A31015

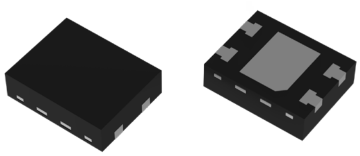
Nanopower Magnetic Hall 1D Linear Sensor with Enable Pin

FEATURES AND BENEFITS

- Wide operating supply and temperature range
  - 1.6 V to 5.5 V, –40°C to 125°C
- Small DFN-4 package
  - 1.54 mm^2 area with 0.5 mm pitch and < 0.5 mm height
- < 1 µW average power with 10 Hz duty cycling
  - < 13 µs enable time
  - High-impedance output in sleep mode
  - < 1 nA maximum sleep mode supply current
- Many orderable configurations to customize IC for optimal system performance
  - Sensitivity: wide range of options
  - Polarity: bipolar, unipolar south, or unipolar north
  - Temperature coefficient: 0 %/°C to 0.2 %/°C

PACKAGE

4-pin DFN / X2SON (suffix EW)



Not to scale

DESCRIPTION

The A31015 is a nanopower, ratiometric linear Hall-effect sensor IC designed specifically to maximize battery life in portable and space-constrained applications. Unlike traditional linear sensors that consume constant power, the A31015 features a dedicated active-high enable (EN) pin, allowing for system microcontrollers to duty cycle the A31015. This power-gating capability reduces the average power consumption to less than 1 µW (at 10 Hz cycling), while the ultra-low leakage sleep mode consumes less than 1 nA.

When enabled, the A31015 wakes up in under 13 µs, providing a high-accuracy analog voltage output proportional to the magnetic field. In sleep mode, the output transitions to a high-impedance state, facilitating easy interface with shared ADC lines or multiplexed sensor arrays.

Packaged in a tiny 1.54 mm^2 DFN-4 (suffix EW), the A31015 delivers reliable magnetic sensing for precision position and travel detection without compromising the thermal or power budget of next-generation products.

APPLICATIONS

- Gaming
- Internet of things and smart home
- Industrial and utility metering
- Medical and personal care

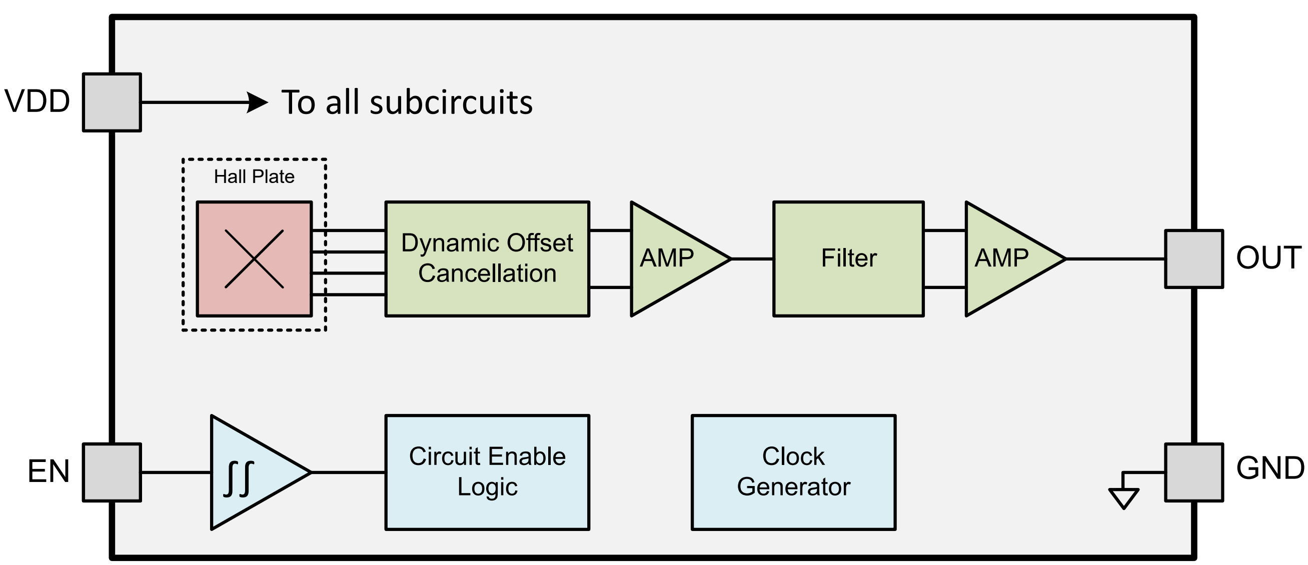
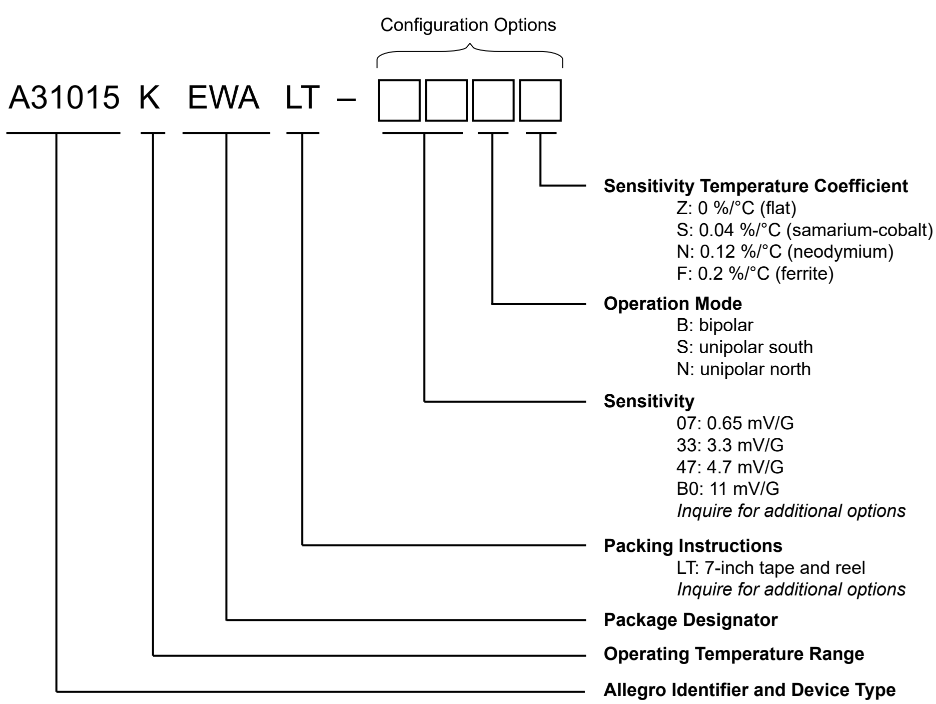


Figure 1: Functional Block Diagram

SELECTION GUIDE [1]

Part Number	Operation Mode	Sensitivity at 3.3 V [2] [mV/G]	Temperature Coefficient [%/°C]	Package	Lead Finish	Eco Plan [3]	MSL Rating [4]	Packing
A31015KEWALT-07BZ	Bipolar	0.65 (±2230 G range)	0	EW (4-pin DFN)	Sn	Green and RoHS	2	7-inch tape and reel (3000 pieces per reel)
A31015KEWALT-33BN	Bipolar	3.3 (±439 G range)	0.12					
A31015KEWALT-47BN	Bipolar	4.7 (±309 G Range)						
A31015KEWALT-B0BN	Bipolar	11 (±132 G range)						
A31015KEWALT-47SN	Unipolar South	4.7 (–28 → 589 G Range)						

