A1360, A1361, and A1362

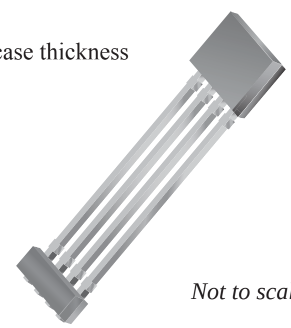
Low-Noise Programmable Linear Hall Effect Sensor ICs with Adjustable Bandwidth (50 kHz Maximum) and Analog Output

Features and Benefits

- 1 mm case thickness provides greater coupling for current sensing applications
- Customer programmable offset and sensitivity
- Factory programmed 0%/°C sensitivity temperature coefficient
- Programmability at end-of-line
- Selectable unipolar or bipolar quiescent voltage levels
- Selectable sensitivity ranges between 0.7 and 1.4 mV/G (A1360), 1.4 to 4.5 mV/G (A1361) and 4.5 to 16 mV/G (A1362)
- Device bandwidth selectable under 50 kHz, via capacitor on FILTER pin
- Ratiometric sensitivity, quiescent voltage output, and clamps for interfacing with application DAC
- Temperature-stable quiescent voltage output and sensitivity
- Precise recoverability after temperature cycling
- Output voltage clamps provide short circuit diagnostic capabilities
- Wide ambient temperature range: – 40°C to 150°C
- Resistant to mechanical stress

Package: 4 pin SIP (suffix KT)

1 mm case thickness



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Description

New applications for linear output Hall effect sensing, such as current measurement, require both high accuracy and increased sensor bandwidth. The Allegro® A1360, A1361, and A1362 programmable linear Hall effect sensor ICs are designed specifically to achieve both goals. Available in a through-hole SIP (single in-line package), the A136x Hall effect sensor ICs are sensitive and temperature-stable. The accuracy of these devices is enhanced via programmability on the device VOUT pin. A capacitor to ground on the FILTER pin on the A136x can be used to tune the device bandwidth in a range less than 50 kHz.

These ratiometric Hall effect sensor ICs provide a voltage output that is proportional to the applied magnetic field. The quiescent output voltage is user-adjustable around either 50% (bidirectional configuration) or 10% (unidirectional configuration) of the supply voltage, V_{CC}. The device sensitivity is adjustable within three guaranteed ranges: 0.7 to 1.4 mV/G (A1360), 1.4 to 4.5 mV/G (A1361), and 4.5 to 16 mV/G (A1362).

Each BiCMOS monolithic circuit integrates a Hall element, temperature-compensation circuitry to reduce the intrinsic sensitivity drift of the Hall element, a small-signal high-gain amplifier, a clamped low-impedance output stage, and a proprietary dynamic offset cancellation technique.

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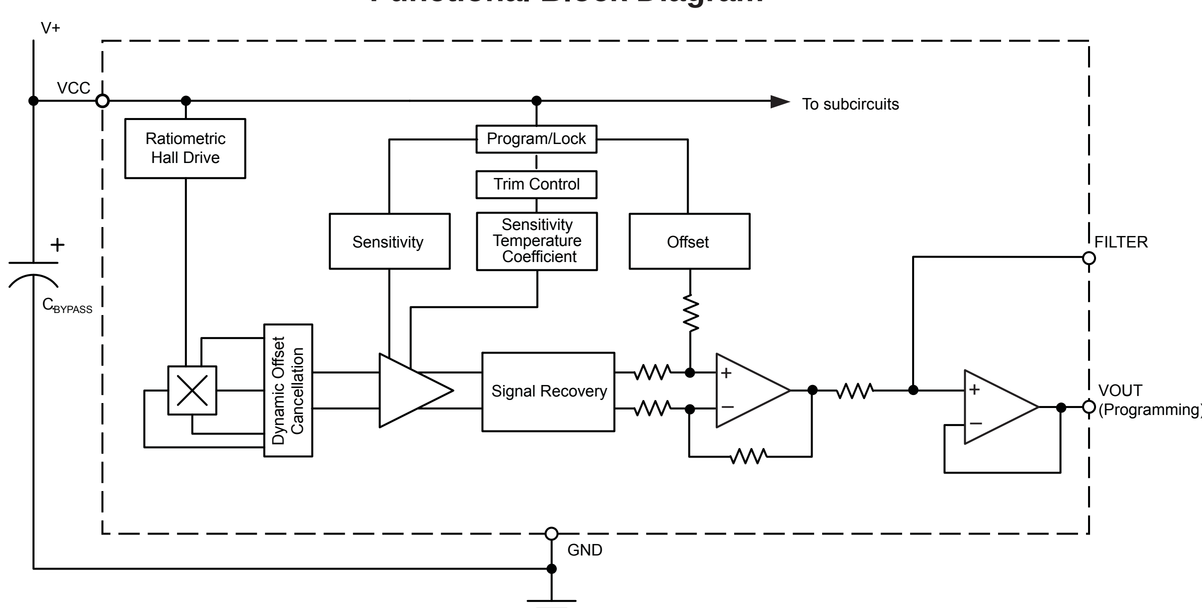
Functional Block Diagram



