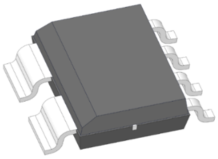
ACS37010 and ACS37012

450 kHz, High Accuracy Current Sensor With FAULT or Reference Output in SOIC-6 Package

FEATURES AND BENEFITS

- High operating bandwidth and fast response time
  - 450 kHz bandwidth
  - 1.3 µs response time
- High-accuracy current measurements
  - ±1.5% sensitivity error over temperature
  - ±4 mV offset voltage over temperature
  - Non-ratiometric operation with VREF output for enhanced accuracy in noisy environments
  - Differential sensing robust against external magnetic fields
  - Magnetic hysteresis-free operation
- Wide operating temperature, –40°C to 150°C
- Low internal primary conductor resistance (0.68 mΩ) for better power efficiency (low dissipation)
- Highly isolated compact surface-mount package
  - 3500 V_{RMS} withstand voltage
  - 905 V_{RMS} / 1280 V_{DC} basic isolation voltages
  - 507 V_{RMS} / 717 V_{DC} reinforced isolation voltages
- AEC-Q100 Grade 0, automotive qualified

PACKAGE:



6-pin Fused-Lead SOIC
(suffix LZ)

Not to scale

DESCRIPTION

The ACS37010 and ACS37012 are fully integrated current sensor ICs that sense current flowing through the compact SOIC LZ package. The current conductor has a very low 0.68 mΩ resistance, ideal for low power dissipation constraints. The sensor is factory-trimmed to provide high accuracy over the entire operating range without the need for customer programming.

The internal construction provides high isolation and excellent magnetic coupling of the field generated by the current flowing in the conductor and the fully monolithic Hall sensor IC. The current is sensed differentially by two Hall plates that subtract interfering common-mode magnetic fields. The sensor provides a very fast 1.3 µs response time analog output with VREF pin for use in noisy supply environments (ACS37010) or a fast logic alert fault output pin with factory pre-programmed trip point provides overcurrent or short-circuit detection and enhanced system protection (ACS37012). The IC has no physical connection to the integrated current conductor and provides 3500 V_{RMS} of isolation between the primary and secondary signal leads of the package.

The ACS37010/12 is in a custom 6-pin SOIC package (suffix LZ). Devices are RoHS-compliant and lead (Pb) free without the use of RoHS exemptions with 100% matte-tin-plated leadframes.

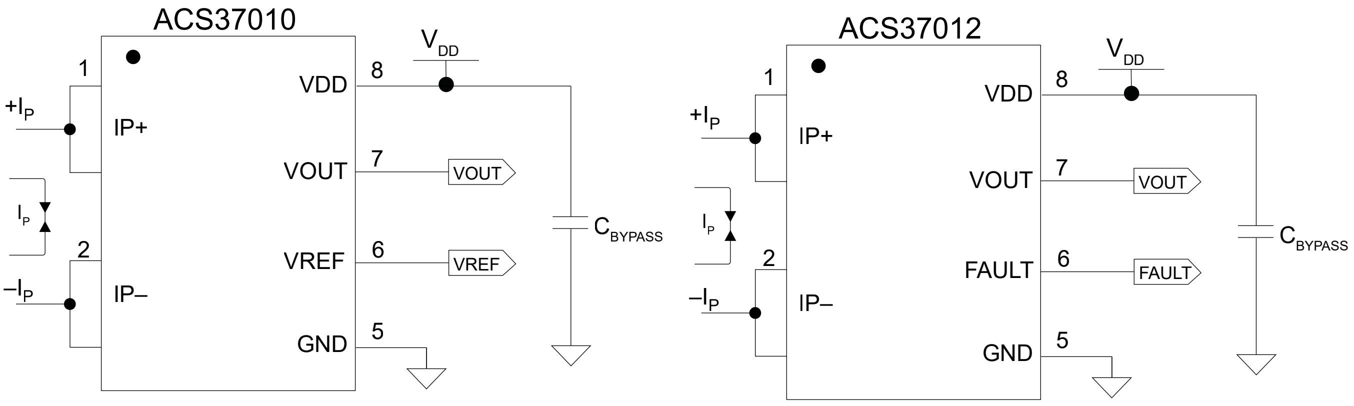


Figure 1: Typical Application Circuit

The device outputs an analog signal, V_{OUT}, that varies linearly with the AC or DC primary current, I_P, within the ranges specified.

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MCO-0001366
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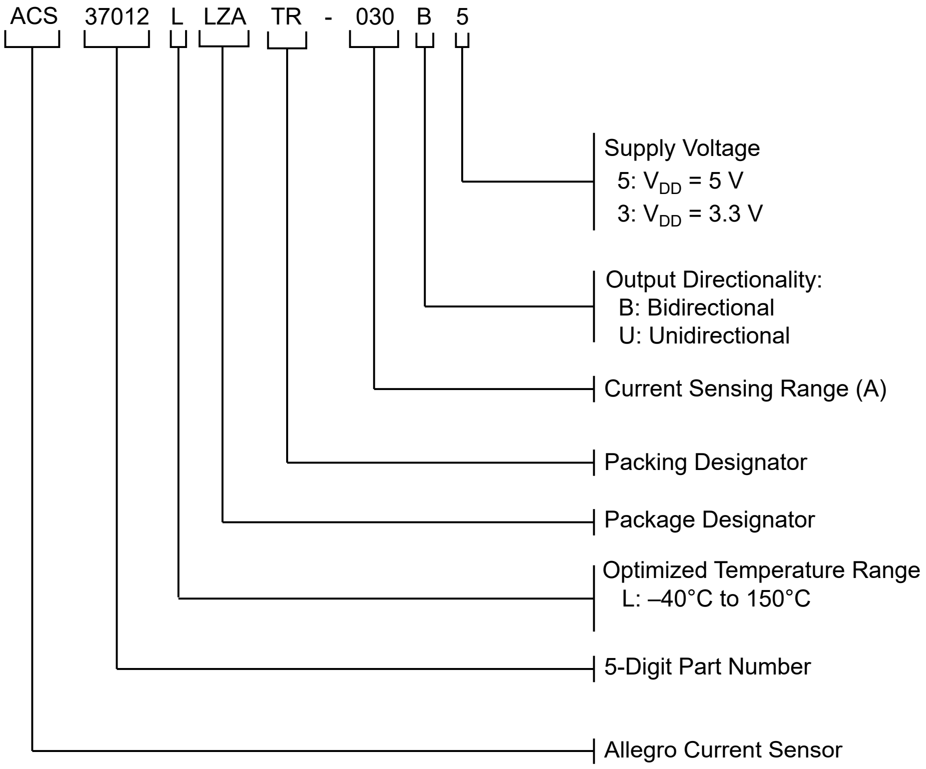
SELECTION GUIDE

Part Number	Current Sensing Range, I_{PR} (A)	Sensitivity (mV/A)	V_{DD} (V)	V_{QVO} (V)	Optimized Temperature Range T_A (°C)	Packing
ACS37010LLZATR-030B5	±30	66.7	5	2.5	–40 to 150	Tape and Reel, 3000 pieces per reel
ACS37010LLZATR-030B3	±30	44	3.3	1.65		
ACS37010LLZATR-050B5	±50	40	5	2.5		
ACS37010LLZATR-050B3	±50	26.4	3.3	1.65		
ACS37012LLZATR-030B5	±30	66.7	5	2.5		
ACS37012LLZATR-030U5	30	133.3	5	0.5		
ACS37012LLZATR-030B3	±30	44	3.3	1.65		
ACS37012LLZATR-050B5	±50	40	5	2.5		
ACS37012LLZATR-050B3	±50	26.4	3.3	1.65		

PART NAMING SPECIFICATION



ABSOLUTE MAXIMUM RATINGS [1]

Characteristic	Symbol	Notes	Min.	Max.	Unit
Supply Voltage	V_{DD}		–0.5	6.5	V
Output Voltage	V_O	Applies to V_{OUT}, V_{REF} or V_{FAULT}	–0.5	$(V_{DD} + 0.7) \leq 6.5$	V
Operating Ambient Temperature	T_A		–40	150	°C
Storage Temperature	T_{STG}		–65	165	°C
Maximum Junction Temperature	$T_{J(MAX)}$	Sensing range of sensor is limited by $T_{J(MAX)}$ = 165°C	–	165	°C

[1] Stresses above those listed under Absolute Maximum Ratings may cause permanent damage to the device. This is a stress rating only; functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum ratings for extended periods may affect device reliability.