[1] Contact Allegro for additional selections and packing options.
[2] Sensitivity (SENS) scales with supply voltage (V_{DD}) to preserve a ratiometric output over V_{DD} levels for the same input magnetic field applied. SENS(1.8 V) = SENS(3.3 V × 0.55 and SENS(5 V) = SENS(3.3 V) × 1.52. See Ratiometric Output section for more information. Magnetic field range is constant over supply voltage.
[3] RoHS is defined as semiconductor products that are compliant with current ER RoHS requirements. It also meets the requirement that a restricted hazardous substance does not exceed 0.1% by weight in the homogeneous material. Green is defined as the content of chlorine (Cl), bromine (Br), and antimony-trioxide-based flame retardants satisfy the JS709B low-halogen requirement of ≤ 1,000 parts per million (ppm).
[4] The moisture sensitivity level (MSL) rating is defined by JEDEC standard classifications.



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SPECIFICATIONS

ABSOLUTE MAXIMUM RATINGS

Characteristic	Symbol	Notes	Rating	Unit
Forward Supply Voltage	V_{DD}		6	V
Reverse Supply Voltage	V_{RDD}		–0.3	V
Forward Enable Voltage	V_{EN}	V_{DD} > 2.5 V	6	V
Reverse Enable Voltage	V_{REN}		–0.3	V
Forward Output Voltage	V_{OUT}		V_{DD} + 0.1	V
Reverse Output Voltage	V_{ROUT}		–0.3	V
Operating Ambient Temperature Range	T_A		–40 to 125	°C
Junction Temperature	T_J		165	°C
Storage Temperature Range	T_{stg}		–65 to 150	°C

THERMAL CHARACTERISTICS

Characteristics	Symbol	Test Conditions	Value	Unit
Package Thermal Resistance	$R_{\Theta JA}$	2-layer PCB with 0.6 in.^{2} of copper area each side, connected by thermal vias	161	°C/W
		4-layer JEDEC standard PCB	135	°C/W

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PACKAGE PINOUT DIAGRAMS WITH SENSITIVE AXIS AND TERMINAL LIST

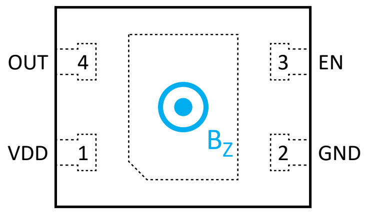

Figure 2: Pinout Diagram
(Top of Package)

Table 1: Terminal List

Pin	Name	Function
1	VDD	Supply
2	GND	Ground
3	EN	Enable
4	OUT	Output
PAD	NC	No connect (tie to GND)

TYPICAL APPLICATION CIRCUIT [1]

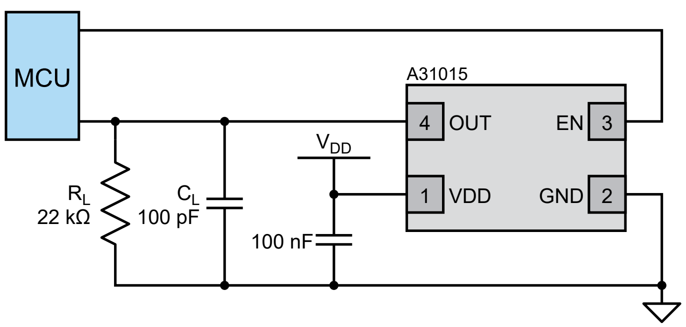

Figure 3: Typical Application Circuit

[1] The EN pin can be tied to the VDD pin if the A31015 is intended to be used in active state indefinitely (no sleep functionality).

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OPERATIONAL CHARACTERISTICS: Valid over operating ambient temperature range unless otherwise noted

Characteristics	Symbol	Test Conditions			Min. [1]	Typ. [2]	Max. [1]	Unit
SUPPLY CHARACTERISTICS								
Supply Voltage	V_{DD}	VDD → GND			1.65	3.3	5.5	V
Enable Input Threshold [3]	$V_{EN(ACTIVE)}$	EN → GND		For active mode	1	–	–	V
	$V_{EN(SLEEP)}$	EN → GND		For sleep mode	–	–	0.4	V
Supply Current	I_{DD}	Sleep mode [4] ($V_{EN} = V_{EN(SLEEP)}$) T_A = 25°C		V_{DD} = 1.8 V	–	40	120	pA
				V_{DD} = 3.3 V	–	65	110	pA
				V_{DD} = 5 V	–	130	210	pA
		Active mode ($V_{EN} = V_{EN(ACTIVE)}$) T_A = 25°C	-33BN option -47BN option -47SN option -B0BN option	V_{DD} = 1.8 V	–	1	1.2	mA
				V_{DD} = 3.3 V	–	1.9	2.1	mA
				V_{DD} = 5 V	–	3	3.3	mA
			-07BZ option	V_{DD} = 1.8 V	–	1.1	1.22	mA
				V_{DD} = 3.3 V	–	2	2.26	mA
				V_{DD} = 5 V	–	3.2	3.53	mA
TIMING CHARACTERISTICS								
Power-On Time	t_{PO}	From $V_{DD} \geq V_{DD(MIN)}$ to V_{OUT} = 95% of final value			–	12	15	μs
Enable Time	t_{EN}	From $V_{EN} \geq V_{EN(ACTIVE)}$ to V_{OUT} = 95% of final value			–	10	13	μs
Sleep Time	t_{SLEEP}	From $V_{EN} \leq V_{EN(SLEEP)}$ to V_{OUT} = high impedance			–	2	3	μs

[1] Minimum and maximum values not measured at final test; determined by design and characterization.
[2] Typical values are for T_A = 25°C and V_{DD} = 3.3 V unless otherwise specified.
[3] EN (enable) is a high-impedance input. Enable input thresholds are constant over supply voltage (not ratiometric). Hysteresis is included between threshold levels.
[4] Specification not measured at final test; determined by design and characterization.

