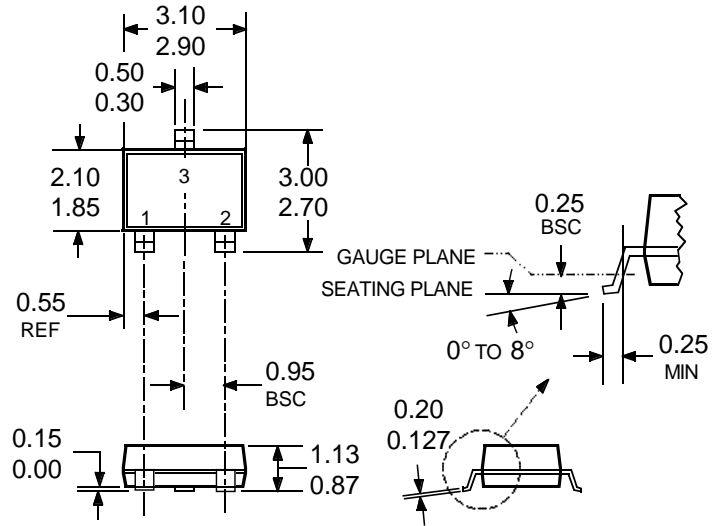
(fits SC-74A solder-pad layout)

Dimensions in Inches
(for reference only)

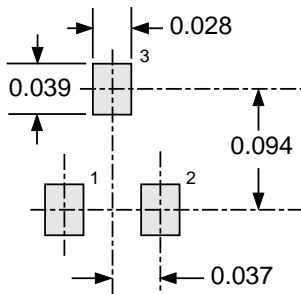


Dwg. MA-010-3C in

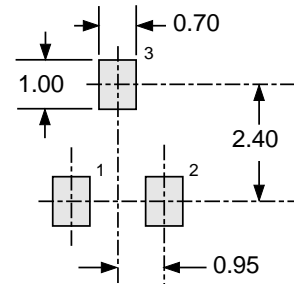
Dimensions in Millimeters
(controlling dimensions)



Dwg. MA-010-3C mm



Dwg. MA-011-3 in



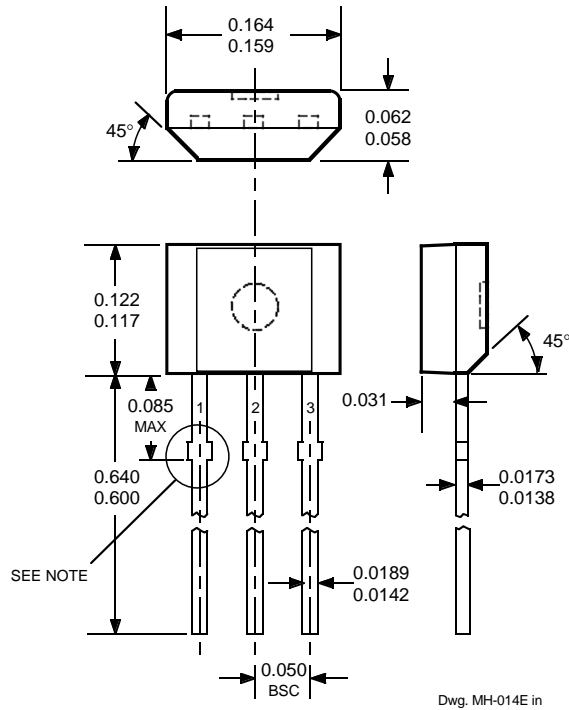
Dwg. MA-011-3 mm

- 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. Where no tolerance is specified, dimension is nominal.