LZ ISOLATION CHARACTERISTICS

Characteristic	Symbol	Notes	Value	Units
Withstand Strength [1][2]	V_{ISO}	Agency rated for 60 seconds per UL 62368-1 (edition 3)	3500	V_{RMS}
Working Voltage for Basic Isolation [2]	V_{WVBI}	Maximum approved working voltage for basic (single) isolation according to UL 62368-1 (edition 3)	1280	V_{PK} or V_{DC}
			905	V_{RMS}
Working Voltage for Reinforced Isolation [2]	V_{WVRI}	Maximum approved working voltage for reinforced isolation according to UL 62368-1 (edition 3)	717	V_{PK} or V_{DC}
			507	V_{RMS}
Surge Voltage	V_{SURGE}	1.2/50 µs waveform, tested in dielectric fluid to determine the intrinsic surge immunity of the isolation barrier	13000	V_{PK}
Impulse Withstand	$V_{IMPULSE}$	1.2/50µs waveform, tested in air	5000	V_{RMS}
Clearance	D_{CL}	Minimum distance through air from IP leads to signal leads	4.1	mm
Creepage	D_{CR}	Minimum distance along package body from IP leads to signal leads	4.1	mm
Distance Through Insulation	DTI	Minimum internal distance through insulation	54	µm
Comparative Tracking Index	CTI	Material Group I	>600	V

[1] Production tested in accordance UL 62368-1 (edition 3).
[2] Certification pending.

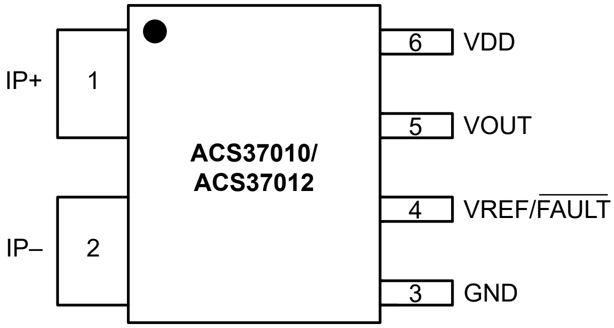
THERMAL CHARACTERISTICS

Characteristic	Symbol	Notes	Value	Unit
Package Thermal Resistance (Junction to Ambient)	$R_{\theta JA}$	Mounted on the standard LC/LZ Current Sensor Evaluation Board (ACSEVB-LC8-LZ6)	19	°C/W
Package Thermal Metric (Junction to Top)	Ψ_{JT}		0.5	°C/W
Package Thermal Resistance (Junction to Case)	$R_{\theta JC}$	Simulated per the methods in JESD51-1	23	°C/W
Package Thermal Resistance (Junction to Board)	$R_{\theta JB}$	Simulated per the methods in JESD51-8	12	°C/W

PACKAGE CHARACTERISTICS

Characteristic	Symbol	Notes	Min.	Typ.	Max.	Unit
Internal Conductor Resistance	R_{IC}	T_A = 25°C	–	0.68	–	mΩ
Internal Conductor Inductance	L_{IC}	T_A = 25°C	–	2.4	–	nH
Moisture Sensitivity Level	MSL	Per IPC/JEDEC J-STD-020	–	2	–	–

PINOUT DIAGRAM AND TERMINAL LIST TABLE



Pinout Diagram
Package LZ, 6-Pin SOIC

Terminal List Table

Number	Name	Description
1	IP+	Terminal for current being sensed
2	IP–	Terminal for current being sensed
3	GND	Device ground terminal
4	VREF/ FAULT	Zero current voltage reference (ACS37010) or overcurrent fault output (ACS37012)
5	VOUT	Analog output
6	VDD	Device power supply terminal

FUNCTIONAL BLOCK DIAGRAM

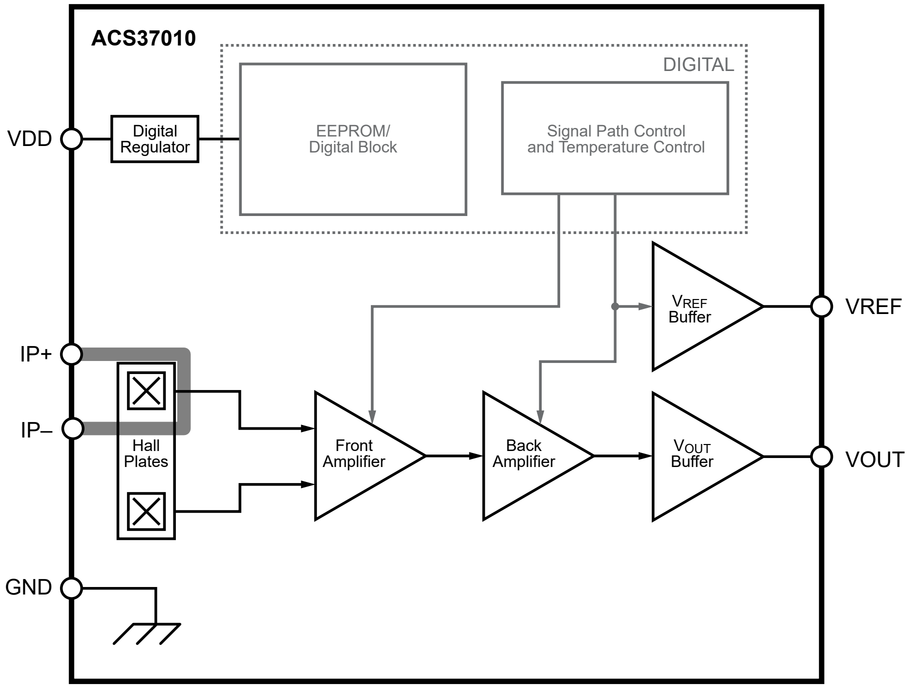


Figure 2: ACS37010 Functional Block Diagram

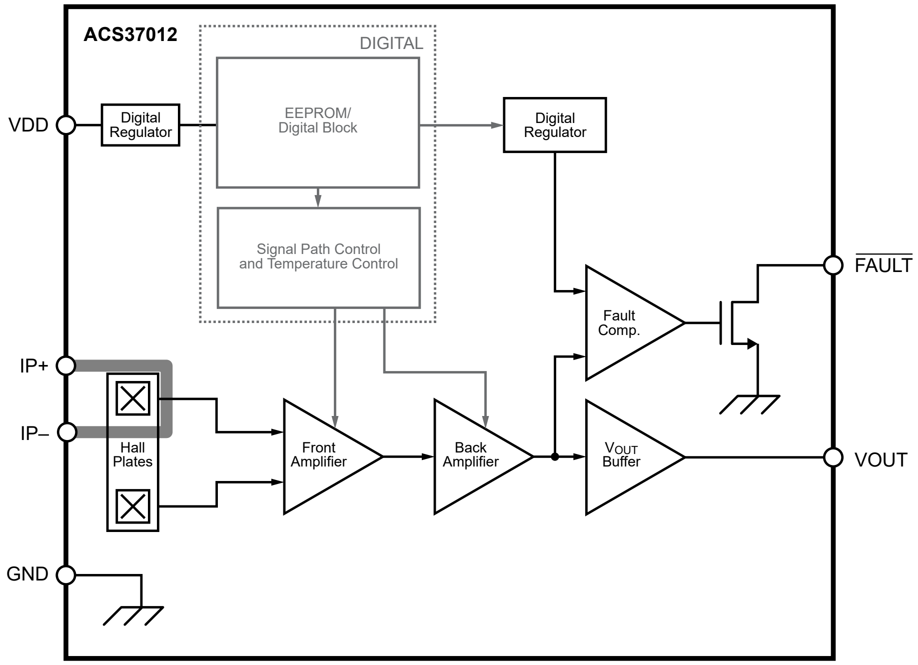


Figure 3: ACS37012 Functional Block Diagram

COMMON ELECTRICAL CHARACTERISTICS: Valid over full operating temperature range, T_A = –40°C to 150°C, C_{BYPASS} = 100 nF, and V_{DD} = 5 V or 3.3 V, unless otherwise specified