Description (continued)

The features of these linear Hall effect sensor ICs make them ideal for meeting high accuracy requirements in automotive and industrial applications. Device specifications are guaranteed over an extended ambient temperature range: –40 °C to 150 °C. The A136x sensor ICs are provided in an extremely thin case (1 mm thick), 4-pin SIP (single in-line package, suffix KT) that is lead (Pb) free, with 100% matte tin leadframe plating.

Selection Guide[1]

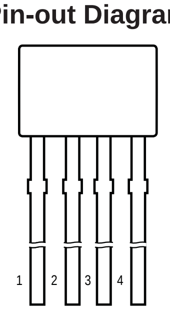
Part Number	Packing[2]	Sensitivity Range (mV/G)
A1360LKTTN-T	4000 pieces per 13-in. reel	0.7 to 1.4
A1361LKTTN-T	4000 pieces per 13-in. reel	1.4 to 4.5
A1362LKTTN-T	4000 pieces per 13-in. reel	4.5 to 16

[1]All variants are programmable for unidirectional or bidirectional use.
[2]Contact Allegro for additional packing options.

Absolute Maximum Ratings

Characteristic	Symbol	Notes	Rating	Units
Forward Supply Voltage	V_{CC}		8	V
Reverse Supply Voltage	V_{RCC}		–0.1	V
Forward Output Voltage	V_{OUT}		28	V
Reverse Output Voltage	V_{ROUT}		–0.1	V
Forward Filter Voltage	V_{FILTER}		8	V
Reverse Filter Voltage	$V_{RFILTER}$		–0.1	V
Output Source Current	$I_{OUT(SOURCE)}$	VOUT to GND	3	mA
Output Sink Current	$I_{OUT(SINK)}$	VCC to VOUT	10	mA
Ambient Operating Temperature	T_A	Range L	–40 to 150	°C
Storage Temperature	T_{stg}		–65 to 165	°C
Junction Temperature	$T_J(max)$		165	°C

Pin-out Diagram



Terminal List Table

Number	Name	Description
1	VCC	Input power supply; use bypass capacitor to connect to ground
2	VOUT	Output signal; also used for programming
3	FILTER	Terminal for external filter capacitor for bandwidth setting
4	GND	Ground

OPERATING CHARACTERISTICS valid over full operating temperature range, T_A; C_{BYPASS} = 0.1 µF, V_{CC} = 5 V, unless otherwise specified

Characteristic	Symbol	Test Conditions	Min.	Typ.	Max.	Units
Electrical Characteristics						
Supply Voltage	V_{CC}		4.5	5.0	5.5	V
Supply Current	I_{CC}	No load on VOUT	–	9.2	12	mA
Power-On Time[1]	t_{PO}	T_A = 25°C, C_L (of test probe) = 10 pF, C_{BYPASS} = open; Sens = 4.5 mV/G	–	30	–	µs
Supply Zener Clamp Voltage	V_Z	T_A = 25°C, I_{CC} = 13 mA	6	7.6	–	V
Internal Bandwidth	BW_i	Small signal –3 dB, 100 $G_{(P-P)}$ magnetic input signal, C_{FILTER} = open, C_L = 10 nF	50	–	–	kHz
Filtered Bandwidth	BW_f	Small signal –3 dB, 100 $G_{(P-P)}$ magnetic input signal, C_{FILTER} = 1 nF, C_L = 10 nF	–	–	50	kHz
Chopping Frequency[2]	f_C	T_A = 25°C	–	210	–	kHz
Output Characteristics						
Propagation Delay Time[1]	t_{pd}	T_A = 25°C, impulse magnetic field of 400 G, C_{FILTER} = open, C_L = 10 nF	–	1.6	–	µs
Rise Time[1]	t_r	T_A = 25°C, impulse magnetic field of 400 G, C_{FILTER} = open, C_L = 10 nF	–	5.5	–	µs
Response Time[1]	$t_{RESPONSE}$	T_A = 25°C, C_L = 10 nF	–	7.0	–	µs
Delay to Clamp[1]	t_{CLP}	T_A = 25°C, impulse magnetic field of 400 G, C_{FILTER} = open, C_L = 10 nF	–	30	–	µs
Output Voltage Clamp[3]	$V_{CLP(HIGH)}$	A1360: T_A = 25°C, B = 600 G, Sens = 5.0 mV/G, $R_{L(PULLDWN)}$ = 10 kΩ	4.65	4.73	4.80	V
		A1361	4.65	4.73	4.80	V
		A1362	4.65	4.78	4.91	V
	$V_{CLP(LOW)}$	A1360: T_A = 25°C, B = 600 G, Sens = 5.0 mV/G, $R_{L(PULLUP)}$ = 10 kΩ	0.25	0.32	0.4	V
		A1361	0.25	0.32	0.4	V
		A1362	0.25	0.32	0.4	V
Noise (peak-to-peak)[4]	$V_{N(p-p)}$	T_A = 25°C, C_L = 10 nF, Sens = 1.5 mV/G, C_{FILTER} = 1 nF (BW_f = 50 kHz)	–	8	–	mV
		T_A = 25°C, C_L = 10 nF, Sens = 6.6 mV/G, C_{FILTER} = 47 nF (BW_f = 2 kHz)	–	8.5	–	mV
		T_A = 25°C, C_L = 10 nF, Sens = 6.6 mV/G, C_{FILTER} = 1 nF (BW_f = 50 kHz)	–	38	–	mV
DC Output Resistance	R_{OUT}		–	<1	–	Ω
Output Load Resistance	$R_{L(PULLUP)}$	VOUT to VCC	4.7	–	–	kΩ
	$R_{L\ (PULLDWN)}$	VOUT to GND	4.7	–	–	kΩ
Output Load Capacitance	C_L	VOUT to GND	–	–	10	nF
Phase Shift[5]	ΔΦ	C_L = 10 nF, C_{FLITER} = 1 nF (BW = 50 kHz), magnetic input signal frequency = 1 kHz with 1 $V_{(p-p)}$ output signal	–	2.5	–	deg.
Output Slew Rate[6]	SR	Sens = 4.5 mV/G, C_L = 10 nF	–	210	–	V/ms

