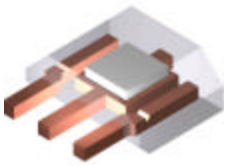
Preliminary

A1321 / A1322 / A1323

RATIOMETRIC, LINEAR HALL EFFECT SENSOR FOR HIGH TEMPERATURE OPERATION



UA-Package

LH-Package

See Block Diagram for Pinning.

ABSOLUTE MAXIMUM RATINGS

Supply Voltage	7V
Output Voltage	7V
Reverse Supply Voltage	-0.1V
Reverse Output Voltage	-0.1V
Output Sink Current	10mA
Operating Temperature, T_a	
Suffix 'E-'	-40°C to 85°C
Suffix 'L-'	-40°C to 150°C
Storage Temperature	170°C
Maximum Junction Temperature.	165°C

The A132X linear Hall-effect sensors are optimized, sensitive, temperature-stable linear Hall-effect sensors with greatly improved offset characteristics. These ratiometric Hall-effect sensors provide a voltage output that is proportional to the applied magnetic field. The linear family has a quiescent output voltage that is 50% of the supply voltage and output sensitivity options of nominally 2.5mV/G, 3.125mV/G, and 5mV/G. The features of this linear family are ideal for use in linear and rotary position sensing systems in harsh environments of automotive and industrial applications over extended temperatures to –40 °C and +150 °C.

Each BiCMOS monolithic circuit integrates a Hall element, improved temperature-compensating circuitry to reduce the intrinsic sensitivity drift of the Hall element, a small-signal high-gain amplifier, and a rail-to-rail low-impedance output stage.

A proprietary dynamic offset cancellation technique, with an internal high-frequency clock reduces the residual offset voltage, which is normally caused by device over molding, temperature dependencies, and thermal stress. The high frequency clock allows for a greater sampling which produces higher accuracy and faster signal processing capability, This technique produces devices that have an extremely stable quiescent output voltage, are immune to mechanical stress, and have precise recoverability after temperature cycling. Having the Hall element and an amplifier on a single chip minimizes many problems normally associated with low-level analog signals.

Output precision is obtained by internal gain and offset trim adjustments made at end-of-line during the manufacturing process.

The A132X family is provided in a 3-pin single inline package (Allegro UA package) and a 3-pin surface mount package (Allegro LH package).

FEATURES/BENEFITS

- Temperature-Stable Quiescent Output Voltage
- Precise Recoverability After Temperature Cycling
- Output Voltage Proportional to Magnetic Flux Density
- Ratiometric Rail-to-Rail Output
- Improved Sensitivity
- 4.5 V to 5.5 V Operation
- Immune to Mechanical Stress
- Solid-State Reliability
- Robust EMC protection

Some restrictions may apply to certain types of sales of the A1322 and L temperature range for all devices. Contact factory for details.

