

FEATURES AND BENEFITS

- User-controlled sleep mode with fast (< 60 μs) wakeup time for lag-free power savings
- 3.2 mA active and 25 μA sleep current reduces total power consumption and extends battery life
- Operates down to 2.5 V supply for battery applications
- Low quiescent voltage output (QVO) maximizes output range and resolution at ADC input
- Ambient temperature range from –20°C to 85°C suited for personal electronics and gaming applications

PACKAGE: 6-pin MLP/DFN (suffix EH)



Not to scale

DESCRIPTION

The A31010 family of linear Hall-effect sensor ICs provides a voltage output that is proportional to the applied magnetic field.

The user-controlled sleep pin and rapid wakeup time allows the A31010 to consume minimal power and provide magnetic data quickly after waking up. These features coupled with a low supply voltage rating of 2.5 V and non-ratiometric output make this IC ideal for battery-powered applications.

Many human machine interface (HMI) applications such as gaming controller joysticks, triggers, and keyboards will benefit from the sensor's unidirectional output.

These devices are available in a small 2 mm × 3 mm, 0.75 mm nominal height micro-leaded package (MLP/DFN). It is lead (Pb) free with 100% matte tin leadframe plating.

APPLICATIONS

- Game controllers
- Joysticks
- Triggers
- Personal electronics
- · Keyboards
- Virtual and augmented reality devices
- · Human-machine interfaces

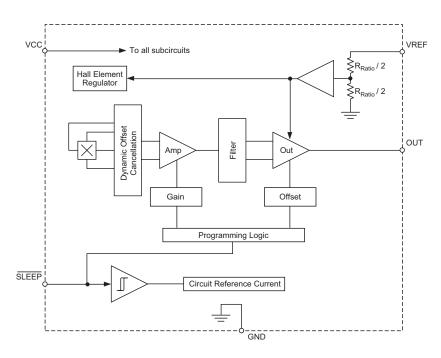


Figure 1: Functional Block Diagram

Low-Power Unidirectional Linear Hall-Effect Sensor IC with User-Controlled Sleep Feature in Compact 2 mm × 3 mm Footprint

SELECTION GUIDE

Part Number	Typical Sensitivity (mV/G) [1]	QVO (%V _{REF})	Output Polarity	Full Scale Field (G) ^[1]	Package	Packing ^[2]
A31010SEHALT-4	3.78	6.47	Unidirectional	+650	DFN/MLP	7-in. reel,
A31010SEHALT-10	10.0	6.47	Unidirectional	+250	2 mm × 3 mm; 0.75 mm nominal height	3000 pieces/reel

 $^{^{[1]}}$ At $V_{CC} = V_{REF} = 3.0 \text{ V}$

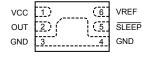


ABSOLUTE MAXIMUM RATINGS*

Characteristic	Symbol	Notes	Rating	Unit
Supply Voltage	V _{CC}		7	V
Reverse Supply Voltage	V _{RCC}		-0.1	V
Reference Voltage	V _{REF}		7	V
Reverse Reference Voltage	V_{RREF}		-0.1	V
Logic Supply Voltage	V _{SLEEP}	V _{CC} > 2.5 V	32	V
Output Voltage	V _{OUT}		V _{CC} + 0.1	V
Reverse Output Voltage	V _{ROUT}		-0.1	V
Operating Ambient Temperature	T _A	RangeS	-20 to 85	°C
Junction Temperature	T _{J(MAX)}		165	°C
Storage Temperature	T _{stg}		-65 to 170	°C

^{*}All ratings with reference to ground

PINOUT DIAGRAM



TERMINAL LIST TABLE

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



^[2] Contact Allegro for other packing options.

Low-Power Unidirectional Linear Hall-Effect Sensor IC with User-Controlled Sleep Feature in Compact 2 mm × 3 mm Footprint

COMMON ELECTRICAL CHARACTERISTICS: Valid at $T_A = 25$ °C, $V_{CC} = 3.0$ V, unless otherwise specified