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A31015KEWALT-07BZ OUTPUT AND MAGNETIC CHARACTERISTICS: Valid over operating ambient temperature range unless otherwise noted

Characteristics	Symbol	Test Conditions		Min. [1]	Typ. [2]	Max. [1]	Unit
OUTPUT CHARACTERISTICS							
Output Voltage Linear Range [3]	$V_{OUT(HIGH)}$	$B_{IN} \geq B_{IN(MAX)}$	V_{DD} = 1.8 V	1.69	–	–	V
			V_{DD} = 3.3 V	3.1	–	–	V
			V_{DD} = 5 V	4.7	–	–	V
	$V_{OUT(LOW)}$	$B_{IN} \leq B_{IN(MIN)}$	V_{DD} = 1.8 V	–	–	0.11	V
			V_{DD} = 3.3 V	–	–	0.2	V
			V_{DD} = 5 V	–	–	0.3	V
Quiescent Voltage Output	$V_{OUT(QVO)}$	B_{IN} = 0 G; T_A = 25°C;	V_{DD} = 1.8 V	0.87	0.9	0.93	V
			V_{DD} = 3.3 V	1.6	1.65	1.7	V
			V_{DD} = 5 V	2.4	2.5	2.6	V
Quiescent Output Lifetime Drift [3][9]	–	V_{DD} = 3.3 V		–	±1	–	mV
Input-Referred Noise Density [3]	N_D	T_A = 25°C; V_{DD} = 3.3 V; $C_L \geq$ 100 pF		–	2.5	–	mG/√Hz
Input-Referred RMS Noise [4]	N_{RMS}	T_A = 25°C; V_{DD} = 3.3 V; $C_L \geq$ 100 pF		–	642	–	mG_{RMS}
Signal-to-Noise Ratio [5]	SNR	T_A = 25°C; V_{DD} = 3.3 V; $C_L \geq$ 100 pF		–	68	–	dB
Linearity Error [3][6]	E_{LIN}	Percentage of the linear range defined by V_{OUT}		–	0.05	0.15	%
Output Bandwidth [3]	BW	Limited by the package leadframe		–	43.3	–	kHz
Output Load Resistance	R_L	Between OUT and GND pins		15	–	–	kΩ
Output Load Capacitance	C_L	Between OUT and GND pins		–	–	1	nF
MAGNETIC CHARACTERISTICS							
Sensitivity [7]	SENS	T_A = 25°C	V_{DD} = 1.8 V	–	0.35	–	mV/G
			V_{DD} = 3.3 V	–	0.65	–	mV/G
			V_{DD} = 5 V	–	0.98	–	mV/G
Sensitivity Ratiometry Error [3]	$E_{SENS(R)}$	T_A = 25°C; 3 V ≤ V_{DD} ≤ 3.6 V; Referenced to SENS at 3.3 V		–1	–	1	%
Sensitivity Symmetry Error [3]	$E_{SENS(S)}$			–	±0.1	–	%
Sensitivity Lifetime Drift [3][9]	–			–	±0.5	–	%
Sensitivity Temperature Coefficient [3]	TC			–	0	–	%/°C
Operational Magnetic Field [3][8]	B_{IN}	T_A = 25°C		–2230	–	2230	G

[1] Minimum and maximum values are guaranteed by design characterization (not tested in production).
[2] Typical values are for T_A = 25°C and V_{DD} = 3.3 V unless otherwise specified.
[3] Specification not measured at final test; determined by design and characterization.
[4] Calculated from input-referred noise density: $N_{RMS} = N_D \times \sqrt{(BW)} \times \sqrt{(\pi/2)}$, where $\sqrt{(\pi/2)}$ is used to account for the noise-equivalent bandwidth of a low-pass filter. If applying an external low-pass filter, this calculation can be re-run using the external filter bandwidth.
[5] Calculated from input-referred RMS noise and operational magnetic field: $SNR = 20 \times \log_{10}(((B_{IN(MAX)} - B_{IN(MIN)}) / (2 \times \sqrt{2})) / N_{RMS})$.
[6] See Linearity and Symmetry section for more information.
[7] Sensitivity (SENS) scales with supply voltage (V_{DD}) to preserve a ratiometric output over V_{DD} levels for the same input magnetic field applied. SENS(1.8 V) = SENS(3.3 V) × 0.55 and SENS(5 V) = SENS(3.3 V) × 1.52. See Ratiometric Output section for more information.
[8] Typical range assuming typical sensitivity. Magnetic field defined as positive with induced south-pole magnetic field. B_{IN} for unipolar mode represent the typical operational magnetic field for the configured magnetic polarity (north or south), where the A31015 responds from $B_{IN(MIN)}$ to $B_{IN(MAX)}$ for the configured magnetic polarity.
[9] Lifetime drift is taken from an average of the magnitude from each stress of qualification testing.

A31015KEWALT-33BN OUTPUT AND MAGNETIC CHARACTERISTICS: Valid over operating ambient temperature range unless otherwise noted

Characteristics	Symbol	Test Conditions		Min. [1]	Typ. [2]	Max. [1]	Unit
OUTPUT CHARACTERISTICS							
Output Voltage Linear Range [3]	$V_{OUT(HIGH)}$	$B_{IN} \geq B_{IN(MAX)}$	V_{DD} = 1.8 V	1.69	–	–	V
			V_{DD} = 3.3 V	3.1	–	–	V
			V_{DD} = 5 V	4.7	–	–	V
	$V_{OUT(LOW)}$	$B_{IN} \leq B_{IN(MIN)}$	V_{DD} = 1.8 V	–	–	0.11	V
			V_{DD} = 3.3 V	–	–	0.2	V
			V_{DD} = 5 V	–	–	0.3	V
Quiescent Voltage Output	$V_{OUT(QVO)}$	B_{IN} = 0 G; T_A = 25°C;	V_{DD} = 1.8 V	0.87	0.9	0.93	V
			V_{DD} = 3.3 V	1.6	1.65	1.7	V
			V_{DD} = 5 V	2.4	2.5	2.6	V
Quiescent Output Lifetime Drift [3][9]	–	V_{DD} = 3.3 V		–	±1	–	mV
Input-Referred Noise Density [3]	N_D	T_A = 25°C; V_{DD} = 3.3 V; $C_L \geq$ 100 pF		–	1.5	–	mG/√Hz
Input-Referred RMS Noise [4]	N_{RMS}	T_A = 25°C; V_{DD} = 3.3 V; $C_L \geq$ 100 pF		–	234	–	mG_{RMS}
Signal-to-Noise Ratio [5]	SNR	T_A = 25°C; V_{DD} = 3.3 V; $C_L \geq$ 100 pF		–	63	–	dB
Linearity Error [3][6]	E_{LIN}	Percentage of the linear range defined by V_{OUT}		–	0.05	0.15	%
Output Bandwidth [3]	BW			11.25	15	18.75	kHz
Output Load Resistance	R_L	Between OUT and GND pins		15	–	–	kΩ
Output Load Capacitance	C_L	Between OUT and GND pins		–	–	1	nF
MAGNETIC CHARACTERISTICS							
Sensitivity [7]	SENS	T_A = 25°C	V_{DD} = 1.8 V	–	1.8	–	mV/G
			V_{DD} = 3.3 V	–	3.3	–	mV/G
			V_{DD} = 5 V	–	5	–	mV/G
Sensitivity Ratiometry Error [3]	$E_{SENS(R)}$	T_A = 25°C; 3 V ≤ V_{DD} ≤ 3.6 V; Referenced to SENS at 3.3 V		–1	–	1	%
Sensitivity Symmetry Error [3]	$E_{SENS(S)}$			–	±0.1	–	%
Sensitivity Lifetime Drift [3][9]	–			–	±0.5	–	%
Sensitivity Temperature Coefficient [3]	TC			–	0.12	–	%/°C
Operational Magnetic Field [3][8]	B_{IN}	T_A = 25°C		–439	–	439	G