Preliminary Information

Always order by complete part number, e.g., A1322LUA

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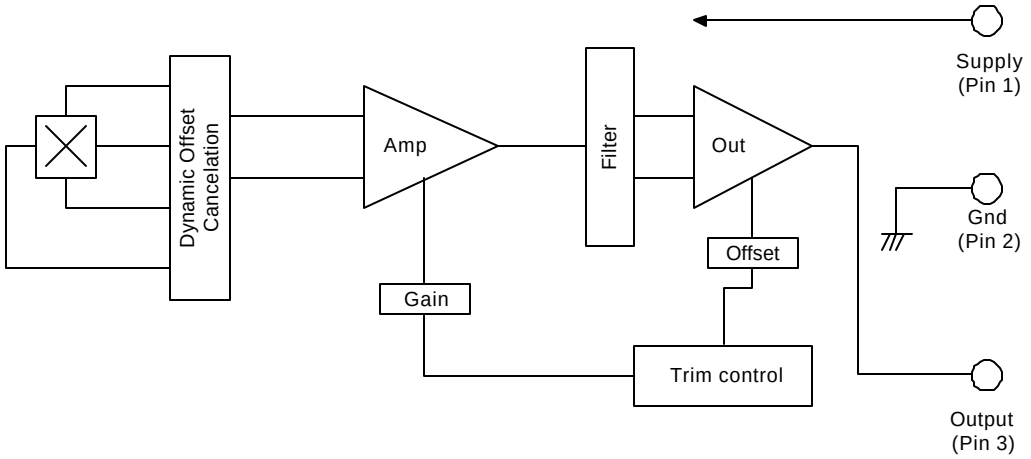
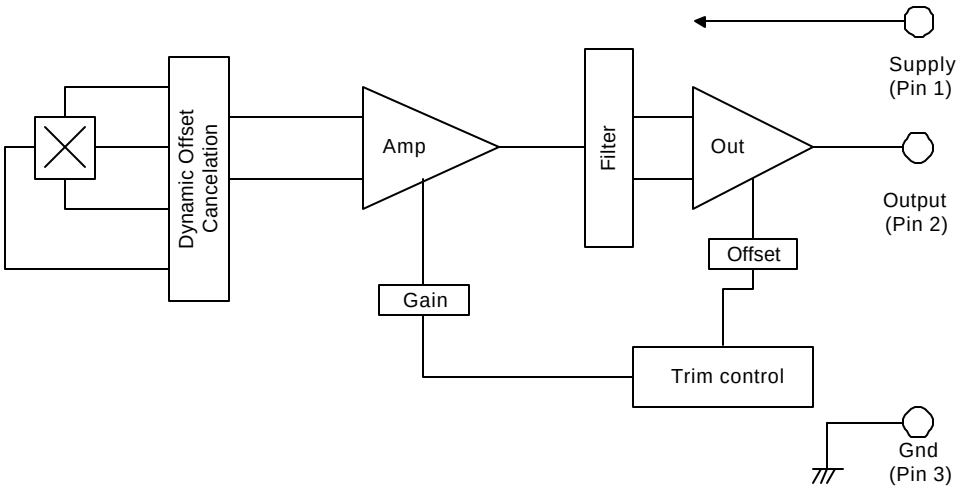
Rev. 1.5 09May03 CMG

Block Diagram – UA Package



Block Diagram – LH Package



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DEVICE CHARACTERISTICS over operating temperature range and Vcc = 5 V unless otherwise noted.

Characteristic	Symbol	Test Conditions	Limits			
			Min.	Typ.	Max.	Units
ELECTRICAL CHARACTERISTICS						
Supply Voltage	V_{cc_op}	Operating, Tj < 165°C	4.5	5.0	5.5	V
Supply Current	I_{cc}	B = 0, I_O = 0		5.6	8	mA
Quiescent Voltage	V_{qo}	B=0, Ta=25°C, I_O = 1 mA	2.425	2.5	2.575	V
Output Voltage	V_{OH}	B = +X*, I_O = -1mA		4.7		V
	V_{OL}	B = -X*, I_O = 1mA		0.2		V
Output Source Current Limit	I_{OLM}	B = -X*, $V_O \rightarrow 0$	-1.0	-1.5		mA
Supply Zener Clamp Voltage	V_Z	Icc = 15mA, Ta = 25°C, T= 2 min		7.6		V
Output Bandwidth	BW			30		kHz
Clock Frequency	F_C			150		kHz
OUTPUT CHARACTERISTICS over operating temperature range and Vcc range unless otherwise noted.						
Noise, V_N[1]	A1323	C_{bypass} = 0.1uF, no load		-	20	mV_{pp}
	A1322	C_{bypass} = 0.1uF, no load		-	25	mV_{pp}
	A1321	C_{bypass} = 0.1uF, no load		-	40	
Output Resistance	Rout	$I_O \leq$ +/-1 mA		1.5	3	Ω
Output Load Resistance	R_L	$I_O \leq$ +/-1 mA, Output-Ground	4.7			kΩ
Output Capacitance Load	C_L	Out - Gnd			10	nF

Note 1 – Typical data is at Ta – 25°C and is for design information only.
Note 2 – Negative current is defined as coming out of (sourcing) the output.
*This test requires positive and negative fields sufficient to swing the output driver between fully OFF and saturated (ON), respectively. It is NOT intended to indicate a range of linear operation.