Characteristic	Symbol	Test Conditions	Min.	Тур.	Max.	Units
Supply Voltage	V _{CC}		2.5	3.0	3.5	V
Supply Current	I _{CC}	Active Mode	_	3.2	3.6	mA
Sleep Current	I _{CCS}	Sleep Mode	_	25	_	μΑ
Supply Zener Clamp Voltage	V _{CCZ}	I _{CC} = 7 mA	6	8.3	_	V
Supply Bypass Capacitor	C _{VCC}	Optional	_	100	_	nF
Output Capacitive Load	C _L		_	_	10	nF
Output Resistive Load	R _L		15	_	_	kΩ
Ratiometric Reference Voltage	V_{REF}		2.5	_	V _{CC}	V
Ratiometric Reference Zener Clamp Voltage	V _{REFZ}	I _{VREF} = 3 mA	6	8.3	_	V
Detiens this Defenses Invest Desistance	Б	$V_{SLEEP} > V_{SH}, V_{CC} = V_{CC(TYP)}$	200	_	_	kΩ
Ratiometric Reference Input Resistance	R _{REF}	$V_{SLEEP} < V_{SL}, V_{CC} = V_{CC(TYP)}$	_	5	_	МΩ
SLEEP Input Voltage Range	V _{SLEEP}		-0.1	_	V _{CC} + 0.5	V
Power-On Time	t _{PO}	$V_{CC} > V_{CC(MIN)}, V_{SLEEP} > V_{SH},$ V_{CC} slew rate = 1 V/ μ s, $C_L \le 10$ nF, $R_L \ge 15$ k Ω	_	40	60	μs
Internal Bandwidth	BW	Small signal –3 dB; C _L ≤ C _{L(MAX)}	_	10	_	kHz
Response Time	t _R		_	35	_	μs
Propagation Delay Time	t _P		_	5	_	μs
Rise Time	t _{RISE}		_	10	_	μs
Noise Density	B _{ND}	V _{CC} = 3.0 V Input Referred, T _A = 25°C	_	2.5	_	mG/√(Hz)
Noise	B _N	V _{CC} = 3.0 V Input Referred, T _A = 25°C	_	0.3	_	G _{RMS}
Linearity Sensitivity Error	E _{LIN}	Through Optimized Sensing Range (B _R)	_	1	_	%
0 1 10 1 1 1 1 1 1	V _{SATH}	V _{REF} ≤ V _{CC}	_	V _{CC} - 0.1	_	V
Output Saturation Voltage	V _{SATL}	V _{REF} ≤ V _{CC}	_	0.1	_	V
Sensitivity Ratiometry Error	E _{SENSR}		_	0	_	%
QVO Ratiometry Error	E _{QVOR}		_	0	_	mV



Low-Power Unidirectional Linear Hall-Effect Sensor IC with User-Controlled Sleep Feature in Compact 2 mm × 3 mm Footprint

SLEEP MODE CHARACTERISTICS: Valid at $T_A = 25$ °C, $V_{CC} = 3.0$ V, unless otherwise specified

Characteristic	Symbol	Test Conditions	Min.	Тур.	Max.	Units
SLEEP Input Thresholds [1]	V _{SH}	V _{SLEEP} > V _{SH} = Active Mode	_	0.45 × V _{CC}	_	V
	V _{SL}	V _{SLEEP} < V _{SL} = Sleep Mode	_	0.2 × V _{CC}	_	V
SLEEP Input Current	I _{SLEEP}	V _{SLEEP} < V _{SL} = Sleep Mode	_	10	_	nA
SLEEP Wakeup Time [2]	t _{WU}	$V_{\text{SLEEP}} > V_{\text{SH}}, V_{\text{CC}} > V_{\text{CC(MIN)}}, C_{\text{L}} \le 10 \text{ nF},$ $R_{\text{L}} \ge 15 \text{ k}\Omega$	_	40	60	μs
SLEEP Power Off Time [3]	t _{SLEEP}	$V_{SLEEP} < V_{SL}$, $V_{CC} > V_{CC(MIN)}$, $C_L \le 10$ nF, $R_L \ge 15$ k Ω	_	1	-	μs

^[1] Sleep mode is active low. When SLEEP pin is pulled below V_{SL}, the device will enter sleep mode and not respond to magnetic input.

A31010SEHALT-4 PERFORMANCE CHARACTERISTICS: Valid at $T_A = 25$ °C, $V_{CC} = V_{REF} = 3.0$ V, unless otherwise specified

Characteristic	Symbol	Test Conditions	Min.	Тур.	Max.	Units
Optimized Sensing Range [1]	B _R		0	-	650	G
Sensitivity	Sens		_	3.78	_	mV/G
Quiescent Output Voltage	QVO	B _{IN} = 0 G	_	6.47	_	%V _{REF}

^[1] Parameter not measured at final test. Determined by design and characterization.

