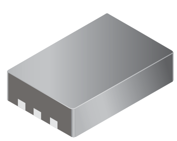
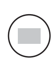
Micro Power 3 V Linear Hall Effect Sensor ICs withTri-State Output and User-Selectable Sleep Mode

Features and Benefits

- High-impedance output during sleep mode
- Compatible with 2.5 to 3.5 V power supplies
- 10 mW power consumption in the active mode
- Miniature MLP/DFN package
- Ratiometric output scales with the ratiometric supply reference voltage (VREF pin)
- Temperature-stable quiescent output voltage and sensitivity
- Wide ambient temperature range: –20°C to 85°C
- ESD protection greater than 3 kV
- Solid-state reliability
- Preset sensitivity and offset at final test

Package: 6 pin MLP/DFN (suffix EH)





Approximate scale

Description

The A139x family of linear Hall effect sensor integrated circuits (ICs) provide a voltage output that is directly proportional to an applied magnetic field. Before amplification, the sensitivity of typical Hall effect ICs (measured in mV/G) is directly proportional to the current flowing through the Hall effect transducer element inside the ICs. In many applications, it is difficult to achieve sufficient sensitivity levels with a Hall effect sensor IC without consuming more than 3 mA of current. The A139x minimize current consumption to less than 25 µA through the addition of a user-selectable sleep mode. This makes these devices perfect for battery-operated applications such as: cellular phones, digital cameras, and portable tools. End users can control the current consumption of the A139x by applying a logic level signal to the $\overline{\text{SLEEP}}$ pin. The outputs of the devices are not valid (high-impedance mode) during sleep mode. The high-impedance output feature allows the connection of multiple A139x Hall effect devices to a single A-to-D converter input.

The quiescent output voltage of these devices is 50 % nominal of the ratiometric supply reference voltage applied to the VREF pin of the device. The output voltage of the device is not ratiometric with respect to the SUPPLY pin.

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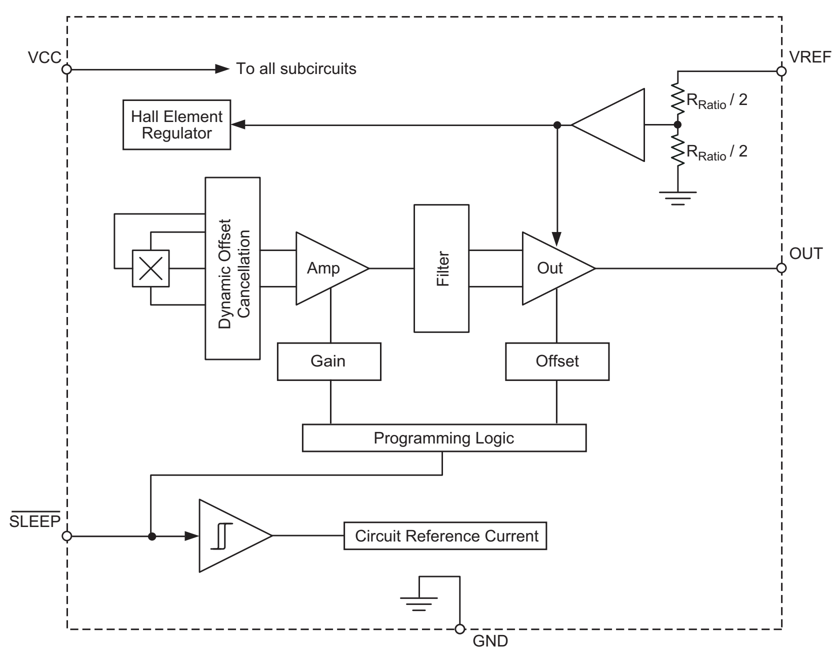
Functional Block Diagram



Description (continued)

Despite the low power consumption of the circuitry in the A139x, the features required to produce a highly-accurate linear Hall effect IC have not been compromised. 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 proprietary dynamic offset cancellation circuits. End of line, post-packaging, factory programming allows precise control of device sensitivity and offset.

These devices are available in a small 2.0 × 3.0 mm, 0.75 mm nominal height microleaded package (MLP/DFN). It is Pb (lead) free, with 100% matte tin leadframe plating.

Selection Guide

Part Number	Sensitivity (mV / G, Typ.)	Package	Packing[1]
A1391SEHLT-T[2]	1.25	DFN/MLP 2×3 mm; 0.75 mm nominal height	7-in. reel, 3000 pieces/reel
A1392SEHLT-T[2]	2.50	DFN/MLP 2×3 mm; 0.75 mm nominal height	7-in. reel, 3000 pieces/reel
A1393SEHLT-T[2]	5	DFN/MLP 2×3 mm; 0.75 mm nominal height	7-in. reel, 3000 pieces/reel
A1395SEHLT-T[2]	10	DFN/MLP 2×3 mm; 0.75 mm nominal height	7-in. reel, 3000 pieces/reel

[1]Contact Allegro™ for additional packing options.