[1] Noise specification includes digital and analog noise.

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MAGNETIC CHARACTERISTICS over temperature range, at V_{cc} = 5 V, I_O = -1 mA (unless otherwise noted).

Characteristic*	Part Numbers									
	A1322E/L			A1321E/L			A1323E/L			
	Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	Units
Sensitivity at TA	2.813	3.125	3.438	4.5	5	5.5	2.25	2.5	2.75	mV/G
Delta Sens at TA = max	-2.5		7.5	-2.5		7.5	-2.5		7.5	%
Delta Sens at TA = min	-9		1	-9		1	-9		1	%
Delta $V_{OQ(\Delta T)}$(B)			+/-10			+/-10			+/-10	G
Ratiometry, $\Delta V_{OQ(\Delta V)}$		100			100			100		%
Ratiometry, $\Delta Sens_{(\Delta V)}$		100			100			100		%
Positive Linearity, Lin+		100			100			100		%
Negative Linearity, Lin-		100			100			100		%
Symmetry		100			100			100		%

Note 1 – 10 G = 1 mT
Note 2 – Except for Delta Sens, typical data is at T_a = 25°C and is for design information only.
*See Characteristics Definitions for test conditions.

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CHARACTERISTIC DEFINITIONS

Quiescent Voltage Output. In the quiescent state (no magnetic field), the output equals one half of the supply voltage over the operating voltage and temperature range. Due to internal component tolerances and thermal considerations, there is a tolerance on the quiescent voltage output and on the quiescent voltage output as a function of supply voltage and ambient temperature. For purposes of specification, the quiescent voltage output as a function of temperature is defined in magnetic flux density units (B) as

$$\Delta V_{OQ(DT)}(B) = \frac{(V_{OQ(T_A)} - V_{OQ(25°C)})}{Sens_{(25°C)}} \qquad (1)$$

This calculation yields the device's equivalent accuracy, over the operating temperature range, in gauss.

Sensitivity. The presence of a south-pole magnetic field perpendicular to the package face (the branded surface) will increase the output voltage from its quiescent value toward the supply voltage rail by an amount proportional to the magnetic field applied. Conversely, the application of a north pole will decrease the output voltage from its quiescent value. This proportionality is specified as the sensitivity of the device and is defined as

$$Sens = \frac{V_{O(-B)} - V_{O(+B)}}{2B} \qquad (2)$$

The stability of sensitivity as a function of temperature is defined as

$$\Delta Sens_{(\Delta T)} = \frac{Sens_{(TA)} - Sens_{(25°C)}}{Sens_{(25°C)}} \times 100\% \qquad (3)$$

Ratiometric. The A132X family features a ratiometric output. The quiescent voltage output and sensitivity are proportional to the supply voltage (ratiometric).

The percent ratiometric change in the quiescent voltage output is defined as

$$DV_{OQ(DV)} = \frac{V_{OQ(Vcc)} / V_{OQ(5V)}}{V_{CC} / 5V} \times 100\% \qquad (4)$$

and the percent ratiometric change in sensitivity is defined as

$$\Delta Sens_{(\Delta V)} = \frac{Sens_{(Vcc)} / Sens_{(5V)}}{V_{CC} / 5V} \times 100\% \qquad (5)$$

Linearity and Symmetry. The on-chip output stage is designed to provide a linear output with a supply voltage of 5 V. Although application of very high magnetic fields will not damage these devices, it will force the output into a non-linear region. Linearity in percent is measured and defined as

$$Lin+ = \frac{V_{O(B)} - V_{OQ}}{2(V_{O(B/2)} - V_{OQ})} \times 100\% \qquad (6)$$

$$Lin- = \frac{V_{O(-B)} - V_{OQ}}{2(V_{O(-B/2)} - V_{OQ})} \times 100\% \qquad (7)$$

and output symmetry as

$$Sym = \frac{V_{O(B)} - V_{OQ}}{(V_{OQ} - V_{O(-B)})} \times 100\% \qquad (8)$$

Additional Applications Information on Linear and other Allegro sensors can be obtained from AMS501: Data Book from *Allegro Microsystems Inc., 115 Northeast Cutoff, Box 15306, Worcester, Ma 01615; (508) 853-5000* Or visit the Allegro web-site, www.allegromicro.com.