A31010SEHALT-10 PERFORMANCE CHARACTERISTICS: Valid at T_A = 25°C, V_{CC} = V_{REF} = 3.0 V, unless otherwise specified

Characteristic	Symbol	Test Conditions	Min.	Тур.	Max.	Units
Optimized Sensing Range [1]	B _R		0	-	250	G
Sensitivity	Sens		_	10	_	mV/G
Quiescent Output Voltage	QVO	B _{IN} = 0 G	_	6.47	_	%V _{REF}

^[1] Parameter not measured at final test. Determined by design and characterization.



^[2] Includes sensor's response time. Device's output will be stable within $t_{WU(MAX)}$ after $V_{SLEEP} > V_{SH}$. ^[3] SLEEP Power Off Time is the time between when $V_{SLEEP} < V_{SL}$ and $I_{CC} < 100 \ \mu A$.

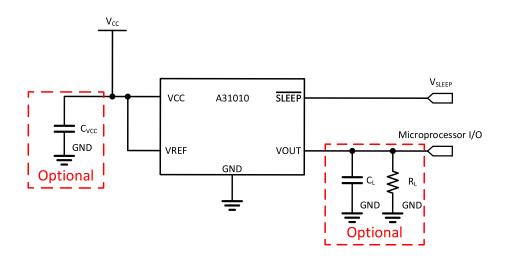


Figure 2: Example Application Circuit. V_{SLEEP} may be controlled by a microprocessor I/O pin.



APPLICATION INFORMATION

Sleep Mode

The A31010 is a low-power Hall-effect sensor IC that is perfect for power-sensitive customer applications. The current consumption of these devices is typically 3.2 mA, while the device is in active mode and less than 25 μ A when the device is in sleep mode. Toggling the logic-level signal connected to the $\overline{\text{SLEEP}}$ pin drives the device into either active mode or sleep mode.

A logic-low sleep signal drives the device into sleep mode, and a logic-high sleep signal drives the device into active mode.

In cases when the VREF pin is powered before the VCC pin, the device will not operate within the specified limits until the supply voltage is equal to the reference voltage. When the device is switched from sleep mode to active mode, a time defined by t_{WU}

must elapse before the output of the device is valid.

The device output transitions into the high-impedance state approximately t_{SLEEP} seconds after a logic-low signal is applied to the \overline{SLEEP} pin (see Figure 3).

If possible, it is recommended to power-up the device in sleep mode. However, if the application requires that the device be powered-on in active mode, then a $10~\mathrm{k}\Omega$ resistor in series with the $\overline{\mathrm{SLEEP}}$ pin is recommended. This resistor will limit the current that flows into the $\overline{\mathrm{SLEEP}}$ pin if certain semiconductor junctions become forward-biased before the ramp-up of voltage on the VCC pin. Note that this current-limiting resistor is not required if the user connects the $\overline{\mathrm{SLEEP}}$ pin directly to the VCC pin. The same precautions are advised if the device supply is powered-off while power is still applied to the $\overline{\mathrm{SLEEP}}$ pin.

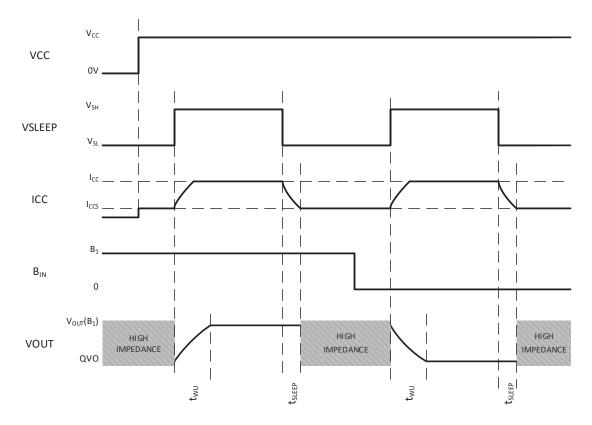


Figure 3: A31010 Timing Diagram



CHARACTERISTIC DEFINITIONS

Ratiometry

A31010 devices feature a ratiometric output. The quiescent voltage output and sensitivity are proportional to the ratiometric supply reference voltage input at the VREF pin. The percent ratiometric change in the quiescent voltage output is defined as:

Equation 1:

$$\Delta QVO_{(\Delta VREF)} = \frac{QVO(VREF) \div QVO(3V)}{VREF \div 3 \text{ V}} \times 100\%$$

And the error is defined as:

Equation 2:

$$E_{\text{QVOR}} = \Delta QVO_{(\Delta \text{VREF})} - 100\%$$

The percent ratiometric change in the sensitivity is defined as:

Equation 3:

$$\Delta Sens_{(\Delta VREF)} = \frac{Sens(VREF) \div Sens(3V)}{VREF \div 3 \text{ V}} \times 100\%$$

And the error is defined as:

Equation 4:

$$E_{\rm SENSR} = \Delta Sens_{(\Delta \rm VREF)} - 100\%$$

Linearity

The on-chip output stage is designed to provide a linear output with the maximum supply voltage of $V_{\rm CCN}$. Although applications with very high magnetic fields will not damage these devices, it will force the output into a non-linear region. Linearity is measured and defined as:

Equation 5:

$$Lin = \frac{VOUT(B) - QVO}{2 \times (VOUT(B/2)) - QVO} \times 100\%$$

And the error is defined as:

Equation 6:

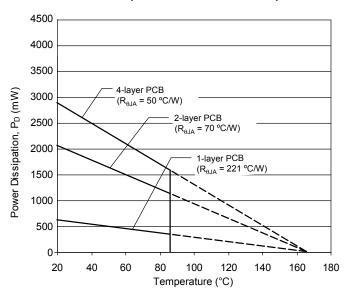
 $E_{\rm LIN} = Lin - 100\%$



THERMAL CHARACTERISTICS: May require derating at maximum conditions

Characteristic	Symbol	Test Conditions		Units
		1-layer PCB with copper limited to solder pads	221	°C/W
Package Thermal Resistance	$R_{ heta JA}$	2-layer PCB with 0.6 in. ² of copper area each side, connected by thermal vias	70	°C/W
		4-layer PCB based on JEDEC standard	50	°C/W

Power Dissipation versus Ambient Temperature





PACKAGE OUTLINE DRAWING

For Reference Only – Not for Tooling Use

Dimensions in millimeters – NOT TO SCALE

Exact case and lead configuration at supplier discretion within limits shown

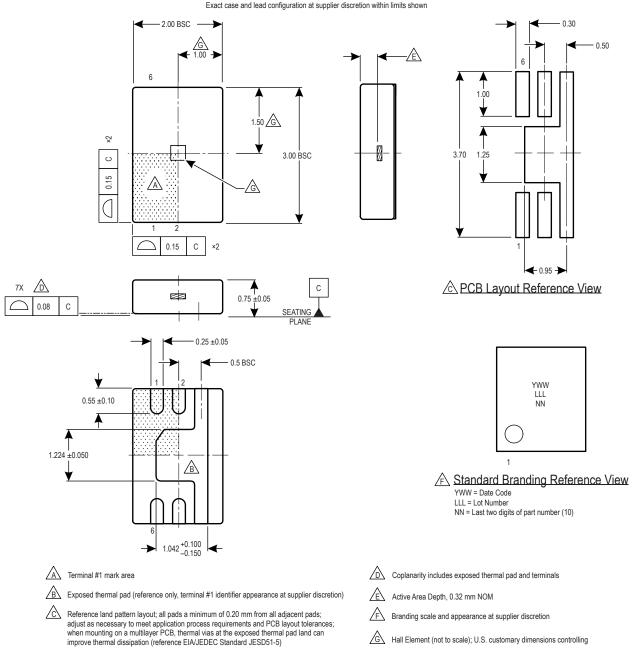


Figure 4: Package EH, 6-pin MLP/DFN



Low-Power Unidirectional Linear Hall-Effect Sensor IC with User-Controlled Sleep Feature in Compact 2 mm × 3 mm Footprint

Revision History

Number	Date	Description
_	September 2, 2021	Initial release
1	February 17, 2022	Updated product offerings

Copyright 2022, Allegro MicroSystems.

Allegro MicroSystems 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.

Allegro's products are not to be used in any devices or systems, including but not limited to life support devices or systems, in which a failure of Allegro's product can reasonably be expected to cause bodily harm.

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

Copies of this document are considered uncontrolled documents.

For the latest version of this document, visit our website:

www.allegromicro.com

