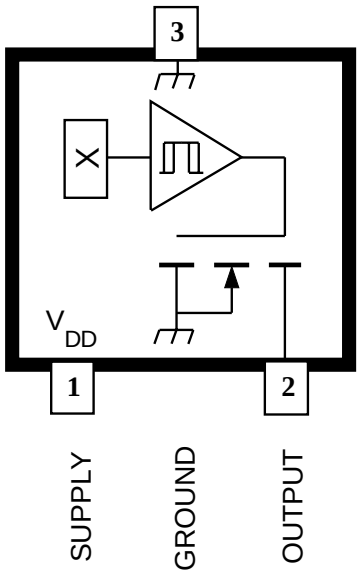
3212

Data Sheet
27622.61*

Preliminary Information
(Subject to change without notice)
November 12, 2001

MICROPOWER, ULTRA-SENSITIVE HALL-EFFECT SWITCH

Package Suffix 'LH' Pinning



Dwg. PH-016-1

Pinning is shown viewed from branded side.

ABSOLUTE MAXIMUM RATINGS
at T_A = +25°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.

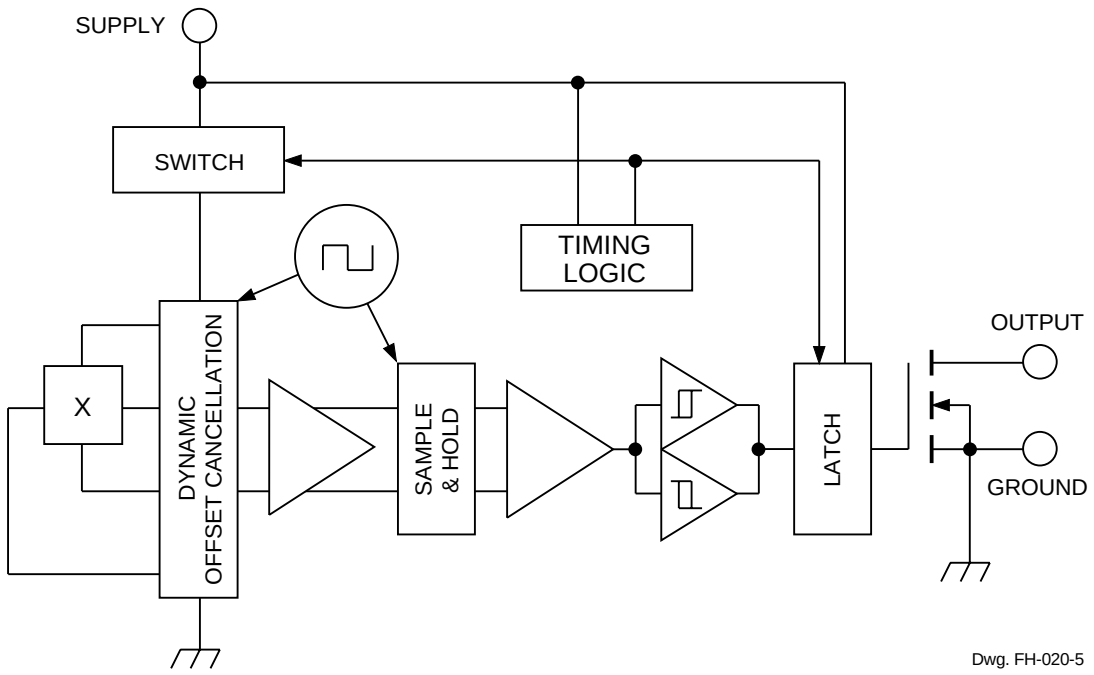
The A3212Ex is rated for operation over a temperature range of -40°C to 85°C. The A3212Lx is rated for operation over a temperature range of -40°C to 150°C. Two package styles provide a magnetically optimized package for most applications. Suffix 'LH' is a miniature low-profile surface-mount package while suffix 'UA' is a three-lead ultra-mini-SIP for through-hole or surface mounting.