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TYPICAL CHARATERISTICS
(Intentionally Left Blank)

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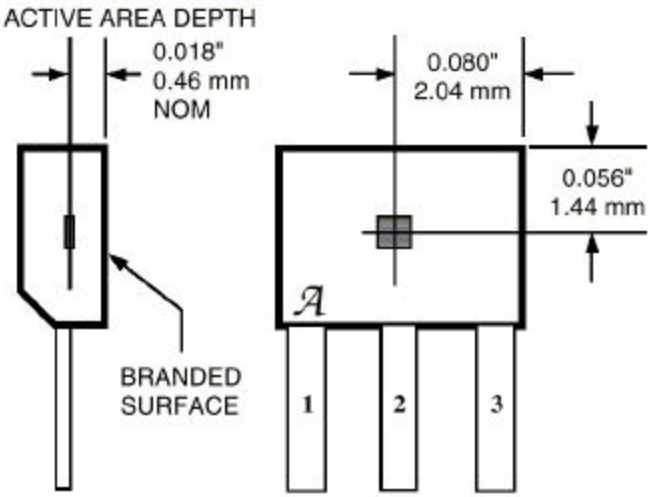
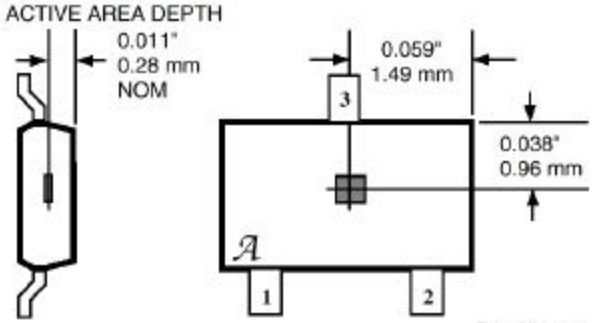
Package Designators 'UA' and 'UA-TL'



Dwg. MH-011-9A

Package Designator 'LH'



Dwg. MH-025

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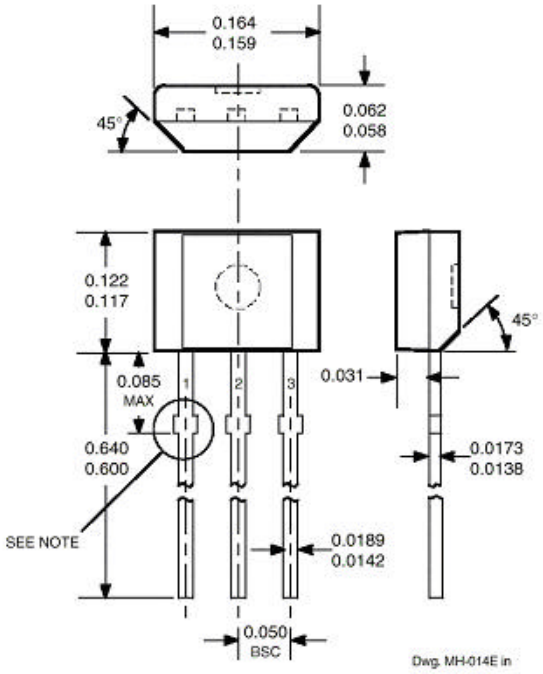
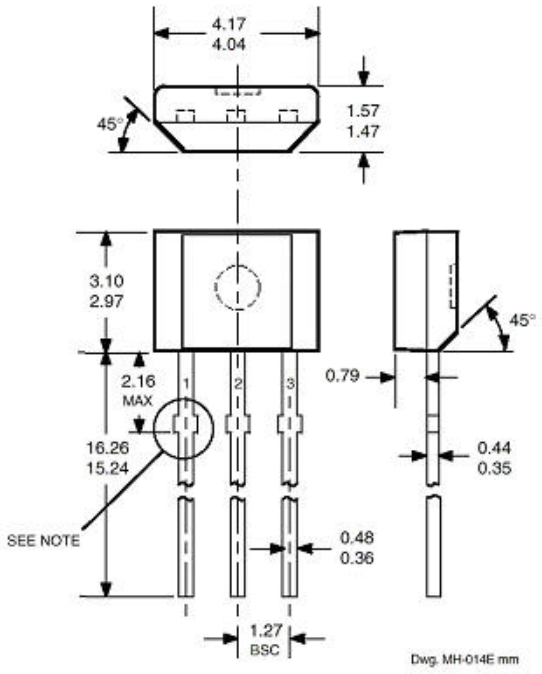
PACKAGE DESIGNATOR 'UA'