[1] Minimum and maximum values are guaranteed by design characterization (not tested in production).
[2] Typical values are for T_A = 25°C and V_{DD} = 3.3 V unless otherwise specified.
[3] Specification not measured at final test; determined by design and characterization.
[4] Calculated from input-referred noise density: $N_{RMS} = N_D \times \sqrt{(BW)} \times \sqrt{(\pi/2)}$, where $\sqrt{(\pi/2)}$ is used to account for the noise-equivalent bandwidth of a low-pass filter. If applying an external low-pass filter, this calculation can be re-run using the external filter bandwidth.
[5] Calculated from input-referred RMS noise and operational magnetic field: SNR = $20 \times \log_{10}(((B_{IN(MAX)} - B_{IN(MIN)}) / (2 \times \sqrt{2})) / N_{RMS})$.
[6] See Linearity and Symmetry section for more information.
[7] Sensitivity (SENS) scales with supply voltage (V_{DD}) to preserve a ratiometric output over V_{DD} levels for the same input magnetic field applied. SENS(1.8 V) = SENS(3.3 V) × 0.55 and SENS(5 V) = SENS(3.3 V) × 1.52. See Ratiometric Output section for more information.
[8] Typical range assuming typical sensitivity. Magnetic field defined as positive with induced south-pole magnetic field. B_{IN} for unipolar mode represent the typical operational magnetic field for the configured magnetic polarity (north or south), where the A31015 responds from $B_{IN(MIN)}$ to $B_{IN(MAX)}$ for the configured magnetic polarity.
[9] Lifetime drift is taken from an average of the magnitude from each stress of qualification testing.

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A31015KEWALT-47BN OUTPUT AND MAGNETIC CHARACTERISTICS: Valid over operating ambient temperature range unless otherwise noted

Characteristics	Symbol	Test Conditions		Min. [1]	Typ. [2]	Max. [1]	Unit
OUTPUT CHARACTERISTICS							
Output Voltage Linear Range [3]	$V_{OUT(HIGH)}$	$B_{IN} \geq B_{IN(MAX)}$	V_{DD} = 1.8 V	1.69	–	–	V
			V_{DD} = 3.3 V	3.1	–	–	V
			V_{DD} = 5 V	4.7	–	–	V
	$V_{OUT(LOW)}$	$B_{IN} \leq B_{IN(MIN)}$	V_{DD} = 1.8 V	–	–	0.11	V
			V_{DD} = 3.3 V	–	–	0.2	V
			V_{DD} = 5 V	–	–	0.3	V
Quiescent Voltage Output	$V_{OUT(QVO)}$	B_{IN} = 0 G; T_A = 25°C;	V_{DD} = 1.8 V	0.87	0.9	0.93	V
			V_{DD} = 3.3 V	1.6	1.65	1.7	V
			V_{DD} = 5 V	2.4	2.5	2.6	V
Quiescent Output Lifetime Drift [3][9]	–	V_{DD} = 3.3 V		–	±1	–	mV
Input-Referred Noise Density [3]	N_D	T_A = 25°C; V_{DD} = 3.3 V; $C_L \geq$ 100 pF		–	1.7	–	mG/√Hz
Input-Referred RMS Noise [4]	N_{RMS}	T_A = 25°C; V_{DD} = 3.3 V; $C_L \geq$ 100 pF; 1 kHz to 15 kHz		–	261	–	mG_{RMS}
Signal-to-Noise Ratio [5]	SNR	T_A = 25°C; V_{DD} = 3.3 V; $C_L \geq$ 100 pF		–	58	–	dB
Linearity Error [3][6]	E_{LIN}	Percentage of the linear range defined by V_{OUT}		–	0.05	0.15	%
Output Bandwidth [3]	BW			11.25	15	18.75	kHz
Output Load Resistance	R_L	Between OUT and GND pins		15	–	–	kΩ
Output Load Capacitance	C_L	Between OUT and GND pins		–	–	1	nF
MAGNETIC CHARACTERISTICS							
Sensitivity [7]	SENS	T_A = 25°C	V_{DD} = 1.8 V	–	2.6	–	mV/G
			V_{DD} = 3.3 V	–	4.7	–	mV/G
			V_{DD} = 5 V	–	7.1	–	mV/G
Sensitivity Ratiometry Error [3]	$E_{SENS(R)}$	T_A = 25°C; 3 V ≤ V_{DD} ≤ 3.6 V; Referenced to SENS at 3.3 V		–1	–	1	%
Sensitivity Symmetry Error [3]	$E_{SENS(S)}$			–	±0.1	–	%
Sensitivity Lifetime Drift [3][9]	–			–	±0.5	–	%
Sensitivity Temperature Coefficient [3]	TC			–	0.12	–	%/°C
Operational Magnetic Field [3][8]	B_{IN}	T_A = 25°C		–309	–	309	G

[1] Minimum and maximum values are guaranteed by design characterization (not tested in production).
[2] Typical values are for T_A = 25°C and V_{DD} = 3.3 V unless otherwise specified.
[3] Specification not measured at final test; determined by design and characterization.
[4] Calculated from input-referred noise density: $N_{RMS} = N_D \times \sqrt{(BW)} \times \sqrt{(\pi/2)}$, where $\sqrt{(\pi/2)}$ is used to account for the noise-equivalent bandwidth of a low-pass filter. If applying an external low-pass filter, this calculation can be re-run using the external filter bandwidth.
[5] Calculated from input-referred RMS noise and operational magnetic field: $SNR = 20 \times \log_{10}(((B_{IN(MAX)} - B_{IN(MIN)}) / (2 \times \sqrt{2})) / N_{RMS})$.
[6] See Linearity and Symmetry section for more information.
[7] Sensitivity (SENS) scales with supply voltage (V_{DD}) to preserve a ratiometric output over V_{DD} levels for the same input magnetic field applied. SENS(1.8 V) = SENS(3.3 V) × 0.55 and SENS(5 V) = SENS(3.3 V) × 1.52. See Ratiometric Output section for more information.
[8] Typical range assuming typical sensitivity. Magnetic field defined as positive with induced south-pole magnetic field. B_{IN} for unipolar mode represent the typical operational magnetic field for the configured magnetic polarity (north or south), where the A31015 responds from $B_{IN(MIN)}$ to $B_{IN(MAX)}$ for the configured magnetic polarity.
[9] Lifetime drift is taken from an average of the magnitude from each stress of qualification testing.