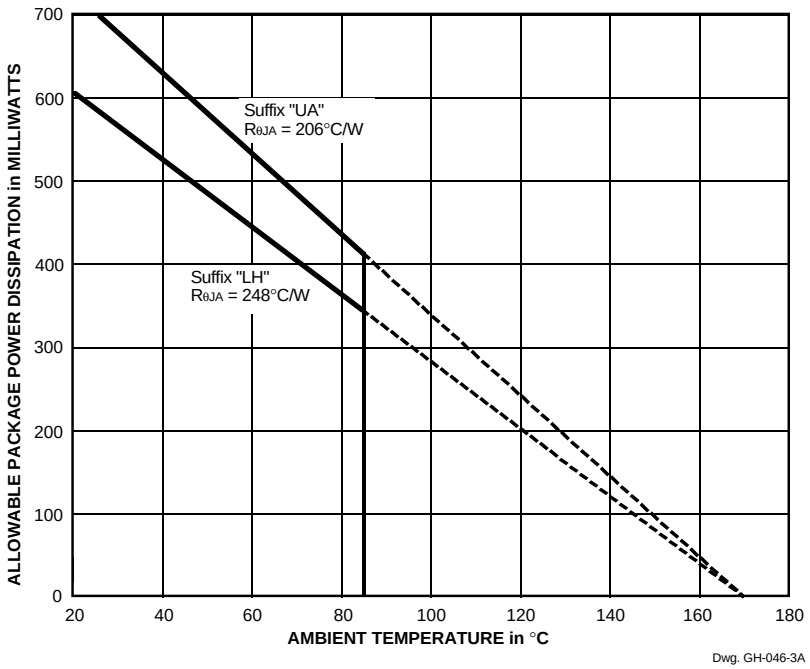
FEATURES

- 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

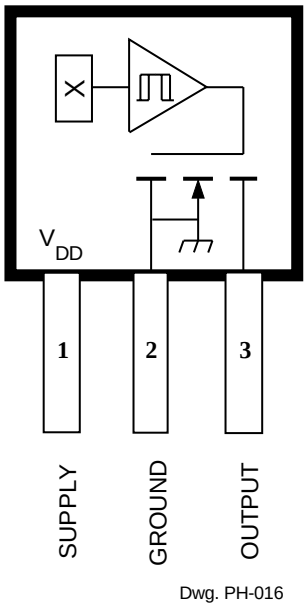
Always order by complete part number: the prefix 'A' + the basic four-digit part number + the suffix 'E' or 'L' to indicate operating temperature range + a suffix to indicate package style, e.g., **A3212ELH** .

FUNCTIONAL BLOCK DIAGRAM





Package Suffix 'UA' Pinning



Pinning is shown viewed from branded side.

115 Northeast Cutoff, Box 15036
Worcester, Massachusetts 01615-0036 (508) 853-5000

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 V, $B_{RPN} < B < B_{RPS}$	—	˙1.0	1.0	µA
Output On Voltage	V_{OUT}	I_{OUT} = 1 mA, V_{DD} = 2.75 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 ($2.5 \le V_{DD} \le 3.5$ V)	$I_{DD(EN)}$	Chip awake (enabled)	—	—	2	mA
	$I_{DD(DIS)}$	Chip asleep (disabled)	—	—	8	µA
	$I_{DD(AVG)}$	V_{DD} = 2.75 V	—	4.2	10	µA
		V_{DD} = 3.5 V	—	4.9	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°C and V_{DD} = 2.75 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	—	—	55	G
	B_{OPN}	North pole to branded side	-55	—	—	G
Release Points	B_{RPS}	South pole to branded side	10	—	—	G
	B_{RPN}	North pole to branded side	—	—	-10	G
Hysteresis	B_{hys}	$\lvert B_{OPx} - B_{RPx} \rvert$	—	8	—	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°C and V_{DD} = 2.75 V and is for design information only.

CRITERIA FOR DEVICE QUALIFICATION

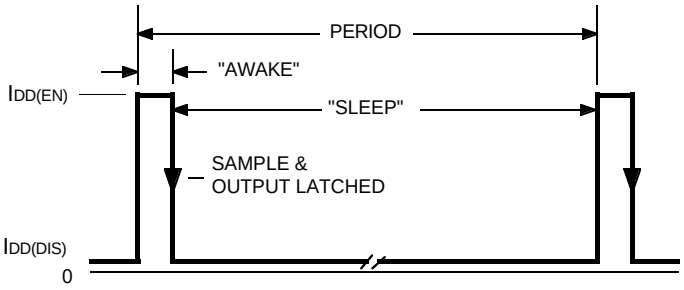
All Allegro sensors are subjected to stringent qualification requirements prior to being released to production. To become qualified, except for the destructive ESD tests, no failures are permitted.