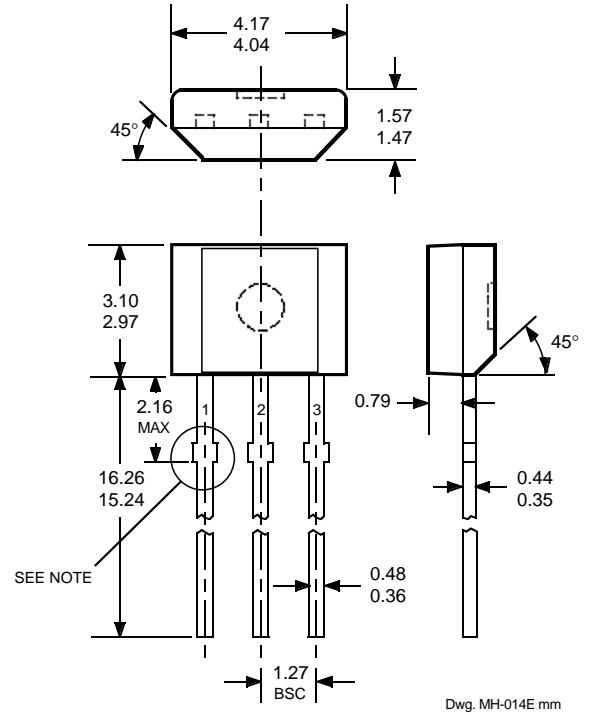
3212 MICROPOWER, ULTRA-SENSITIVE HALL-EFFECT SWITCHES

PACKAGE DESIGNATOR 'UA'

Dimensions in Inches
(controlling dimensions)



Dimensions in Millimeters
(for reference only)

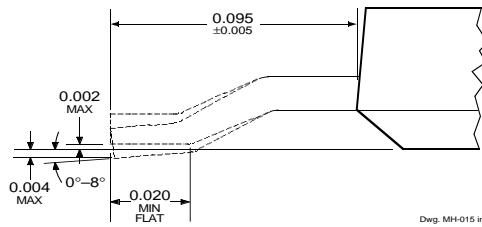


- NOTES:
1. Tolerances on package height and width represent allowable mold offsets. Dimensions given are measured at the widest point (parting line).
 2. Exact body and lead configuration at vendor's option within limits shown.
 3. Height does not include mold gate flash.
 4. Recommended minimum PWB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

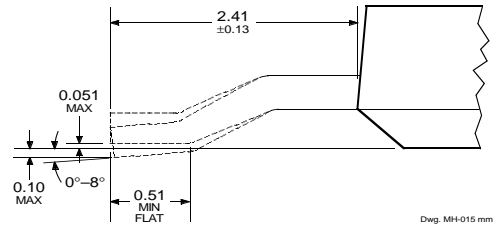
3212 MICROPOWER, ULTRA-SENSITIVE HALL-EFFECT SWITCHES

Surface-Mount Lead Form (order A3212EUA-TL)

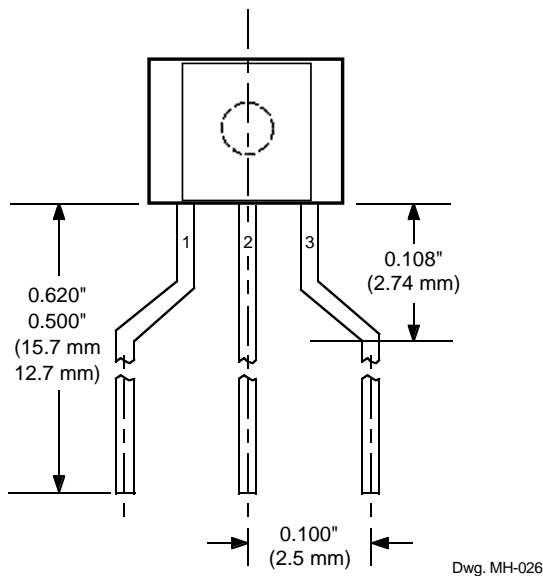
Dimensions in Inches
(controlling dimensions)



Dimensions in Millimeters
(for reference only)



Radial Lead Form (order A3212EUA-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).

The products described herein are manufactured under one or more of the following U.S. patents: 4,761,569; 5,619,137; 5,621,319. In addition, a patent is pending for Allegro's magnetic pole-independent feature. Allegro has several foreign counterpart patents as well. Allegro has not licensed any of these patents to any third party.

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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