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A31015KEWALT-B0BN OUTPUT AND MAGNETIC CHARACTERISTICS: Valid over operating ambient temperature range unless otherwise noted

Characteristics	Symbol	Test Conditions		Min. [1]	Typ. [2]	Max. [1]	Unit
OUTPUT CHARACTERISTICS							
Output Voltage Linear Range [3]	$V_{OUT(HIGH)}$	$B_{IN} \ge B_{IN(MAX)}$	V_{DD} = 1.8 V	1.69	–	–	V
			V_{DD} = 3.3 V	3.1	–	–	V
			V_{DD} = 5 V	4.7	–	–	V
	$V_{OUT(LOW)}$	$B_{IN} \le B_{IN(MIN)}$	V_{DD} = 1.8 V	–	–	0.11	V
			V_{DD} = 3.3 V	–	–	0.2	V
			V_{DD} = 5 V	–	–	0.3	V
Quiescent Voltage Output	$V_{OUT(QVO)}$	B_{IN} = 0 G; T_A = 25°C;	V_{DD} = 1.8 V	0.83	0.9	0.97	V
			V_{DD} = 3.3 V	1.55	1.65	1.75	V
			V_{DD} = 5 V	2.36	2.5	2.64	V
Quiescent Output Lifetime Drift [3][9]	–	V_{DD} = 3.3 V		–	±1	–	mV
Input-Referred Noise Density [3]	N_D	T_A = 25°C; V_{DD} = 3.3 V; $C_L \ge$ 100 pF		–	1.8	–	mG/√Hz
Input-Referred RMS Noise [4]	N_{RMS}	T_A = 25°C; V_{DD} = 3.3 V; $C_L \ge$ 100 pF		–	279	–	mG_{RMS}
Signal-to-Noise Ratio [5]	SNR	T_A = 25°C; V_{DD} = 3.3 V; $C_L \ge$ 100 pF		–	50	–	dB
Linearity Error [3][6]	E_{LIN}	Percentage of the linear range defined by V_{OUT}		–	0.05	0.15	%
Output Bandwidth [3]	BW			11.25	15	18.75	kHz
Output Load Resistance	R_L	Between OUT and GND pins		15	–	–	kΩ
Output Load Capacitance	C_L	Between OUT and GND pins		–	–	1	nF
MAGNETIC CHARACTERISTICS							
Sensitivity [7]	SENS	T_A = 25°C	V_{DD} = 1.8 V	–	6	–	mV/G
			V_{DD} = 3.3 V	–	11	–	mV/G
			V_{DD} = 5 V	–	16.7	–	mV/G
Sensitivity Ratiometry Error [3]	$E_{SENS(R)}$	T_A = 25°C; 3 V ≤ V_{DD} ≤ 3.6 V; Referenced to SENS at 3.3 V		–1	–	1	%
Sensitivity Symmetry Error [3]	$E_{SENS(S)}$			–	±0.1	–	%
Sensitivity Lifetime Drift [3][9]	–			–	±0.5	–	%
Sensitivity Temperature Coefficient [3]	TC			–	0.12	–	%/°C
Operational Magnetic Field [3][8]	B_{IN}	T_A = 25°C		–132	–	132	G

[1] Minimum and maximum values are guaranteed by design characterization (not tested in production).
[2] Typical values are for T_A = 25°C and V_{DD} = 3.3 V unless otherwise specified.
[3] Specification not measured at final test; determined by design and characterization.
[4] Calculated from input-referred noise density: $N_{RMS} = N_D \times \sqrt{(BW)} \times \sqrt{(\pi/2)}$, where $\sqrt{(\pi/2)}$ is used to account for the noise-equivalent bandwidth of a low-pass filter. If applying an external low-pass filter, this calculation can be re-run using the external filter bandwidth.
[5] Calculated from input-referred RMS noise and operational magnetic field: $SNR = 20 \times \log_{10}(((B_{IN(MAX)} - B_{IN(MIN)}) / (2 \times \sqrt{2})) / N_{RMS})$.
[6] See Linearity and Symmetry section for more information.
[7] Sensitivity (SENS) scales with supply voltage (V_{DD}) to preserve a ratiometric output over V_{DD} levels for the same input magnetic field applied. SENS(1.8 V) = SENS(3.3 V) × 0.55 and SENS(5 V) = SENS(3.3 V) × 1.52. See Ratiometric Output section for more information.
[8] Typical range assuming typical sensitivity. Magnetic field defined as positive with induced south-pole magnetic field. B_{IN} for unipolar mode represent the typical operational magnetic field for the configured magnetic polarity (north or south), where the A31015 responds from $B_{IN(MIN)}$ to $B_{IN(MAX)}$ for the configured magnetic polarity.
[9] Lifetime drift is taken from an average of the magnitude from each stress of qualification testing.

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A31015KEWALT-47SN OUTPUT AND MAGNETIC CHARACTERISTICS: Valid over operating ambient temperature range unless otherwise noted

Characteristics	Symbol	Test Conditions		Min. [1]	Typ. [2]	Max. [1]	Unit
OUTPUT CHARACTERISTICS							
Output Voltage Linear Range [3]	$V_{OUT(HIGH)}$	$B_{IN} \geq B_{IN(MAX)}$	V_{DD} = 1.8 V	1.69	–	–	V
			V_{DD} = 3.3 V	3.1	–	–	V
			V_{DD} = 5 V	4.7	–	–	V
	$V_{OUT(LOW)}$	$B_{IN} \leq B_{IN(MIN)}$	V_{DD} = 1.8 V	–	–	0.11	V
			V_{DD} = 3.3 V	–	–	0.2	V
			V_{DD} = 5 V	–	–	0.3	V
Quiescent Voltage Output	$V_{OUT(QVO)}$	B_{IN} = 0 G; T_A = 25°C;	V_{DD} = 1.8 V	0.11	0.18	0.25	V
			V_{DD} = 3.3 V	0.23	0.33	0.43	V
			V_{DD} = 5 V	0.36	0.5	0.64	V
Quiescent Output Lifetime Drift [3][9]	–	V_{DD} = 3.3 V		–	±1	–	mV
Input-Referred Noise Density [3]	N_D	T_A = 25°C; V_{DD} = 3.3 V; C_L ≥ 100 pF		–	1.7	–	mG/√Hz
Input-Referred RMS Noise [4]	N_{RMS}	T_A = 25°C; V_{DD} = 3.3 V; C_L ≥ 100 pF; 1 kHz to 15 kHz		–	261	–	mG_{RMS}
Signal-to-Noise Ratio [5]	SNR	T_A = 25°C; V_{DD} = 3.3 V; C_L ≥ 100 pF		–	58	–	dB
Linearity Error [3][6]	E_{LIN}	Percentage of the linear range defined by V_{OUT}		–	0.05	0.15	%
Output Bandwidth [3]	BW			11.25	15	18.75	kHz
Output Load Resistance	R_L	Between OUT and GND pins		15	–	–	kΩ
Output Load Capacitance	C_L	Between OUT and GND pins		–	–	1	nF
MAGNETIC CHARACTERISTICS							
Sensitivity [7]	SENS	T_A = 25°C	V_{DD} = 1.8 V	–	2.6	–	mV/G
			V_{DD} = 3.3 V	–	4.7	–	mV/G
			V_{DD} = 5 V	–	7.1	–	mV/G
Sensitivity Ratiometry Error [3]	$E_{SENS(R)}$	T_A = 25°C; 3 V ≤ V_{DD} ≤ 3.6 V; Referenced to SENS at 3.3 V		–1	–	1	%
Sensitivity Symmetry Error [3]	$E_{SENS(S)}$			–	±0.1	–	%
Sensitivity Lifetime Drift [3][9]	–			–	±0.5	–	%
Sensitivity Temperature Coefficient [3]	TC			–	0.12	–	%/°C
Operational Magnetic Field [3][8]	B_{IN}	T_A = 25°C		–28	–	589	G