Qualification Test	Test Method and Test Conditions	Test Length	Samples	Comments
Biased Humidity (HAST)	T_A = 130°C, RH = 85%	50 hrs	77	$V_{DD} = V_{OUT}$ = 3 V
High-Temperature Operating Life (HTOL)	JESD22-A108, T_A = 150°C, $T_J \leq$ 165°C	408 hrs	77	$V_{DD} = V_{OUT}$ = 3 V
Accelerated HTOL	T_A = 175°C, $T_J \leq$ 190°C	504 hrs	77	$V_{DD} = V_{OUT}$ = 3 V
Autoclave, Unbiased	JESD22-A102, Condition C, T_A = 121°C, 15 psig	96 hrs	77	
High-Temperature (Bake) Storage Life	MIL-STD-883, Method 1008, T_A = 170°C	1000 hrs	77	
Temperature Cycle	MIL-STD-883, Method 1010, -65°C to +150°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	

Allegro® MicroSystems, Inc.
115 Northeast Cutoff, Box 15036
Worcester, Massachusetts 01615-0036 (508) 853-5000

FUNCTIONAL DESCRIPTION

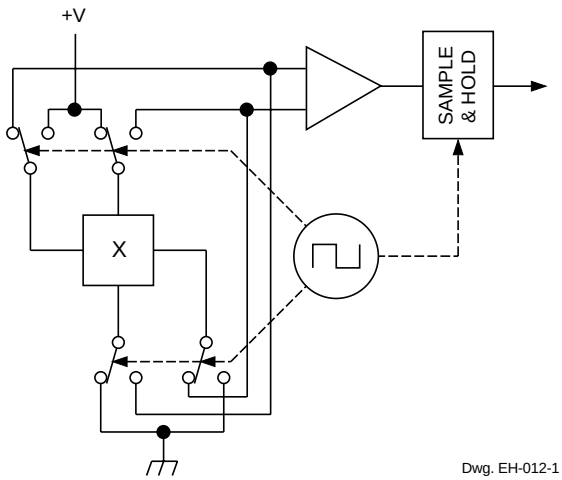
Low Average Power. Internal timing circuitry activates the sensor for 45 µs and deactivates it for the remainder of the period (45 ms). A short "awake" time allows for stabilization prior to the sensor sampling and data latching on the falling edge of the timing pulse. The output during the "sleep" time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



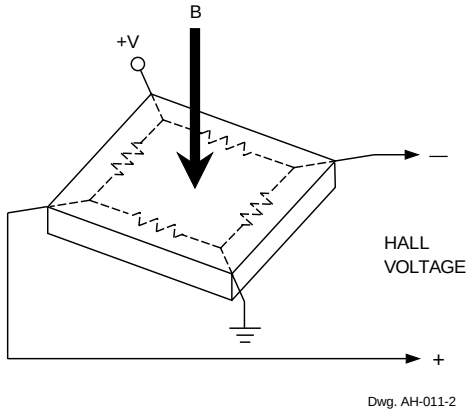
Dwg. WH-017-2

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*.



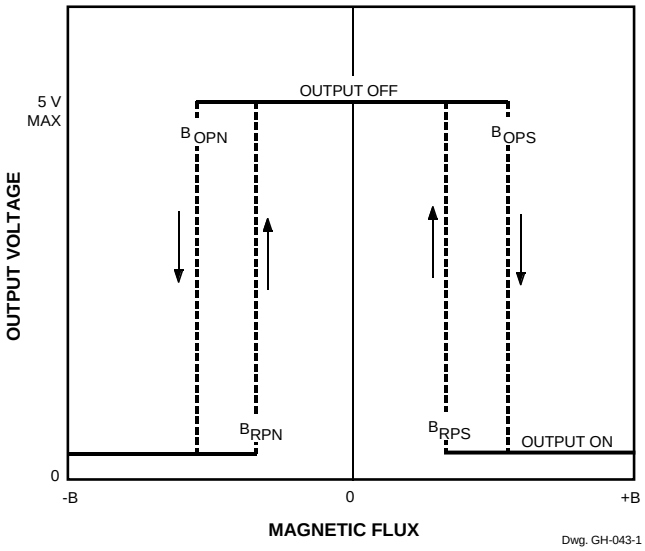
Dwg. EH-012-1



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.