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OPERATING CHARACTERISTICS (continued) valid over full operating temperature range, T_A; C_{BYPASS} = 0.1 µF, V_{CC} = 5 V, unless otherwise specified

Characteristic	Symbol	Test Conditions		Min.	Typ.	Max.	Units
Pre-Programming Target[7]							
Pre-Programming Quiescent Voltage Output	$V_{OUT(Q)PRE}$	B = 0 G, T_A = 25°C		–	2.0	–	V
Pre-Programming Sensitivity	$Sens_{PRE}$	A1360	T_A = 25°C	–	0.5	–	mV/G
		A1361		–	1.1	–	mV/G
		A1362		–	2.7	–	mV/G
Quiescent Voltage Output Programming							
Initial Quiescent Voltage Output[8]	$V_{OUT(Q)UNIinit}$	B = 0 G, T_A = 25°C		–	$V_{CLP(LOW)}$	–	V
	$V_{OUT(Q)BIinit}$			–	$V_{OUT(Q)PRE}$	–	V
Coarse Quiescent Voltage Output Programming Bits[9]				–	1	–	bit
Guaranteed Quiescent Voltage Output Range[10,11]	$V_{OUT(Q)UNI}$	B = 0 G, T_A = 25°C		0.40	–	1.15	V
	$V_{OUT(Q)BI}$			2.15	–	2.85	V
Quiescent Voltage Output Programming Bits				–	8	–	bit
Average Quiescent Voltage Output Step Size[12,13]	$Step_{VOUT(Q)}$	T_A = 25°C		3.4	3.85	4.4	mV
Quiescent Output Voltage Programming Resolution[14]	$Err_{PGVOUT(Q)}$	T_A = 25°C		–	$Step_{VOUT(Q)}$ × ±0.5	–	mV
Sensitivity Programming							
Initial Sensitivity	$Sens_{init}$	T_A = 25°C		–	$Sens_{PRE}$	–	mV/G
Guaranteed Sensitivity Range[15,16]	Sens	A1360	T_A = 25°C	0.7	–	1.4	mV/G
		A1361		1.4	–	4.5	mV/G
		A1362		4.5	–	16	mV/G
Sensitivity Programming Bits				–	8	–	bit
Average Sensitivity Step Size[12.13]	$Step_{SENS}$	A1360	T_A = 25°C	4.2	5.3	6.2	µV/G
		A1361		15	16	21	µV/G
		A1362		65	79	90	µV/G
Sensitivity Programming Resolution[14]	Err_{PGSENS}	T_A = 25°C		–	$Step_{SENS}$ × ±0.5	–	µV/G
Lock Bit Programming							
Overall Programming Lock Bit	LOCK			–	1	–	bit
Factory-Programmed Sensitivity Temperature Coefficient							
Sensitivity Temperature Coefficient[17]	TC_{SENS}			–0.025	0	0.025	%/°C
Error Components							
Linearity Sensitivity Error[18]	Lin_{ERR}	A1360		–3.0	–	3.0	%
		A1361		–2.5	–	2.5	%
		A1362		–2.0	–	2.0	%
Symmetry Sensitivity Error[19]	Sym_{ERR}	A1360		–3.5	–	3.5	%
		A1361		–3.0	–	3.0	%
		A1362		–3.0	–	3.0	%
Ratiometry Quiescent Voltage Output Error[20]	$Rat_{ERRVOUT(Q)}$			–	< ±1.5	–	%
Ratiometry Sensitivity Error[20]	$Rat_{ERRSENS}$			–	< ±1.5	–	%
Ratiometry Clamp Error[21]	$Rat_{SENSCLP}$	T_A = 25°C		–	< ±1.5	–	%