[1] Minimum and maximum values are guaranteed by design characterization (not tested in production).
[2] Typical values are for T_A = 25°C and V_{DD} = 3.3 V unless otherwise specified.
[3] Specification not measured at final test; determined by design and characterization.
[4] Calculated from input-referred noise density: $N_{RMS} = N_D \times \sqrt{(BW)} \times \sqrt{(\pi/2)}$, where $\sqrt{(\pi/2)}$ is used to account for the noise-equivalent bandwidth of a low-pass filter. If applying an external low-pass filter, this calculation can be re-run using the external filter bandwidth.
[5] Calculated from input-referred RMS noise and operational magnetic field: $SNR = 20 \times \log_{10}(((B_{IN(MAX)} - B_{IN(MIN)}) / (2 \times \sqrt{2})) / N_{RMS})$.
[6] See Linearity and Symmetry section for more information.
[7] Sensitivity (SENS) scales with supply voltage (V_{DD}) to preserve a ratiometric output over V_{DD} levels for the same input magnetic field applied. SENS(1.8 V) = SENS(3.3 V) × 0.55 and SENS(5 V) = SENS(3.3 V) × 1.52. See Ratiometric Output section for more information.
[8] Typical range assuming typical sensitivity. Magnetic field defined as positive with induced south-pole magnetic field. B_{IN} for unipolar mode represent the typical operational magnetic field for the configured magnetic polarity (north or south), where the A31015 responds from $B_{IN(MIN)}$ to $B_{IN(MAX)}$ for the configured magnetic polarity.
[9] Lifetime drift is taken from an average of the magnitude from each stress of qualification testing.

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CHARACTERISTIC PLOTS [1]

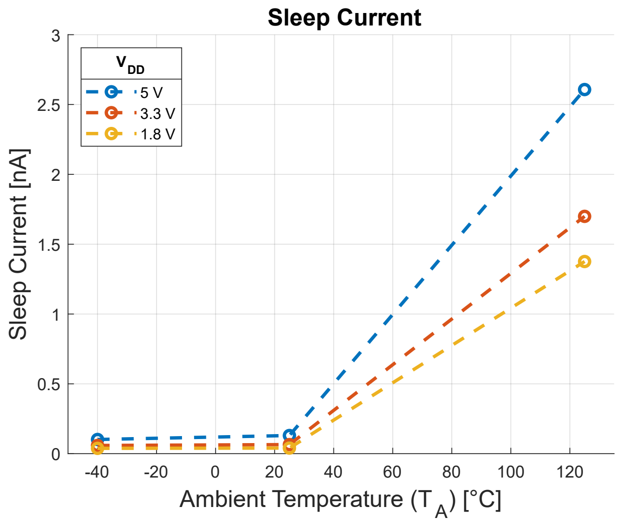

Figure 4: Sleep Current

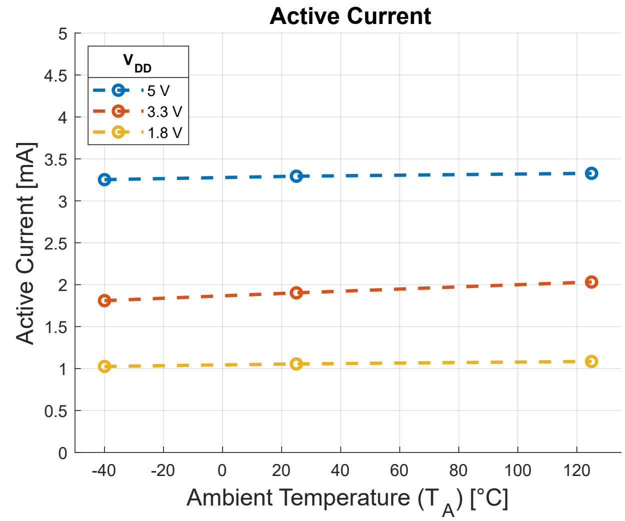

Figure 5: Active Current

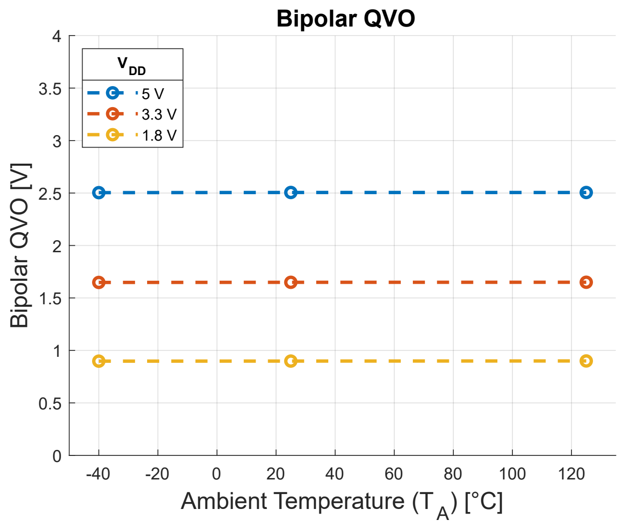

Figure 6: Bipolar QVO

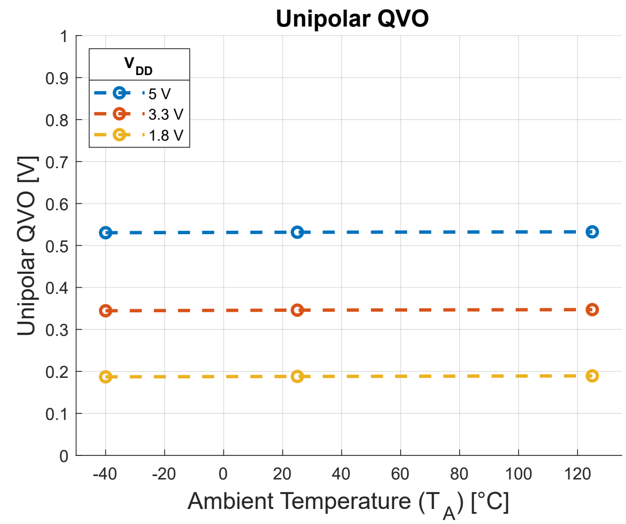

Figure 7: Unipolar QVO

[1] Characterization plots represent mean (average) performance over a large volume of devices tested.

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CHARACTERISTIC PLOTS (CONTINUED) [1]

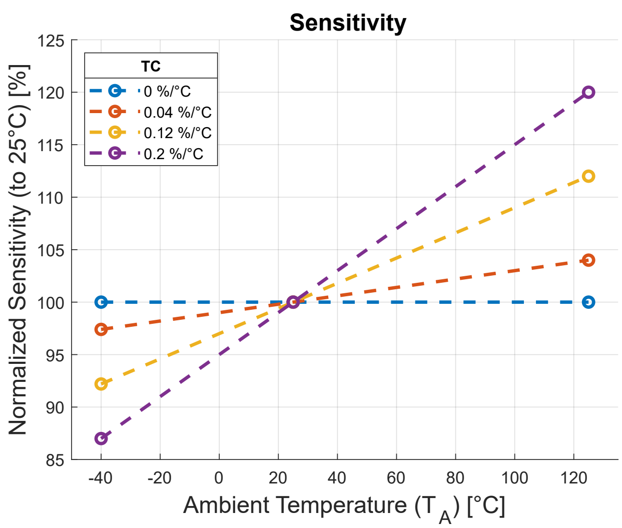

Figure 8: Sensitivity

[1] Characterization plots represent mean (average) performance over a large volume of devices tested.