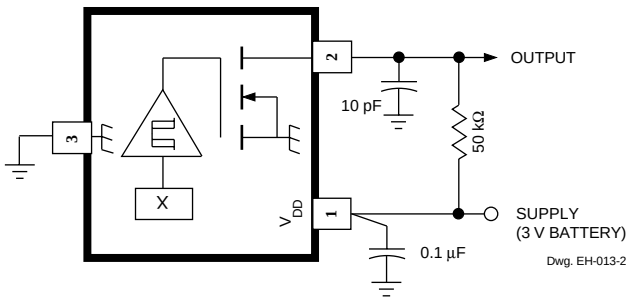


Applications. Allegro's pole-independent sensing technique allows for operation with either a north pole or south pole magnet orientation, enhancing the manufacturability of the device. The state-of-the-art technology provides the same output polarity for either pole face.

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.

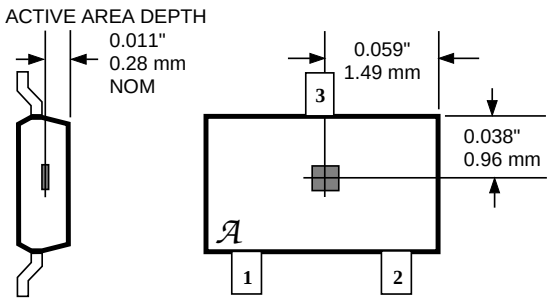
The simplest form of magnet that will operate these devices is a bar magnet with either pole near the branded surface of the device. Many other methods of operation are possible. Extensive applications information on magnets and Hall-effect sensors is also available in the *Allegro Electronic Data Book*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

www.allegromicro.com

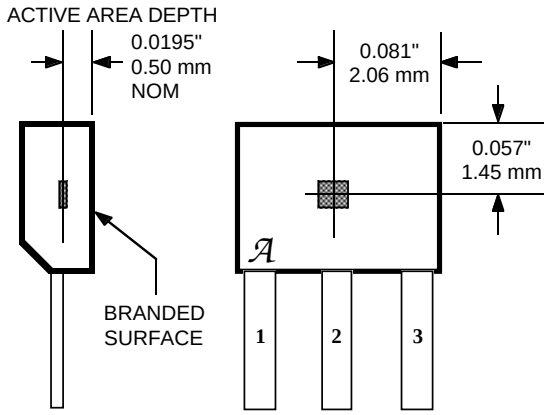


SENSOR LOCATIONS
(±0.005 [0.13 mm] die placement)

Package Designator 'LH'



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



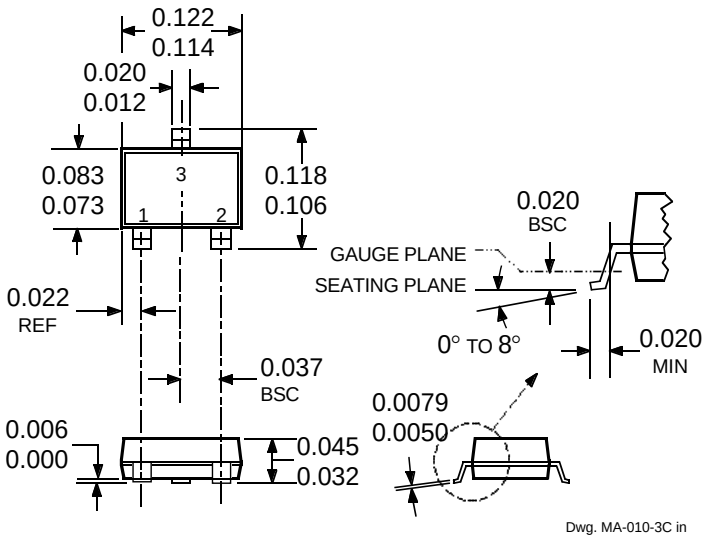
Although sensor location is accurate to three sigma for a particular design, product improvements may result in small changes to sensor location.