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OPERATING CHARACTERISTICS (continued) valid over full operating temperature range, T_A; C_{BYPASS} = 0.1 µF, V_{CC} = 5 V, unless otherwise specified

Characteristic	Symbol	Test Conditions		Min.	Typ.	Max.	Units
Drift Characteristics							
Quiescent Voltage Output Drift Through Temperature Range[1]	$\Delta V_{OUT(Q)}$	A1360	$V_{OUT(Q)}$ = 2.5 V; Sens = Sens(min)	–20	–	20	mV
		A1361		–20	–	20	mV
		A1362		–60	–	60	mV
		A1360	$V_{OUT(Q)}$ = 2.5 V; Sens = Sens(max)	– 35	–	35	mV
		A1361		–50	–	50	mV
		A1362		–160	–	160	mV
Sensitivity Drift Due to Package Hysteresis[1]	$\Delta Sens_{PKG}$	T_A = 25°C, after temperature cycling		–	< ±1	–	%

[1] See Characteristic Definitions section.
[2] f_C varies up to approximately ±20% over the full operating ambient temperature range, T_A, and process.
[3] V_{CLP} voltages are production-tested, with the sole exception of the A1360 $V_{CLP(HIGH)}$, which is guaranteed by design (the low sensitivity and corresponding high gauss levels required for testing A1360 $V_{CLP(HIGH)}$ make production testing impractical).
[4] Noise is dependent on the sensitivity of the device and the filter capacitance. An 8 mV peak-to-peak noise floor exists that is independent of device sensitivity. This noise floor attenuates proportionate to the filter capacitance (and device bandwidth).
[5] Unit of measure (phase degrees) in reference to the magnetic input signal.
[6] High-to-low transition of output voltage is a function of external load components and device sensitivity.
[7] Raw device characteristic values before any programming.
[8] $V_{OUT(Q)UNIinit}$ typically starts below the lower clamp voltage, $V_{CLP(LOW)}$. When programming the fine quiescent duty cycle for this parameter, several codes may need to be addressed before $V_{OUT(Q)UNI}$ can be measured above $V_{CLP(LOW)}$.
[9] Bits for selecting between $V_{OUT(Q)UNI}$ and $V_{OUT(Q)BI}$ programming ranges.
[10] $V_{OUT(Q)}$ guaranteed by design.
[11] $V_{OUT(Q)}$(max) is the value available with all programming fuses blown (maximum programming code set). The $V_{OUT(Q)}$ range is the total range from $V_{OUT(Q)init}$ up to and including $V_{OUT(Q)}$(max). See Characteristic Definitions section. Quiescent Voltage Output may drift by an additional ±10 mV over the lifetime of this product.
[12] Step size is larger than required, in order to provide for manufacturing spread. See Characteristic Definitions section.
[13] Non-ideal behavior in the programming DAC can cause the step size at each significant bit rollover code to be greater than twice the maximum specified value of $Step_{VOUT(Q)}$ or $Step_{SENS}$.
[14] Overall programming value accuracy. See Characteristic Definitions section.
[15] Sens guaranteed by design.
[16] Sens(max) is the value available with all programming fuses blown (maximum programming code set). Sens range is the total range from $Sens_{init}$ up to and including Sens(max). See Characteristic Definitions section. Sensitivity may drift by an additional ±2% over the lifetime of this product.
[17] Programmed at 150°C and calculated relative to 25°C.
[18] Linearity is only guaranteed for output voltage ranges of ±2 V from the quiescent output for bidirectional devices and +2 V from the quiescent output for unidirectional devices. These linearity ranges are only valid within the operating output range of the device. The operating output range is confined to the region between the output clamps. Linearity may shift by up to +/- 1 % over the lifetime of this product.
[19] Symmetry error is only valid for bidirectional devices. Symmetry may shift by up to ±1% over the lifetime of this product.
[20] Percent change from actual value at V_{CC} = 5 V, for a given temperature, over the guaranteed supply voltage operating range.
[21] Percent change from actual value at V_{CC} = 5 V, T_A = 25°C, over the guaranteed supply voltage operating range.