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CHARACTERISTIC DEFINITIONS

Power-On Time

When the supply is ramped to the operating voltage, the A31015 output requires a finite time to react to an input magnetic field. Power-on time (t_{PO}) is defined as the time required for the output voltage to begin responding to an applied magnetic field after the power supply has reached the minimum specified operating voltage ($V_{DD(MIN)}$).

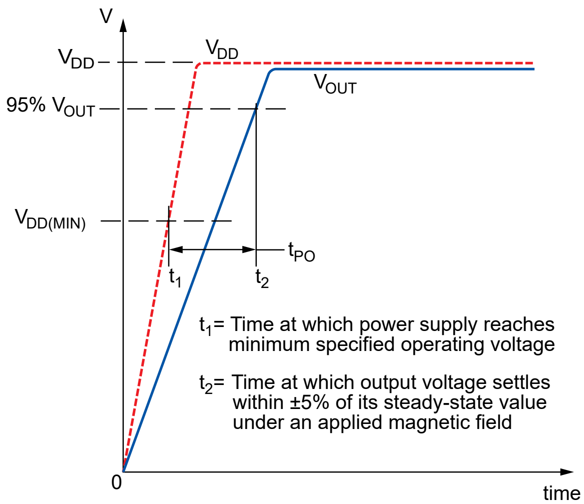

Figure 9: Power-On Time (t_{PO})

Quiescent Voltage Output (QVO)

In the quiescent state (no magnetic field, B = 0 G), the output ($V_{OUT(QVO)}$) is at a constant ratio to the supply voltage (V_{DD}) across the entire operating range of V_{DD} and operating ambient temperature (T_A).

Sensitivity

The output voltage changes proportionally to the magnitude and polarity of the applied magnetic field. This proportionality is specified as magnetic sensitivity (SENS) in mV/G, and defined as:

$$SENS = \frac{V_{OUT(+B)} - V_{OUT(-B)}}{(+B) - (-B)} \times 100\% \quad (1)$$

Ratiometric Output

The A31015 features a ratiometric output referenced at 3.3 V. The quiescent voltage output ($V_{OUT(QVO)}$) and sensitivity (SENS) are proportional to the applied supply voltage (V_{DD}).

The quiescent voltage output for a given supply voltage is defined as:

$$V_{OUT(QVO)} = V_{OUT(QVO,3.3\ V)} \times \frac{V_{DD}}{3.3\ V} \quad (2)$$

The sensitivity for a given supply voltage is defined as:

$$SENS = SENS(3.3\ V) \times \frac{V_{DD}}{3.3\ V} \quad (3)$$

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Linearity and Symmetry

The on-chip output stage is designed to provide a linear output with a maximum supply voltage of $V_{DD(MAX)}$. Although applications of very high magnetic fields do not damage the A31015, applying magnetic fields beyond the operational limit (B_{IN}) force the output into a non-linear region.

Linearity error (nonlinearity) is defined as the deviation of the output voltage (V_{OUT}) from the linear relationship of the applied magnetic field (B_{IN}) and the sensitivity (SENS).

Linearity error (as a percentage) is defined as:

$$E_{LIN} = \frac{V_{OUT} - [(B_{IN} \times SENS) + V_{OUT(QVO)}]}{V_{OUT(LIN)}} \times 100\% \qquad (4)$$

where $V_{OUT(LIN)}$ is defined as the linear range of the output voltage, constrained by the operational magnetic input field. See Figure 10.

Sensitivity symmetry defines how well the sensitivity matches with positive and negative fields and is defined as:

$$SYM = \frac{V_{OUT(+B)} - V_{OUT(QVO)}}{V_{OUT(QVO)} - V_{OUT(-B)}} \times 100\% \qquad (5)$$

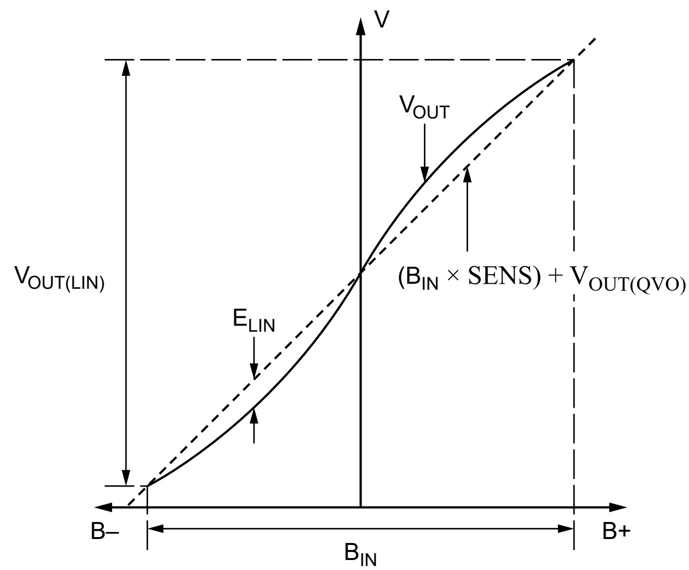

Figure 10: Linearity Error (E_{LIN}), Bipolar

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LOW-POWER FUNCTIONALITY

The A31015 low-power Hall-effect sensor IC is perfect for power sensitive applications. Toggling the logic-level signal connected to the EN (enable) pin drives the A31015 into either active mode or sleep mode. A logic-low enable signal drives the A31015 into sleep mode, while a logic-high enable signal drives the A31015 into active mode (see Operating Characteristics section for typical active and sleep mode current levels, I_{DD}).

When the A31015 is switched from sleep mode to active mode, a time defined by t_{EN} must elapse before the output of the A31015 is valid. The A31015 output transitions to a high-impedance state approximately t_{SLEEP} seconds after a logic-low signal is applied to the EN (enable) pin (see Figure 11).