Characteristics	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Supply Voltage	V_{DD}	5 V variant	4.5	5	5.5	V
		3.3 V variant	3	3.3	3.6	V
Supply Current	I_{DD}	5 V variant, no load on VOUT or VREF	–	16	20	mA
		3.3 V variant, no load on VOUT or VREF	–	14	18	mA
Output Resistive Load [1]	C_{L_VOUT}		–	–	6	nF
Supply Bypass Capacitor	C_{BYPASS}		0.1	1	–	µF
Power-On Reset Release Voltage	V_{POR}	V_{DD} rising 1 V/ms	2.7	2.9	3	V
Power-On Reset Hysteresis	V_{POR_HYS}		250	300	500	mV
Power-On Time	t_{PO}	T_A = 25°C	–	65	–	µs
Undervoltage Detection Threshold [2]	V_{UVD}	T_A = 25°C, V_{DD} falling 1 V/ms	3.8	4.1	4.25	V
Undervoltage Detection Hysteresis [2]	V_{UVD_HYS}		200	250	400	mV
Undervoltage Detection Time [2]	t_{UVD}		–	70	200	µs
Undervoltage Detection Release Time [2]	t_{UVD_R}		–	6	–	µs
Overvoltage Detection Threshold	V_{OVD}	V_{DD} rising 1 V/ms	6.1	6.3	6.5	V
Overvoltage Detection Hysteresis	V_{OVD_HYS}	T_A = 25°C	400	500	600	mV
Overvoltage Detection Time	t_{OVD}		–	70	200	µs
Overvoltage Detection Release Time	t_{OVD_R}		–	3	–	µs
OUTPUT SIGNAL CHARACTERISTICS (VOUT)						
Rise Time	t_R	T_A = 25°C, C_{L_VOUT} = 6 nF, C_{BYPASS} = 1 µF	–	1	2.5	µs
Response Time	t_{RESP}	T_A = 25°C, C_{L_VOUT} = 6 nF, C_{BYPASS} = 1 µF	–	1.3	2.5	µs
Propagation Delay	t_{PD}	T_A = 25°C, C_{L_VOUT} = 6 nF, C_{BYPASS} = 1 µF	–	0.7	1.5	µs
Bandwidth	BW	T_A = 25°C, Small Signal –3 dB, C_{L_VOUT} = 6 nF, C_{BYPASS} = 1 µF	–	450	–	kHz
Noise Density	N_D	T_A = 25°C, C_{L_VOUT} = 6 nF, C_{BYPASS} = 1 µF, 5 V variant	–	150	–	µA/√Hz
		T_A = 25°C, C_{L_VOUT} = 6 nF, C_{BYPASS} = 1 µF, 3.3 V variant	–	230	–	µA/√Hz
Output Saturation Voltage [3]	V_{SAT_H}	R_{L_VOUT} = 10 kΩ to GND	V_{DD} – 0.25	–	–	V
	V_{SAT_L}	R_{L_VOUT} = 10 kΩ to VDD	–	–	0.15	V
Short-Circuit Current	I_{SC_VOUT}	T_A = 25°C, VOUT shorted to GND	–	25	–	mA
		T_A = 25°C, VOUT shorted to VDD	–	–25	–	mA
Common Mode Field Sensitivity	CMFS		–	4	–	mA/G

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COMMON ELECTRICAL CHARACTERISTICS (continued): Valid over full operating temperature range, T_A = –40°C to 150°C, C_{BYPASS} = 100 nF, and V_{DD} = 5 V or 3.3 V, unless otherwise specified

Characteristics	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
REFERENCE OUTPUT CHARACTERISTICS (VREF)[4]						
VREF Resistive Load	R_{L_VREF}	VREF to GND or VREF to VDD	10	–	–	kΩ
VREF Capacitive Load	C_{L_VREF}	VREF to GND	–	1	6	nF
VREF Short-Circuit Current	I_{SC_VREF}	VREF shorted to GND	–	25	–	mA
		VREF shorted to VDD	–	–25	–	mA
OVERCURRENT CHARACTERISTICS (FAULT)[5]						
Overcurrent Operating Point	I_{OC}	Internally set as a percent of full scale current	–	100	–	$\%I_{PR}$
FAULT Pull-Up Resistance	R_{L_FAULT}	FAULT to VDD	4.7	–	500	kΩ
Overcurrent Error	E_{OC}		–10	–	10	$\%I_{OC}$[6]
FAULT Output Low Voltage	V_{FAULT_L}	R_{L_FAULT} = 10 kΩ, fault condition present	–	–	0.4	V
FAULT Leakage Current	I_{FAULT_OFF}	R_{L_FAULT} = 10 kΩ, no fault condition present	–	100	500	nA
Overcurrent Hysteresis	I_{OC_HYS}		–	9.5	–	$\%I_{PR}$
Overcurrent Response Time	t_{OC_RESP}		–	1.7	2.7	µs

[1] Validated by design and characterization.
[2] Only enabled on 5 V devices.
[3] The sensor may continue to respond to current beyond the specified Current Sensing Range, I_{PR}, until the output saturates at the high or low saturation voltage; however, the linearity and performance beyond the specified Current Sensing Range are not validated.
[4] ACS37010 only.
[5] ACS37012 only.
[6] Where I_{OC} is the specific point at which the OCF trigger will occur.

ACS37010LLZATR-030B5 PERFORMANCE CHARACTERISTICS: Valid over full operating temperature range, T_A = –40°C to 150°C, C_{BYPASS} = 100 nF, and V_{DD} = 5 V, unless otherwise specified

Characteristic	Symbol	Test Conditions	Min.	Typ.[1]	Max.	Units
NOMINAL PERFORMANCE						
Current Sensing Range [2]	I_{PR}	Limited by $T_{J(MAX)}$ = 165°C	–30	–	30	A
Sensitivity	Sens	$I_{PR(MIN)} < I_P < I_{PR(MAX)}$	–	66.7	–	mV/A
Quiescent Voltage Output	V_{QVO}	I_P = 0 A	–	2.5	–	V
Reference Voltage Output	V_{REF}		–	2.5	–	V
ERROR COMPONENTS [1]						
Sensitivity Error	E_{SENS}	I_P = 0.5 × $I_{PR(MAX)}$, T_A = 25°C to 150°C	–1.5	±0.8	1.5	%
		I_P = 0.5 × $I_{PR(MAX)}$, T_A = –40°C to 25°C	–1.5	±0.8	1.5	%
Quiescent Voltage Output Error	V_{QVO_E}	I_P = 0 A, T_A = 25°C to 150°C	–8	±5	8	mV
		I_P = 0 A, T_A = –40°C to 25°C	–8	±5	8	mV
Reference Voltage Output Error	V_{REF_E}	T_A = 25°C to 150°C	–8	±5	8	mV
		T_A = –40°C to 25°C	–8	±5	8	mV
Offset Error	V_{OE}	I_P = 0 A, T_A = 25°C to 150°C	–4	±2	4	mV
		I_P = 0 A, T_A = –40°C to 25°C	–4	±2	4	mV
Noise	N	T_A = 25°C, C_{L_VOUT} = 6 nF, C_{BYPASS} = 1 µF, BW = 450 kHz	–	8.5	–	mV_{RMS}
Power Supply Sensitivity Error	E_{SENS_PS}	$V_{DD(MIN)}$ to $V_{DD(MAX)}$	–1.2	±0.7	1.2	%
Power Supply Quiescent Voltage Output Error	V_{QVO_PS}	$V_{DD(MIN)}$ to $V_{DD(MAX)}$	–9	±6	9	mV
Power Supply Reference Voltage Output Error	V_{REF_PS}	$V_{DD(MIN)}$ to $V_{DD(MAX)}$	–9	±6	9	mV
Power Supply Offset Error	V_{OE_PS}	$V_{DD(MIN)}$ to $V_{DD(MAX)}$	–8	±5	8	mV
ERROR COMPONENTS INCLUDING LIFETIME DRIFT [2][3]						
Sensitivity Error Including Lifetime Drift	E_{SENS_LTD}	I_P = 0.5 × $I_{PR(MAX)}$, T_A = 25°C to 150°C	–2.5	–	2.5	%
		I_P = 0.5 × $I_{PR(MAX)}$, T_A = –40°C to 25°C	–3.5	–	3.5	%
Quiescent Voltage Output Error Including Lifetime Drift	V_{QVO_LTD}	I_P = 0 A, T_A = 25°C to 150°C	–10	–	10	mV
		I_P = 0 A, T_A = –40°C to 25°C	–10	–	10	mV
Reference Voltage Output Error Including Lifetime Drift	V_{REF_LTD}	T_A = 25°C to 150°C	–10	–	10	mV
		T_A = –40°C to 25°C	–10	–	10	mV
Offset Error Including Lifetime Drift	V_{OE_LTD}	I_P = 0 A, T_A = 25°C to 150°C	–3	–	3	mV
		I_P = 0 A, T_A = –40°C to 25°C	–3	–	3	mV

[1] Typical values are the mean ±3 sigma of production distributions.
[2] Validated by design and characterization.
[3] Lifetime drift minimum/maximum values are ±3 sigma, and are based on a statistical combination of production distributions and worst-case drift distributions observed after AEC-Q100 qualification stresses.