Allegro MicroSystems, Inc.
115 Northeast Cutoff, Box 15036
Worcester, Massachusetts 01615-0036 (508) 853-5000

PACKAGE DESIGNATOR 'LH'

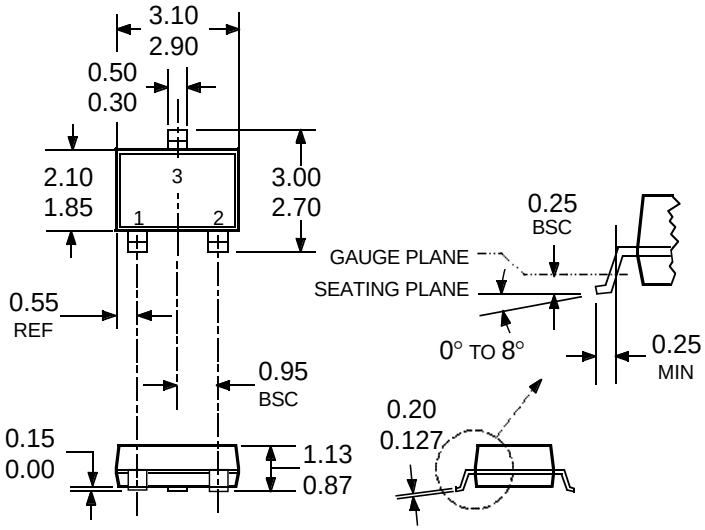
(fits SC-74A solder-pad layout)

Dimensions in Inches
(for reference only)

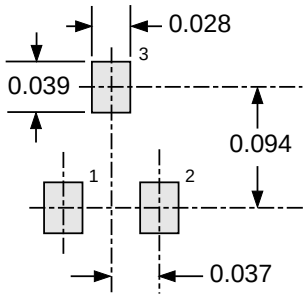


Dwg. MA-010-3C in

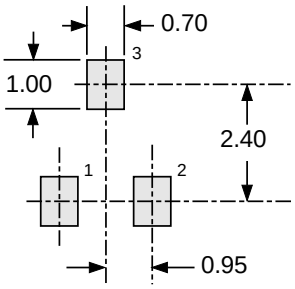
Dimensions in Millimeters
(controlling dimensions)



Dwg. MA-010-3C mm



Dwg. MA-011-3 in

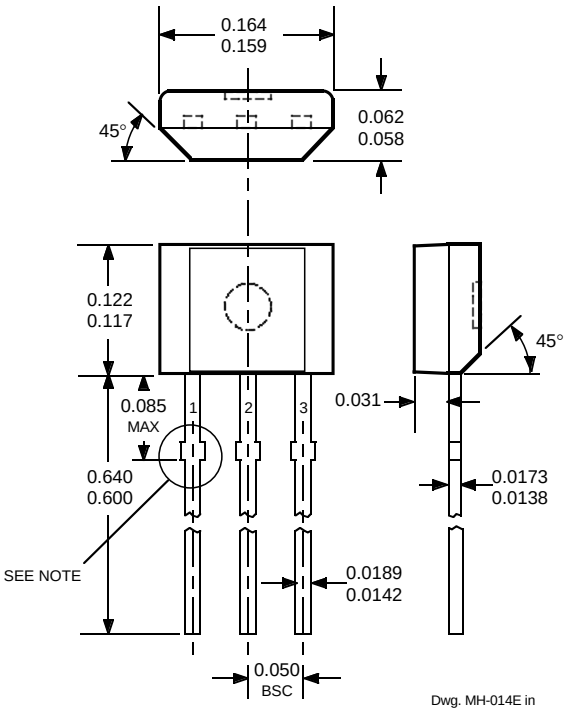


Dwg. MA-011-3 mm

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.

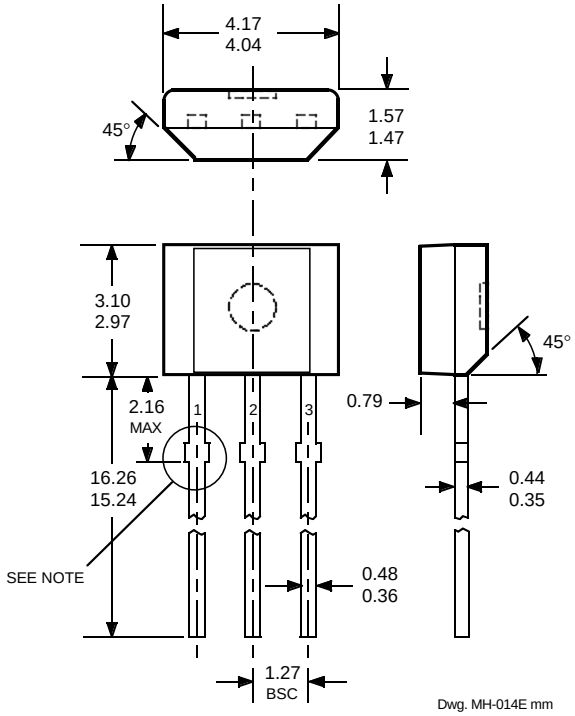
PACKAGE DESIGNATOR 'UA'