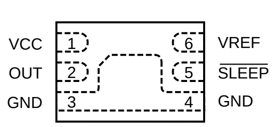
[2]Allegro products sold in DFN package types are not intended for automotive applications.

Absolute Maximum Ratings*

Characteristic	Symbol	Notes	Rating	Unit
Supply Voltage	V_{CC}		8	V
Reverse-Supply Voltage	V_{RCC}		–0.1	V
Ratiometric Supply Reference Voltage	V_{REF}		7	V
Reverse-Ratiometric Supply Reference Voltage	V_{RREF}		–0.1	V
Logic Supply Voltage	$V_{\overline{SLEEP}}$	(V_{CC} > 2.5 V)	32	V
Reverse-Logic Supply Voltage	$V_{R\overline{SLEEP}}$		–0.1	V
Output Voltage	V_{OUT}		V_{CC} + 0.1	V
Reverse-Output Voltage	V_{ROUT}		–0.1	V
Operating Ambient Temperature	T_A	Range S	–20 to 85	ºC
Junction Temperature	T_J(MAX)		165	ºC
Storage Temperature	T_{stg}		–65 to 170	ºC

*All ratings with reference to ground

Pin-out Diagram



Terminal List Table

Pin	Name	Function
1	VCC	Supply
2	OUT	Output
3	GND	Ground
4	GND	Ground
5	$\overline{SLEEP}$	Toggle sleep mode
6	VREF	Supply for ratiometric reference

Device Characteristics Tables

ELECTRICAL CHARACTERISTICS valid through full operating ambient temperature range, unless otherwise noted

Characteristic	Symbol	Test Conditions	Min.	Typ.[1]	Max.	Units
Supply Voltage	V_{CC}		2.5	–	3.5	V
Nominal Supply Voltage	V_{CCN}		–	3.0	–	V
Supply Zener Clamp Voltage	V_{CCZ}	I_{CC} = 7 mA, T_A = 25°C	6	8.3	–	V
Ratiometric Reference Voltage[2]	V_{REF}		2.5	–	V_{CC}	V
Ratiometric Reference Zener Clamp Voltage	V_{REFZ}	I_{VREF} = 3 mA, T_A = 25°C	6	8.3	–	V
$\overline{SLEEP}$ Input Voltage			–0.1	–	V_{CC} + 0.5	V
$\overline{SLEEP}$ Input Threshold	V_{INH}	For active mode	–	0.45 × V_{CC}	–	V
	V_{INL}	For sleep mode	–	0.20 × V_{CC}	–	V
Ratiometric Reference Input Resistance	R_{REF}	$V_{SLEEP} > V_{INH}$, $V_{CC} = V_{CCN}$, T_A = 25°C	250	–	–	kΩ
		$V_{SLEEP} < V_{INL}$, $V_{CC} = V_{CCN}$, T_A = 25°C	–	5	–	MΩ
Chopper Stabilization Chopping Frequency	f_C	$V_{CC} = V_{CCN}$, T_A = 25°C	–	200	–	kHz
$\overline{SLEEP}$ Input Current	I_{SLEEP}	V_{SLEEP} = 3 V, $V_{CC} = V_{CCN}$	–	1	–	μA
Supply Current[3]	I_{CC}	$V_{SLEEP} < V_{INL}$, $V_{CC} = V_{CCN}$, T_A = 25°C	–	0.025	–	mA
		$V_{SLEEP} > V_{INH}$, $V_{CC} = V_{CCN}$, T_A = 25°C	–	3.2	–	mA
Quiescent Output Power Supply Rejection[4]	PSR_{VOQ}	f_{AC} < 1 kHz	–	–60	–	dB

[1] Typical data are for initial design estimations only, and assume optimum manufacturing and application conditions, such as T_A = 25°C. Performance may vary for individual units, within the specified maximum and minimum limits.

[2] Voltage applied to the VREF pin. Note that the V_{REF} voltage must be less than or equal to V_{cc}. Degradation in device accuracy will occur with applied voltages of less than 2.5 V.

[3] If the VREF pin is tied to the VCC pin, the supply current would be $I_{CC} + V_{REF} / R_{REF}$

[4] f_{AC} is any AC component frequency that exists on the supply line.