ACS37010LLZATR-030U5 PERFORMANCE CHARACTERISTICS: Valid over full operating temperature range, T_A = –40°C to 150°C, C_{BYPASS} = 100 nF, and V_{DD} = 5 V, unless otherwise specified

Characteristic	Symbol	Test Conditions	Min.	Typ.[1]	Max.	Units
NOMINAL PERFORMANCE						
Current Sensing Range [2]	I_{PR}	Limited by $T_{J(MAX)}$ = 165°C	0	–	30	A
Sensitivity	Sens	$I_{PR(MIN)} < I_P < I_{PR(MAX)}$	–	133.3	–	mV/A
Quiescent Voltage Output	V_{QVO}	I_P = 0 A	–	0.5	–	V
Reference Voltage Output	V_{REF}		–	0.5	–	V
ERROR COMPONENTS [1]						
Sensitivity Error	E_{SENS}	I_P = 0.5 × $I_{PR(MAX)}$, T_A = 25°C to 150°C	–1.5	±1	1.5	%
		I_P = 0.5 × $I_{PR(MAX)}$, T_A = –40°C to 25°C	–1.5	±1	1.5	%
Quiescent Voltage Output Error	V_{QVO_E}	I_P = 0 A, T_A = 25°C to 150°C	–8	±5	8	mV
		I_P = 0 A, T_A = –40°C to 25°C	–8	±5	8	mV
Reference Voltage Output Error	V_{REF_E}	T_A = 25°C to 150°C	–8	±5	8	mV
		T_A = –40°C to 25°C	–8	±5	8	mV
Offset Error	V_{OE}	I_P = 0 A, T_A = 25°C to 150°C	–4	±3	4	mV
		I_P = 0 A, T_A = –40°C to 25°C	–4	±3	4	mV
Noise	N	T_A = 25°C, C_{L_VOUT} = 6 nF, C_{BYPASS} = 1 µF, BW = 450 kHz	–	17	–	mV_{RMS}
Power Supply Sensitivity Error	E_{SENS_PS}	$V_{DD(MIN)}$ to $V_{DD(MAX)}$	–1.2	±0.8	1.2	%
Power Supply Quiescent Voltage Output Error	V_{QVO_PS}	$V_{DD(MIN)}$ to $V_{DD(MAX)}$	–9	±6	9	mV
Power Supply Reference Voltage Output Error	V_{REF_PS}	$V_{DD(MIN)}$ to $V_{DD(MAX)}$	–9	±6	9	mV
Power Supply Offset Error	V_{OE_PS}	$V_{DD(MIN)}$ to $V_{DD(MAX)}$	–8	±5	8	mV
ERROR COMPONENTS INCLUDING LIFETIME DRIFT [2][3]						
Sensitivity Error Including Lifetime Drift	E_{SENS_LTD}	I_P = 0.5 × $I_{PR(MAX)}$, T_A = 25°C to 150°C	–2.5	–	2.5	%
		I_P = 0.5 × $I_{PR(MAX)}$, T_A = –40°C to 25°C	–3.5	–	3.5	%
Quiescent Voltage Output Error Including Lifetime Drift	V_{QVO_LTD}	I_P = 0 A, T_A = 25°C to 150°C	–10	–	10	mV
		I_P = 0 A, T_A = –40°C to 25°C	–10	–	10	mV
Reference Voltage Output Error Including Lifetime Drift	V_{REF_LTD}	T_A = 25°C to 150°C	–10	–	10	mV
		T_A = –40°C to 25°C	–10	–	10	mV
Offset Error Including Lifetime Drift	V_{OE_LTD}	I_P = 0 A, T_A = 25°C to 150°C	–4	–	4	mV
		I_P = 0 A, T_A = –40°C to 25°C	–4	–	4	mV

[1] Typical values are the mean ±3 sigma of production distributions.
[2] Validated by design and characterization.
[3] Lifetime drift minimum/maximum values are ±3 sigma, and are based on a statistical combination of production distributions and worst-case drift distributions observed after AEC-Q100 qualification stresses.

ACS37010LLZATR-030B3 PERFORMANCE CHARACTERISTICS: Valid over full operating temperature range, T_A = –40°C to 150°C, C_{BYPASS} = 100 nF, and V_{DD} = 3.3 V, unless otherwise specified

Characteristic	Symbol	Test Conditions	Min.	Typ.[1]	Max.	Units
NOMINAL PERFORMANCE						
Current Sensing Range [2]	I_{PR}	Limited by $T_{J(MAX)}$ = 165°C	–30	–	30	A
Sensitivity	Sens	$I_{PR(MIN)} < I_P < I_{PR(MAX)}$	–	44	–	mV/A
Quiescent Voltage Output	V_{QVO}	I_P = 0 A	–	1.65	–	V
Reference Voltage Output	V_{REF}		–	1.65	–	V
ERROR COMPONENTS [1]						
Sensitivity Error	E_{SENS}	I_P = 0.5 × $I_{PR(MAX)}$, T_A = 25°C to 150°C	–1.5	±1	1.5	%
		I_P = 0.5 × $I_{PR(MAX)}$, T_A = –40°C to 25°C	–1.5	±1	1.5	%
Quiescent Voltage Output Error	V_{QVO_E}	I_P = 0 A, T_A = 25°C to 150°C	–8	±4	8	mV
		I_P = 0 A, T_A = –40°C to 25°C	–8	±4	8	mV
Reference Voltage Output Error	V_{REF_E}	T_A = 25°C to 150°C	–8	±4	8	mV
		T_A = –40°C to 25°C	–8	±4	8	mV
Offset Error	V_{OE}	I_P = 0 A, T_A = 25°C to 150°C	–3	±1.5	3	mV
		I_P = 0 A, T_A = –40°C to 25°C	–3	±2	3	mV
Noise	N	T_A = 25°C, C_{L_VOUT} = 6 nF, C_{BYPASS} = 1 µF, BW = 450 kHz	–	8.5	–	mV_{RMS}
Power Supply Sensitivity Error	E_{SENS_PS}	$V_{DD(MIN)}$ to $V_{DD(MAX)}$	–1.4	±1.2	1.4	%
Power Supply Quiescent Voltage Output Error	V_{QVO_PS}	$V_{DD(MIN)}$ to $V_{DD(MAX)}$	–6	±3	6	mV
Power Supply Reference Voltage Output Error	V_{REF_PS}	$V_{DD(MIN)}$ to $V_{DD(MAX)}$	–6	±3	6	mV
Power Supply Offset Error	V_{OE_PS}	$V_{DD(MIN)}$ to $V_{DD(MAX)}$	–6	±3	6	mV
ERROR COMPONENTS INCLUDING LIFETIME DRIFT [2][3]						
Sensitivity Error Including Lifetime Drift	E_{SENS_LTD}	I_P = 0.5 × $I_{PR(MAX)}$, T_A = 25°C to 150°C	–2.5	–	2.5	%
		I_P = 0.5 × $I_{PR(MAX)}$, T_A = –40°C to 25°C	–3.5	–	3.5	%
Quiescent Voltage Output Error Including Lifetime Drift	V_{QVO_LTD}	I_P = 0 A, T_A = 25°C to 150°C	–10	–	10	mV
		I_P = 0 A, T_A = –40°C to 25°C	–10	–	10	mV
Reference Voltage Output Error Including Lifetime Drift	V_{REF_LTD}	T_A = 25°C to 150°C	–10	–	10	mV
		T_A = –40°C to 25°C	–10	–	10	mV
Offset Error Including Lifetime Drift	V_{OE_LTD}	I_P = 0 A, T_A = 25°C to 150°C	–3	–	3	mV
		I_P = 0 A, T_A = –40°C to 25°C	–3	–	3	mV

[1] Typical values are the mean ±3 sigma of production distributions.
[2] Validated by design and characterization.
[3] Lifetime drift minimum/maximum values are ±3 sigma, and are based on a statistical combination of production distributions and worst-case drift distributions observed after AEC-Q100 qualification stresses.

ACS37010LLZATR-050B5 PERFORMANCE CHARACTERISTICS: Valid over full operating temperature range, T_A = –40°C to 150°C, C_{BYPASS} = 100 nF, and V_{DD} = 5 V, unless otherwise specified