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.

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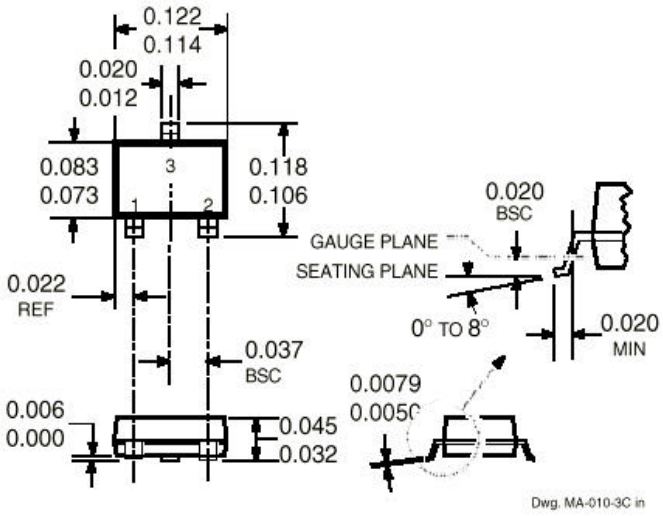
PACKAGE DESIGNATOR 'LH'

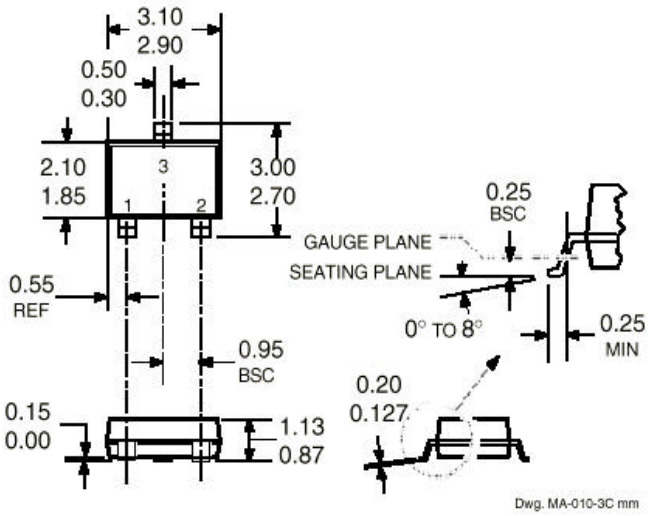
(fits SC-74A solder-pad layout)

Dimensions in Inches
(for reference only)

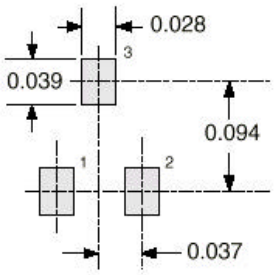


Dwg. MA-010-3C in

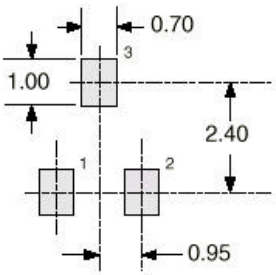
Dimensions in Millimeters
(controlling dimensions)



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.
5. Add "LT" to part number for tape and reel.

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A1321/A1322/A1323
RATIOMETRIC, LINEAR
HALL EFFECT SENSOR

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