OUTPUT CHARACTERISTICS valid through full operating ambient temperature range, unless otherwise noted

Characteristic	Symbol	Test Conditions	Min.	Typ.[1]	Max.	Units
Linear Output Voltage Range	V_{OUTH}	$V_{CC} = V_{CCN}$, $V_{REF} \le V_{CC}$	–	V_{REF} – 0.1	–	V
	V_{OUTL}	$V_{CC} = V_{CCN}$, $V_{REF} \le V_{CC}$	–	0.1	–	V
Maximum Voltage Applied to Output	V_{OUTMAX}	$V_{SLEEP} < V_{INL}$	–	–	V_{CC} + 0.1	V
Sensitivity[2]	Sens	A1391: T_A = 25°C, $V_{CC} = V_{REF} = V_{CCN}$	–	1.25	–	mV/G
		A1392: T_A = 25°C, $V_{CC} = V_{REF} = V_{CCN}$	–	2.50	–	mV/G
		A1393: T_A = 25°C, $V_{CC} = V_{REF} = V_{CCN}$	–	5	–	mV/G
		A1395: T_A = 25°C, $V_{CC} = V_{REF} = V_{CCN}$	–	10	–	mV/G
Quiescent Output	V_{OUTQ}	T_A = 25°C, B = 0 G	–	0.500 × V_{REF}	–	V
Output Resistance[3]	R_{OUT}	f_{out} = 1 kHz, $V_{SLEEP} > V_{INH}$, active mode	–	20	–	Ω
		f_{out} = 1 kHz, $V_{SLEEP} < V_{INL}$, sleep mode	–	4M	–	Ω
Output Load Resistance	R_L	Output to ground	15	–	–	kΩ
Output Load Capacitance	C_L	Output to ground	–	–	10	nF
Output Bandwidth	BW	–3 dB point, V_{OUT} = 1 V_{pp} sinusoidal, $V_{CC} = V_{CCN}$	–	10	–	kHz
Noise[4,5]	V_n	1391: C_{bypass} = 0.1 µF, $BW_{externalLPF}$ = 2 kHz	–	6	12	mV_{pp}
		1391: C_{bypass} = 0.1 µF, no load	–	–	20	mV_{pp}
		1392: C_{bypass} = 0.1 µF, no load	–	–	40	mV_{pp}
		1393: C_{bypass} = 0.1 µF, $BW_{externalLPF}$ = 2 kHz	–	12	24	mV_{pp}
		1393: C_{bypass} = 0.1 µF, no load	–	–	40	mV_{pp}
		1395: C_{bypass} = 0.1 µF, no load	–	–	80	mV_{pp}

[1]Typical data are for initial design estimations only, and assume optimum manufacturing and application conditions, such as T_A = 25°C. Performance may vary for individual units, within the specified maximum and minimum limits.

[2]For V_{REF} values other than $V_{REF} = V_{CCN}$, the sensitivity can be derived from the following equation: K × V_{REF}, where K =0.416 for the A1391, K= 0.823 for the A1392, K = 1.664 for the A1393, and K = 3.328 for the A1395.

[3]f_{OUT} is the output signal frequency.

[4]Noise specification includes digital and analog noise.

[5]Values for $BW_{externalLPF}$ do not include any noise resulting from noise on the externally-supplied VREF voltage.

OUTPUT TIMING CHARACTERISTICS[1] T_A = 25°C

Characteristic	Symbol	Test Conditions	Min.	Typ.[2]	Max.	Units
Power-On Time[3]	t_{PON}		–	40	60	μs
Power-Off Time[4]	t_{POFF}		–	1	–	μs

[1]See figure 1 for explicit timing delays.
[2]Typical data are for initial design estimations only, and assume optimum manufacturing and application conditions, such as T_A = 25°C. Performance may vary for individual units, within the specified maximum and minimum limits.
[3]Power-On Time is the elapsed time after the voltage on the $\overline{\text{SLEEP}}$ pin exceeds the active mode threshold voltage,V_{INH}, until the time the device output reaches 90% of its value.
[4]Power-Off Time is the duration of time between when the signal on the $\overline{\text{SLEEP}}$ pin switches from HIGH to LOW and when I_{CC} drops to under 100 μA. During this time period, the output goes into the HIGH impedance state.

MAGNETIC CHARACTERISTICS T_A = 25°C

Characteristic	Symbol	Test Conditions	Min.	Typ.*	Max.	Units
Ratiometry	$\Delta V_{OUTQ(\Delta V)}$		–	100	–	%
Ratiometry	$\Delta Sens_{(\Delta V)}$		–	100	–	%
Positive Linearity	Lin+		–	100	–	%
Negative Linearity	Lin–		–	100	–	%
Symmetry	Sym		–	100	–	%

*Typical data are for initial design estimations only, and assume optimum manufacturing and application conditions, such as T_A = 25°C. Performance may vary for individual units, within the specified maximum and minimum limits.