Characteristic	Symbol	Test Conditions	Min.	Typ.[1]	Max.	Units
NOMINAL PERFORMANCE						
Current Sensing Range [2]	I_{PR}	Limited by $T_{J(MAX)}$ = 165°C	–50	–	50	A
Sensitivity	Sens	$I_{PR(MIN)} < I_P < I_{PR(MAX)}$	–	40	–	mV/A
Quiescent Voltage Output	V_{QVO}	I_P = 0 A	–	2.5	–	V
Reference Voltage Output	V_{REF}		–	2.5	–	V
ERROR COMPONENTS [1]						
Sensitivity Error	E_{SENS}	I_P = 0.5 × $I_{PR(MAX)}$, T_A = 25°C to 150°C	–1.5	±1.1	1.5	%
		I_P = 0.5 × $I_{PR(MAX)}$, T_A = –40°C to 25°C	–1.5	±1.1	1.5	%
Quiescent Voltage Output Error	V_{QVO_E}	I_P = 0 A, T_A = 25°C to 150°C	–8	±5	8	mV
		I_P = 0 A, T_A = –40°C to 25°C	–8	±5	8	mV
Reference Voltage Output Error	V_{REF_E}	T_A = 25°C to 150°C	–8	±5	8	mV
		T_A = –40°C to 25°C	–8	±5	8	mV
Offset Error	V_{OE}	I_P = 0 A, T_A = 25°C to 150°C	–4	±2	4	mV
		I_P = 0 A, T_A = –40°C to 25°C	–4	±2	4	mV
Noise	N	T_A = 25°C, C_{L_VOUT} = 6 nF, C_{BYPASS} = 1 µF, BW = 450 kHz	–	5	–	mV_{RMS}
Power Supply Sensitivity Error	E_{SENS_PS}	$V_{DD(MIN)}$ to $V_{DD(MAX)}$	–1.2	±0.8	1.2	%
Power Supply Quiescent Voltage Output Error	V_{QVO_PS}	$V_{DD(MIN)}$ to $V_{DD(MAX)}$	–9	±6	9	mV
Power Supply Reference Voltage Output Error	V_{REF_PS}	$V_{DD(MIN)}$ to $V_{DD(MAX)}$	–9	±6	9	mV
Power Supply Offset Error	V_{OE_PS}	$V_{DD(MIN)}$ to $V_{DD(MAX)}$	–8	±5	8	mV
ERROR COMPONENTS INCLUDING LIFETIME DRIFT [2][3]						
Sensitivity Error Including Lifetime Drift	E_{SENS_LTD}	I_P = 0.5 × $I_{PR(MAX)}$, T_A = 25°C to 150°C	–3	–	3	%
		I_P = 0.5 × $I_{PR(MAX)}$, T_A = –40°C to 25°C	–3.5	–	3.5	%
Quiescent Voltage Output Error Including Lifetime Drift	V_{QVO_LTD}	I_P = 0 A, T_A = 25°C to 150°C	–15	–	15	mV
		I_P = 0 A, T_A = –40°C to 25°C	–15	–	15	mV
Reference Voltage Output Error Including Lifetime Drift	V_{REF_LTD}	T_A = 25°C to 150°C	–15	–	15	mV
		T_A = –40°C to 25°C	–15	–	15	mV
Offset Error Including Lifetime Drift	V_{OE_LTD}	I_P = 0 A, T_A = 25°C to 150°C	–3	–	3	mV
		I_P = 0 A, T_A = –40°C to 25°C	–3	–	3	mV

[1] Typical values are the mean ±3 sigma of production distributions.
[2] Validated by design and characterization.
[3] Lifetime drift minimum/maximum values are ±3 sigma, and are based on a statistical combination of production distributions and worst-case drift distributions observed after AEC-Q100 qualification stresses.

ACS37010LLZATR-050B3 PERFORMANCE CHARACTERISTICS: Valid over full operating temperature range, T_A = –40°C to 150°C, C_{BYPASS} = 100 nF, and V_{DD} = 3.3 V, unless otherwise specified

Characteristic	Symbol	Test Conditions	Min.	Typ.[1]	Max.	Units
NOMINAL PERFORMANCE						
Current Sensing Range [2]	I_{PR}	Limited by $T_{J(MAX)}$ = 165°C	–50	–	50	A
Sensitivity	Sens	$I_{PR(MIN)} < I_P < I_{PR(MAX)}$	–	26.4	–	mV/A
Quiescent Voltage Output	V_{QVO}	I_P = 0 A	–	1.65	–	V
Reference Voltage Output	V_{REF}		–	1.65	–	V
ERROR COMPONENTS [1]						
Sensitivity Error	E_{SENS}	I_P = 0.5 × $I_{PR(MAX)}$, T_A = 25°C to 150°C	–1.5	±1.1	1.5	%
		I_P = 0.5 × $I_{PR(MAX)}$, T_A = –40°C to 25°C	–1.5	±1	1.5	%
Quiescent Voltage Output Error	V_{QVO_E}	I_P = 0 A, T_A = 25°C to 150°C	–8	±4	8	mV
		I_P = 0 A, T_A = –40°C to 25°C	–8	±4	8	mV
Reference Voltage Output Error	V_{REF_E}	T_A = 25°C to 150°C	–8	±4	8	mV
		T_A = –40°C to 25°C	–8	±4	8	mV
Offset Error	V_{OE}	I_P = 0 A, T_A = 25°C to 150°C	–3	±1.5	3	mV
		I_P = 0 A, T_A = –40°C to 25°C	–3	±1.5	3	mV
Noise	N	T_A = 25°C, C_{L_VOUT} = 6 nF, C_{BYPASS} = 1 µF, BW = 450 kHz	–	5	–	mV_{RMS}
Power Supply Sensitivity Error	E_{SENS_PS}	$V_{DD(MIN)}$ to $V_{DD(MAX)}$	–1.4	±1.1	1.4	%
Power Supply Quiescent Voltage Output Error	V_{QVO_PS}	$V_{DD(MIN)}$ to $V_{DD(MAX)}$	–6	±3	6	mV
Power Supply Reference Voltage Output Error	V_{REF_PS}	$V_{DD(MIN)}$ to $V_{DD(MAX)}$	–6	±3	6	mV
Power Supply Offset Error	V_{OE_PS}	$V_{DD(MIN)}$ to $V_{DD(MAX)}$	–6	±3	6	mV
ERROR COMPONENTS INCLUDING LIFETIME DRIFT [2][3]						
Sensitivity Error Including Lifetime Drift	E_{SENS_LTD}	I_P = 0.5 × $I_{PR(MAX)}$, T_A = 25°C to 150°C	–2.5	–	2.5	%
		I_P = 0.5 × $I_{PR(MAX)}$, T_A = –40°C to 25°C	–3.5	–	3.5	%
Quiescent Voltage Output Error Including Lifetime Drift	V_{QVO_LTD}	I_P = 0 A, T_A = 25°C to 150°C	–13	–	13	mV
		I_P = 0 A, T_A = –40°C to 25°C	–13	–	13	mV
Reference Voltage Output Error Including Lifetime Drift	V_{REF_LTD}	T_A = 25°C to 150°C	–13	–	13	mV
		T_A = –40°C to 25°C	–13	–	13	mV
Offset Error Including Lifetime Drift	V_{OE_LTD}	I_P = 0 A, T_A = 25°C to 150°C	–3	–	3	mV
		I_P = 0 A, T_A = –40°C to 25°C	–3	–	3	mV

[1] Typical values are the mean ±3 sigma of production distributions.
[2] Validated by design and characterization.
[3] Lifetime drift minimum/maximum values are ±3 sigma, and are based on a statistical combination of production distributions and worst-case drift distributions observed after AEC-Q100 qualification stresses.

ACS37012LLZATR-030B5 PERFORMANCE CHARACTERISTICS: Valid over full operating temperature range, T_A = –40°C to 150°C, C_{BYPASS} = 100 nF, and V_{DD} = 5 V, unless otherwise specified

Characteristic	Symbol	Test Conditions	Min.	Typ.[1]	Max.	Units
NOMINAL PERFORMANCE						
Current Sensing Range [2]	I_{PR}	Limited by $T_{J(MAX)}$ = 165°C	–30	–	30	A
Sensitivity	Sens	$I_{PR(MIN)} < I_P < I_{PR(MAX)}$	–	66.7	–	mV/A
Quiescent Voltage Output	V_{QVO}	I_P = 0 A	–	2.5	–	V
Overcurrent FAULT Threshold	I_{OC}		–	100	–	$\%I_{PR}$
Overcurrent FAULT Hysteresis	I_{OC_HYS}		–	2.9	–	A
FAULT ERROR						
Overcurrent Error	I_{OC_E}		–3	–	3	A
ERROR COMPONENTS [1]						
Sensitivity Error	E_{SENS}	$I_P = 0.5 \times I_{PR(MAX)}$, T_A = 25°C to 150°C	–1.5	±0.8	1.5	%
		$I_P = 0.5 \times I_{PR(MAX)}$, T_A = –40°C to 25°C	–1.5	±0.8	1.5	%
Quiescent Voltage Output Error	V_{QVO_E}	I_P = 0 A, T_A = 25°C to 150°C	–8	±5	8	mV
		I_P = 0 A, T_A = –40°C to 25°C	–8	±5	8	mV
Noise	N	T_A = 25°C, C_{L_VOUT} = 6 nF, C_{BYPASS} = 1 µF, BW = 450 kHz	–	8.5	–	mV_{RMS}
Power Supply Sensitivity Error	E_{SENS_PS}	$V_{DD(MIN)}$ to $V_{DD(MAX)}$	–1.2	±0.7	1.2	%
Power Supply Quiescent Voltage Output Error	V_{QVO_PS}	$V_{DD(MIN)}$ to $V_{DD(MAX)}$	–9	±6	9	mV
ERROR COMPONENTS INCLUDING LIFETIME DRIFT [2][3]						
Sensitivity Error Including Lifetime Drift	E_{SENS_LTD}	$I_P = 0.5 \times I_{PR(MAX)}$, T_A = 25°C to 150°C	–2.5	–	2.5	%
		$I_P = 0.5 \times I_{PR(MAX)}$, T_A = –40°C to 25°C	–3.5	–	3.5	%
Quiescent Voltage Output Error Including Lifetime Drift	V_{QVO_LTD}	I_P = 0 A, T_A = 25°C to 150°C	–10	–	10	mV
		I_P = 0 A, T_A = –40°C to 25°C	–10	–	10	mV

[1] Typical values are the mean ±3 sigma of production distributions.
[2] Validated by design and characterization.
[3] Lifetime drift minimum/maximum values are ±3 sigma, and are based on a statistical combination of production distributions and worst-case drift distributions observed after AEC-Q100 qualification stresses.