Dimensions in Inches
(controlling dimensions)



Dwg. MH-014E in

Dimensions in Millimeters
(for reference only)



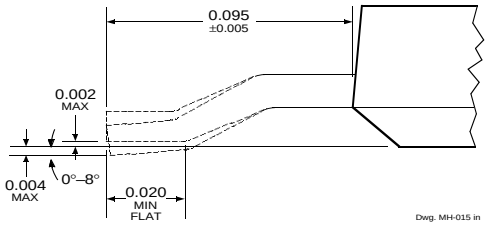
Dwg. MH-014E mm

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.

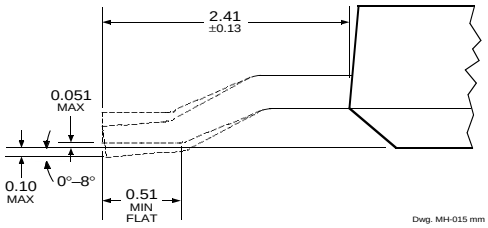
Allegro® MicroSystems, Inc.
115 Northeast Cutoff, Box 15036
Worcester, Massachusetts 01615-0036 (508) 853-5000

Surface-Mount Lead Form (order A3212EUA-TL)

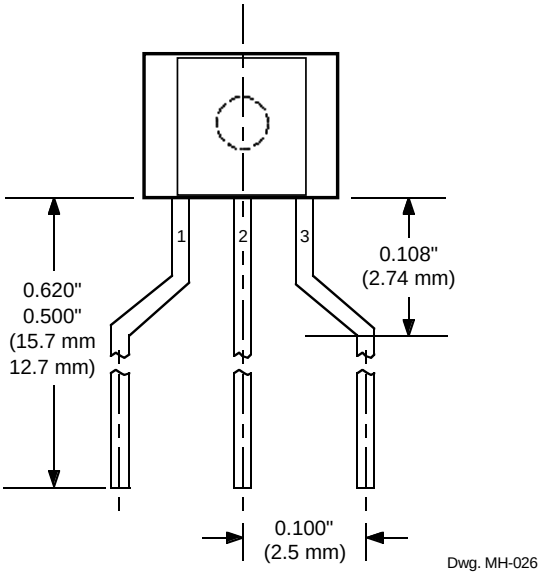
Dimensions in Inches
(controlling dimensions)



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).

HALL-EFFECT SENSORS

UNIPOLAR HALL-EFFECT DIGITAL SWITCHES

Partial Part Number	Operate Point (G) Over Oper. Voltage & Temp. Range	Release Point (G)	Hysteresis (G)	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
A3240x	<50 (Typ 35)	>5 (Typ 25)	Typ 10	E, L	LH, LT, UA	chopper stabilized
A3361E	<125	>40	5 to 30	E	LH, LT, UA	2-wire, chopper stabilized, output normally high
A3362E	<125	>40	5 to 30	E	LH, LT, UA	2-wire, chopper stabilized, output normally low

MICROPOWER OMNIPOLAR HALL-EFFECT DIGITAL SWITCHES

Partial Part Number	Operate Points (G) Over Oper. Voltage & Temp. Range	Release Points (G)	Hysteresis (G)	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)
A3212x	>-55, <55	<-10, >10	Typ. 8	E, L	LH, UA	<10 (Typ 4.2)

BIPOLAR HALL-EFFECT DIGITAL SWITCHES

Partial Part Number	Operate Point (G) Over Oper. Voltage & Temp. Range	Release Point (G)	Hysteresis (G)	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°C and nominal operating voltage.

2) x = Operating Temperature Range [suffix letter or (prefix)]: S (UGN) = -20°C to +85°C, E = -40°C to +85°C, J = -40°C to +115°C, K (UGS) = -40°C to +125°C, L (UGL) = -40°C to +150°C.

Allegro® MicroSystems, Inc.
115 Northeast Cutoff, Box 15036
Worcester, Massachusetts 01615-0036 (508) 853-5000