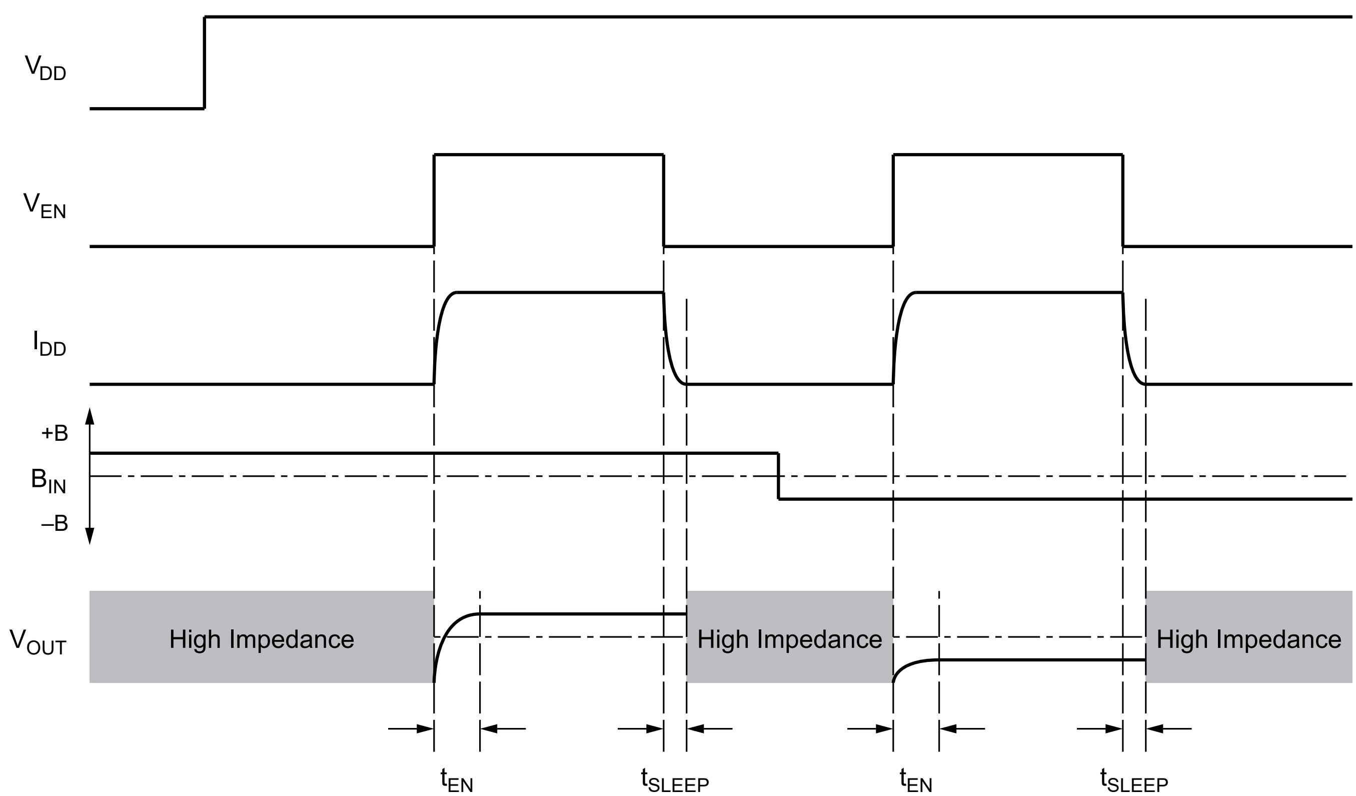
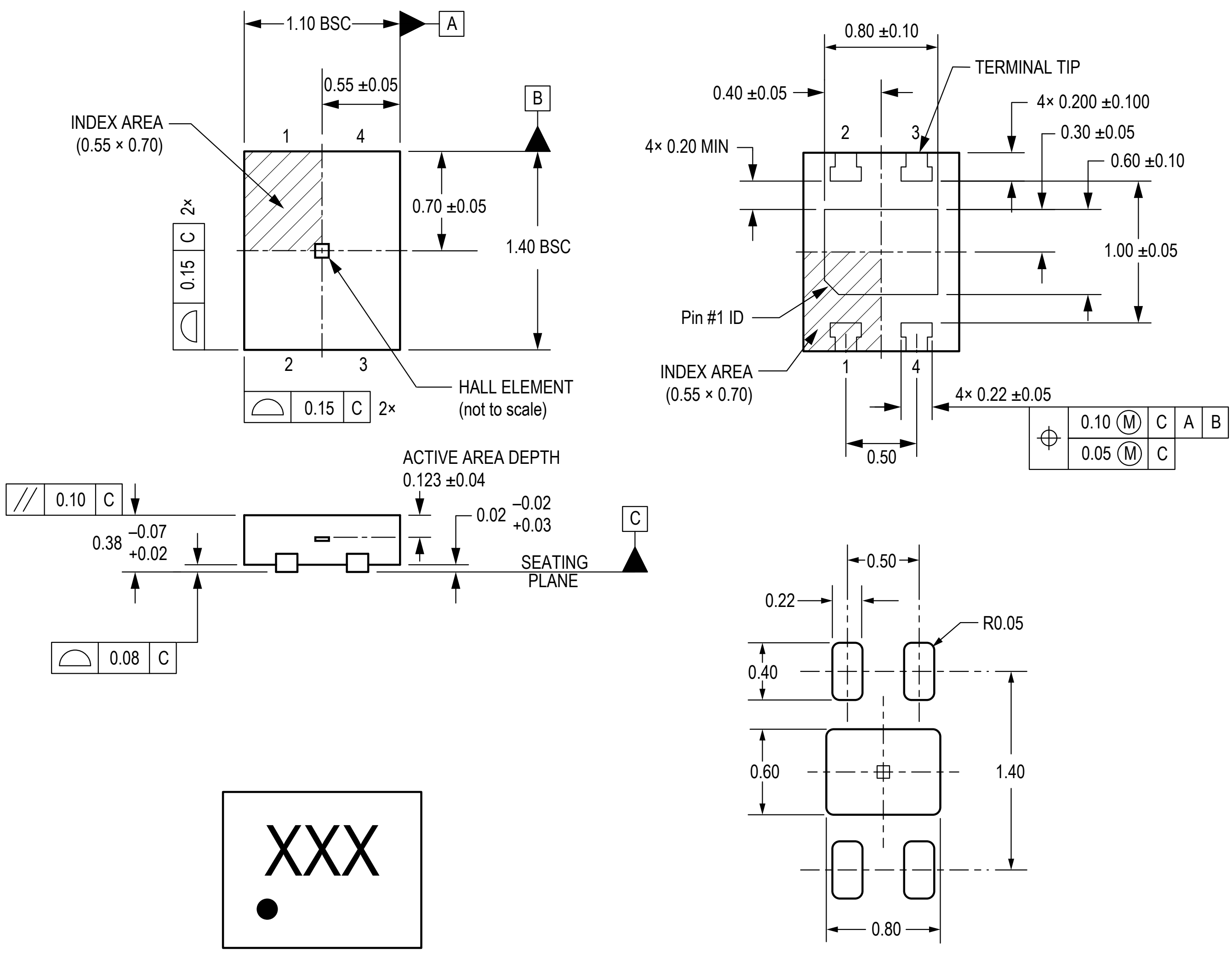


Figure 11: Timing Diagram

PACKAGE OUTLINE DRAWING

For Reference Only – Not for Tooling Use
(Reference DWG-0000368, Rev. 2)
Dimensions in millimeters
NOT TO SCALE
Exact case and lead configuration at supplier discretion within limits shown



STANDARD BRANDING REFERENCE VIEW

Line 1: Allegro Part Number (3 characters)
Line 2: Pin 1 Dot

PCB LAYOUT REFERENCE VIEW

All pads a minimum of 0.20 mm from all adjacent pads; adjust as necessary to meet application process requirements and PCB layout tolerances; when mounting on a multilayer PCB, thermal vias can improve thermal dissipation (reference EIA/JEDEC Standard JESD51-5).

Figure 12: Package EW, 4-Pin DFN (X2SON)

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Revision History

Number	Date	Description
–	March 20, 2026	Initial release to Allegro website
1	June 11, 2026	Added -07BZ, -33BN, and -B0BN part variants (pages 2, 5-10, 12)

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