ACS37012LLZATR-030B3 PERFORMANCE CHARACTERISTICS: Valid over full operating temperature range, T_A = –40°C to 150°C, C_{BYPASS} = 100 nF, and V_{DD} = 3.3 V, unless otherwise specified

Characteristic	Symbol	Test Conditions	Min.	Typ.[1]	Max.	Units
NOMINAL PERFORMANCE						
Current Sensing Range [2]	I_{PR}	Limited by $T_{J(MAX)}$ = 165°C	–30	–	30	A
Sensitivity	Sens	$I_{PR(MIN)} < I_P < I_{PR(MAX)}$	–	44	–	mV/A
Quiescent Voltage Output	V_{QVO}	I_P = 0 A	–	1.65	–	V
Overcurrent FAULT Threshold	I_{OC}		–	100	–	$\%I_{PR}$
Overcurrent FAULT Hysteresis	I_{OC_HYS}		–	2.9	–	A
FAULT ERROR						
Overcurrent Error	I_{OC_E}		–3	–	3	A
ERROR COMPONENTS [1]						
Sensitivity Error	E_{SENS}	$I_P = 0.5 \times I_{PR(MAX)}$, T_A = 25°C to 150°C	–1.5	±1	1.5	%
		$I_P = 0.5 \times I_{PR(MAX)}$, T_A = –40°C to 25°C	–1.5	±1	1.5	%
Quiescent Voltage Output Error	V_{QVO_E}	I_P = 0 A, T_A = 25°C to 150°C	–8	±4	8	mV
		I_P = 0 A, T_A = –40°C to 25°C	–8	±4	8	mV
Noise	N	T_A = 25°C, C_{L_VOUT} = 6 nF, C_{BYPASS} = 1 µF, BW = 450 kHz	–	8.5	–	mV_{RMS}
Power Supply Sensitivity Error	E_{SENS_PS}	$V_{DD(MIN)}$ to $V_{DD(MAX)}$	–1.4	±1.2	1.4	%
Power Supply Quiescent Voltage Output Error	V_{QVO_PS}	$V_{DD(MIN)}$ to $V_{DD(MAX)}$	–6	±3	6	mV
ERROR COMPONENTS INCLUDING LIFETIME DRIFT [2][3]						
Sensitivity Error Including Lifetime Drift	E_{SENS_LTD}	$I_P = 0.5 \times I_{PR(MAX)}$, T_A = 25°C to 150°C	–2.5	–	2.5	%
		$I_P = 0.5 \times I_{PR(MAX)}$, T_A = –40°C to 25°C	–3.5	–	3.5	%
Quiescent Voltage Output Error Including Lifetime Drift	V_{QVO_LTD}	I_P = 0 A, T_A = 25°C to 150°C	–10	–	10	mV
		I_P = 0 A, T_A = –40°C to 25°C	–10	–	10	mV

[1] Typical values are the mean ±3 sigma of production distributions.
[2] Validated by design and characterization.
[3] Lifetime drift minimum/maximum values are ±3 sigma, and are based on a statistical combination of production distributions and worst-case drift distributions observed after AEC-Q100 qualification stresses.

ACS37012LLZATR-050B5 PERFORMANCE CHARACTERISTICS: Valid over full operating temperature range, T_A = –40°C to 150°C, C_{BYPASS} = 100 nF, and V_{DD} = 5 V, unless otherwise specified

Characteristic	Symbol	Test Conditions	Min.	Typ.[1]	Max.	Units
NOMINAL PERFORMANCE						
Current Sensing Range [2]	I_{PR}	Limited by $T_{J(MAX)}$ = 165°C	–50	–	50	A
Sensitivity	Sens	$I_{PR(MIN)} < I_P < I_{PR(MAX)}$	–	40	–	mV/A
Quiescent Voltage Output	V_{QVO}	I_P = 0 A	–	2.5	–	V
Overcurrent FAULT Threshold	I_{OC}		–	100	–	$\%I_{PR}$
Overcurrent FAULT Hysteresis	I_{OC_HYS}		–	4.8	–	A
FAULT ERROR						
Overcurrent Error	I_{OC_E}		–5	–	5	A
ERROR COMPONENTS [1]						
Sensitivity Error	E_{SENS}	$I_P = 0.5 \times I_{PR(MAX)}$, T_A = 25°C to 150°C	–1.5	±1.1	1.5	%
		$I_P = 0.5 \times I_{PR(MAX)}$, T_A = –40°C to 25°C	–1.5	±1.1	1.5	%
Quiescent Voltage Output Error	V_{QVO_E}	I_P = 0 A, T_A = 25°C to 150°C	–8	±5	8	mV
		I_P = 0 A, T_A = –40°C to 25°C	–8	±5	8	mV
Noise	N	T_A = 25°C, C_{L_VOUT} = 6 nF, C_{BYPASS} = 1 µF, BW = 450 kHz	–	5	–	mV_{RMS}
Power Supply Sensitivity Error	E_{SENS_PS}	$V_{DD(MIN)}$ to $V_{DD(MAX)}$	–1.2	±0.8	1.2	%
Power Supply Quiescent Voltage Output Error	V_{QVO_PS}	$V_{DD(MIN)}$ to $V_{DD(MAX)}$	–9	±6	9	mV
ERROR COMPONENTS INCLUDING LIFETIME DRIFT [2][3]						
Sensitivity Error Including Lifetime Drift	E_{SENS_LTD}	$I_P = 0.5 \times I_{PR(MAX)}$, T_A = 25°C to 150°C	–3	–	3	%
		$I_P = 0.5 \times I_{PR(MAX)}$, T_A = –40°C to 25°C	–3.5	–	3.5	%
Quiescent Voltage Output Error Including Lifetime Drift	V_{QVO_LTD}	I_P = 0 A, T_A = 25°C to 150°C	–15	–	15	mV
		I_P = 0 A, T_A = –40°C to 25°C	–15	–	15	mV

[1] Typical values are the mean ±3 sigma of production distributions.
[2] Validated by design and characterization.
[3] Lifetime drift minimum/maximum values are ±3 sigma, and are based on a statistical combination of production distributions and worst-case drift distributions observed after AEC-Q100 qualification stresses.

ACS37012LLZATR-050B3 PERFORMANCE CHARACTERISTICS: Valid over full operating temperature range, T_A = –40°C to 150°C, C_{BYPASS} = 100 nF, and V_{DD} = 3.3 V, unless otherwise specified

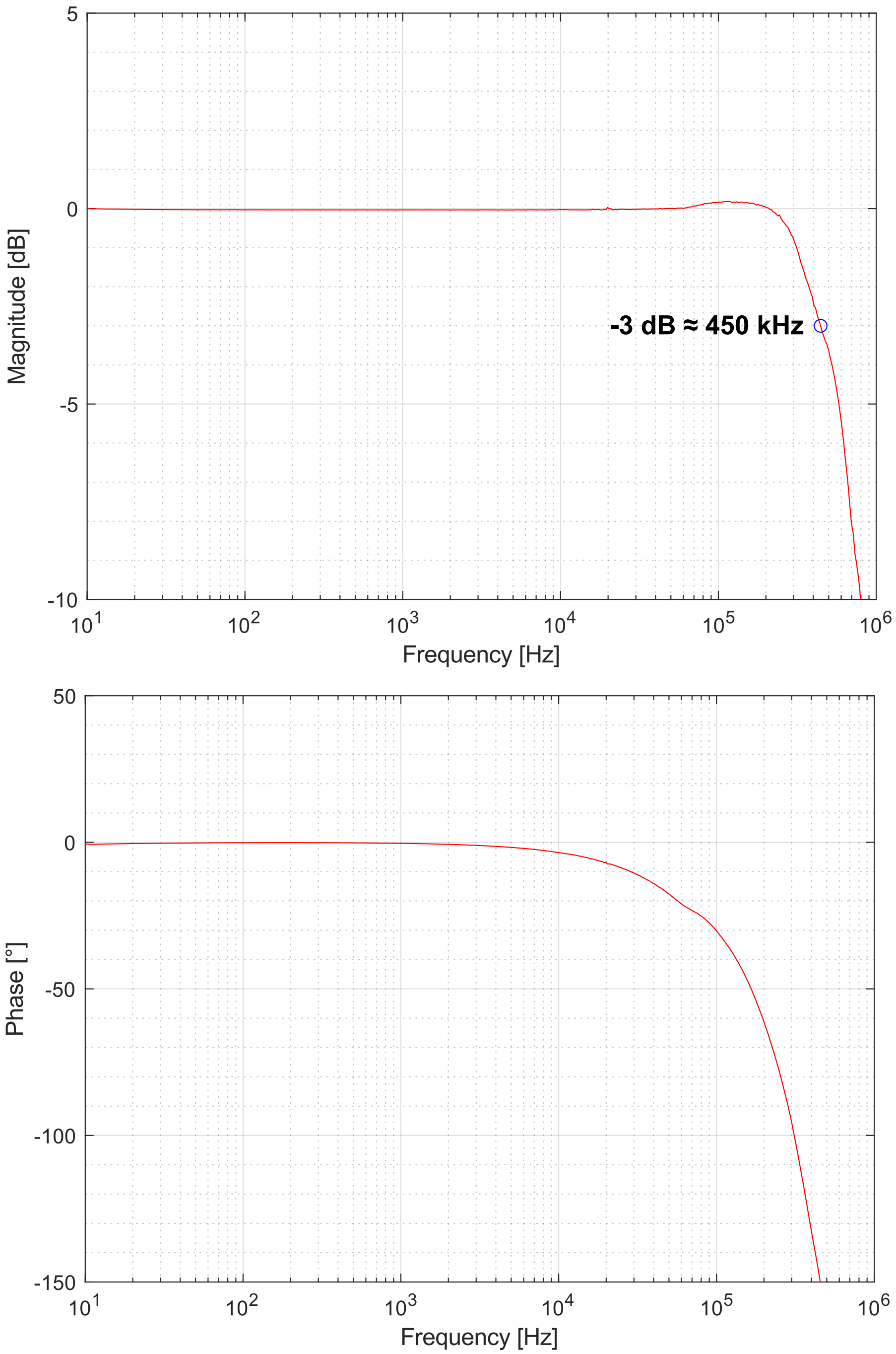
Characteristic	Symbol	Test Conditions	Min.	Typ.[1]	Max.	Units
NOMINAL PERFORMANCE						
Current Sensing Range [2]	I_{PR}	Limited by $T_{J(MAX)}$ = 165°C	–50	–	50	A
Sensitivity	Sens	$I_{PR(MIN)} < I_P < I_{PR(MAX)}$	–	26.4	–	mV/A
Quiescent Voltage Output	V_{QVO}	I_P = 0 A	–	1.65	–	V
Overcurrent FAULT Threshold	I_{OC}		–	100	–	$\%I_{PR}$
Overcurrent FAULT Hysteresis	I_{OC_HYS}		–	4.8	–	A
FAULT ERROR						
Overcurrent Error	I_{OC_E}		–5	–	5	A
ERROR COMPONENTS						
Sensitivity Error	E_{SENS}	I_P = 0.5 × $I_{PR(MAX)}$, T_A = 25°C to 150°C	–1.5	±1.1	1.5	%
		I_P = 0.5 × $I_{PR(MAX)}$, T_A = –40°C to 25°C	–1.5	±1	1.5	%
Quiescent Voltage Output Error	V_{QVO_E}	I_P = 0 A, T_A = 25°C to 150°C	–8	±4	8	mV
		I_P = 0 A, T_A = –40°C to 25°C	–8	±4	8	mV
Noise	N	T_A = 25°C, C_{L_VOUT} = 6 nF, C_{BYPASS} = 1 µF, BW = 450 kHz	–	5	–	mV_{RMS}
Power Supply Sensitivity Error	E_{SENS_PS}	$V_{DD(MIN)}$ to $V_{DD(MAX)}$	–1.4	±1.1	1.4	%
Power Supply Quiescent Voltage Output Error	V_{QVO_PS}	$V_{DD(MIN)}$ to $V_{DD(MAX)}$	–6	±3	6	mV
ERROR COMPONENTS INCLUDING LIFETIME DRIFT [2][3]						
Sensitivity Error Including Lifetime Drift	E_{SENS_LTD}	I_P = 0.5 × $I_{PR(MAX)}$, T_A = 25°C to 150°C	–2.5	–	2.5	%
		I_P = 0.5 × $I_{PR(MAX)}$, T_A = –40°C to 25°C	–3.5	–	3.5	%
Quiescent Voltage Output Error Including Lifetime Drift	V_{QVO_LTD}	I_P = 0 A, T_A = 25°C to 150°C	–13	–	13	mV
		I_P = 0 A, T_A = –40°C to 25°C	–13	–	13	mV

[1] Typical values are the mean ±3 sigma of production distributions.

[2] Validated by design and characterization.

[3] Lifetime drift minimum/maximum values are ±3 sigma, and are based on a statistical combination of production distributions and worst-case drift distributions observed after AEC-Q100 qualification stresses.

CHARACTERISTIC PERFORMANCE
ACS37010 AND ACS37012 TYPICAL FREQUENCY RESPONSE



RESPONSE CHARACTERISTICS DEFINITIONS AND TYPICAL PERFORMANCE DATA

Response Time ($t_{RESPONSE}$)

The time interval between a) when the sensed input current reaches 90% of its final value, and b) when the sensor output reaches 90% of its full-scale value.

Propagation Delay (t_{pd})

The time interval between a) when the sensed input current reaches 20% of its full-scale value, and b) when the sensor output reaches 20% of its full-scale value.

Rise Time (t_r)

The time interval between a) when the sensor reaches 10% of its full-scale value, and b) when it reaches 90% of its full-scale value.

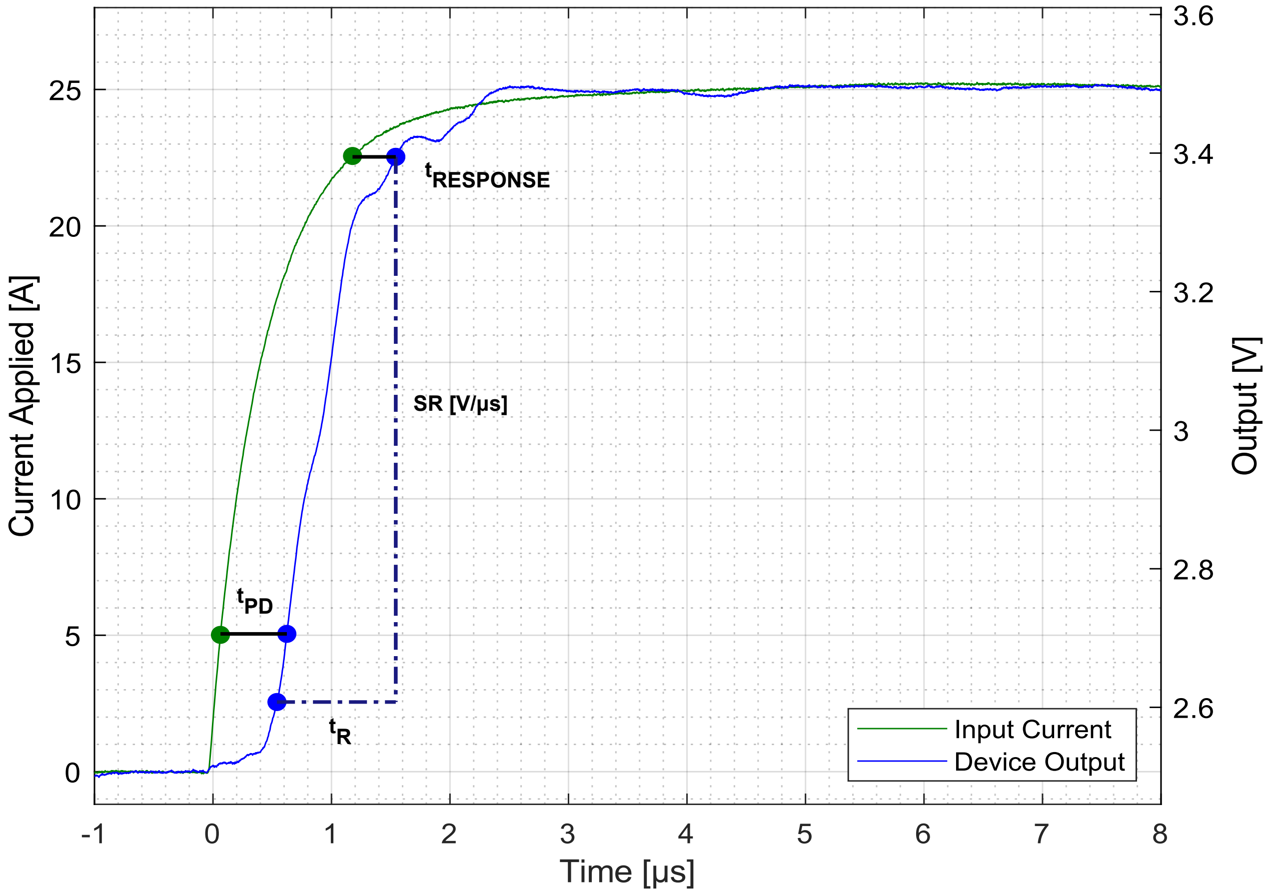
Output Slew Rate (SR)

The rate of change [V/µs] in the output voltage from a) when the sensor reaches 10% of its full-scale value, and b) when it reaches 90% of its full-scale value.

Response Time, Propagation Delay, Rise Time, and Output Slew Rate

Applied current step with 10% to 90% rise time = 1 µs

Test Conditions: T_A = 25°C, C_{BYPASS} = 1 µF, C_{L_VOUT} = 6 nF



FUNCTIONAL DESCRIPTION OF POWER ON/OFF OPERATION

Introduction

To ensure that the device output is reporting accurately, the ACS37010/12 contains an overvoltage and an undervoltage detection flag. This internal flag on V_{OUT} can be used to alert the system when the supply voltage for the device is outside of the operational range by putting the output into a known high-impedance (high Z) state. UVD is only active on 5 V devices.

The provided graphs in this section show V_{OUT} moving with V_{DD}. The voltage of V_{OUT} during a high-impedance state will be most consistent with a known load (R_{L_VOUT}, C_{L_VOUT}). All figures below all use the same labeling scheme for different power thresholds. References in brackets "[ ]" are valid for each of these plots.

Note: when VREF is mentioned, this only applies to the ACS37010.

POWER-ON OPERATION

UVD Enabled

When UVD is enabled, as V_{DD} ramps up, the AC37010 V_{OUT} and V_{REF} pins are high Z until V_{DD} reaches and passes V_{UVD} [2]. Once V_{DD} passes [2], the device takes some time without V_{DD} dropping below $V_{POR} - V_{POR\_HYS}$ [8] before the device enters normal operation.

UVD Disabled

When UVD is disabled, as V_{DD} ramps up, the AC37010 V_{OUT} and V_{REF} pins are high Z until V_{DD} reaches and passes V_{POR} [1]. Once V_{DD} has passed V_{POR} [1], V_{OUT} enters normal operation.

POWER-OFF OPERATION

UVD Enabled

When UVD is enabled, before the device powers off, it will force V_{OUT} to GND if V_{DD} reaches less than $V_{UVD} - V_{UVD\_HYS}$ [6]. When $V_{POR} - V_{POR\_HYS}$ [8] is reached, V_{OUT} and V_{REF} will go high Z.

UVD Disabled

When UVD is disabled, V_{REF} and V_{OUT} continue to report until V_{DD} is less than $V_{POR} - V_{POR\_HYS}$ [8], at which point, V_{OUT} and V_{REF} will enter a high Z state.

NOTE: Because the device is entering a high Z state and not driving the output, the time it takes the output to reach a steady state will depend on the external circuitry used.

Voltage Thresholds

POWER-ON RESET RELEASE VOLTAGE(V_{POR})

If V_{DD} falls below $V_{POR} - V_{POR\_HYS}$ [8] while in operation, the digital circuitry turns off and the output will re-enter a high Z state. After V_{DD} recovers and exceeds V_{UVD} [2], the output will begin reporting again after the delay of $t_{PO.}$

UNDERVOLTAGE DETECTION THRESHOLD (V_{UVD})

The 5 V devices are factory-programmed with UVD enabled. It is important to note that, when powering up the device for the first time after a Power-On Reset event, V_{OUT} and V_{REF} will remain high Z until V_{DD} is raised above V_{UVD} [2], at which point the V_{OUT} and V_{REF} outputs will begin to resume normal operation. If UVD is disabled or it is a 3.3 V device, V_{OUT} and V_{REF} will begin normal operation after V_{DD} raises above V_{POR} [1] under the same conditions.

If V_{DD} drops below $V_{UVD} - V_{UVD\_HYS}$ [6] after normal operation, V_{OUT} will pull to GND regardless of R_{L_VOUT} configuration. The V_{OUT} will remain at GND until V_{DD} raises above V_{UVD} [7] or V_{DD} falls below $V_{POR} - V_{POR\_HYS}$ [8]. If V_{DD} rises above V_{UVD} [7] after a UVD event, the V_{OUT} and V_{REF} outputs will resume operation. If V_{DD} drops below $V_{PO} - V_{POR\_HYS}$ [8], the device will enter a POR event and reset; V_{OUT} and V_{REF} will switch to high Z if this occurs.

OVERVOLTAGE DETECTION THRESHOLD (V_{OVD})

When V_{DD} raises above V_{OVD} [4], the output of the V_{OUT} pin will go high Z, V_{REF} be pulled to GND, and V_{OUT} will be pulled to either VDD or GND, depending on the configuration (pull-up vs. pull-down) of R_{L_VOUT}.

OVERVOLTAGE/UNDERVOLTAGE DETECTION HYSTERESIS (V_{OVD_HYS}, V_{UVD_HYS})

There is hysteresis between enable and disable thresholds to reduce nuisance flagging and clears.

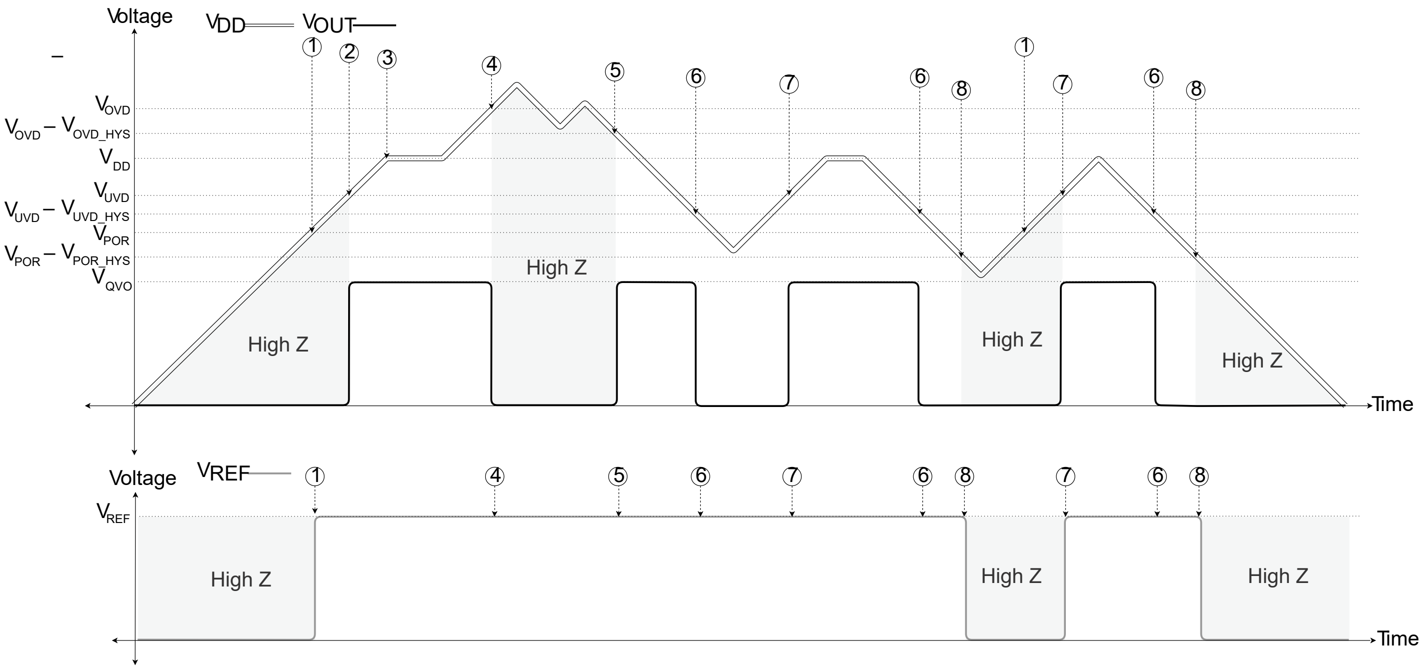


Figure 5: Power States Thresholds with V_{OUT} Behavior for a 5 V Device, R_{L_VOUT} = Pull-Down, UVD Enabled

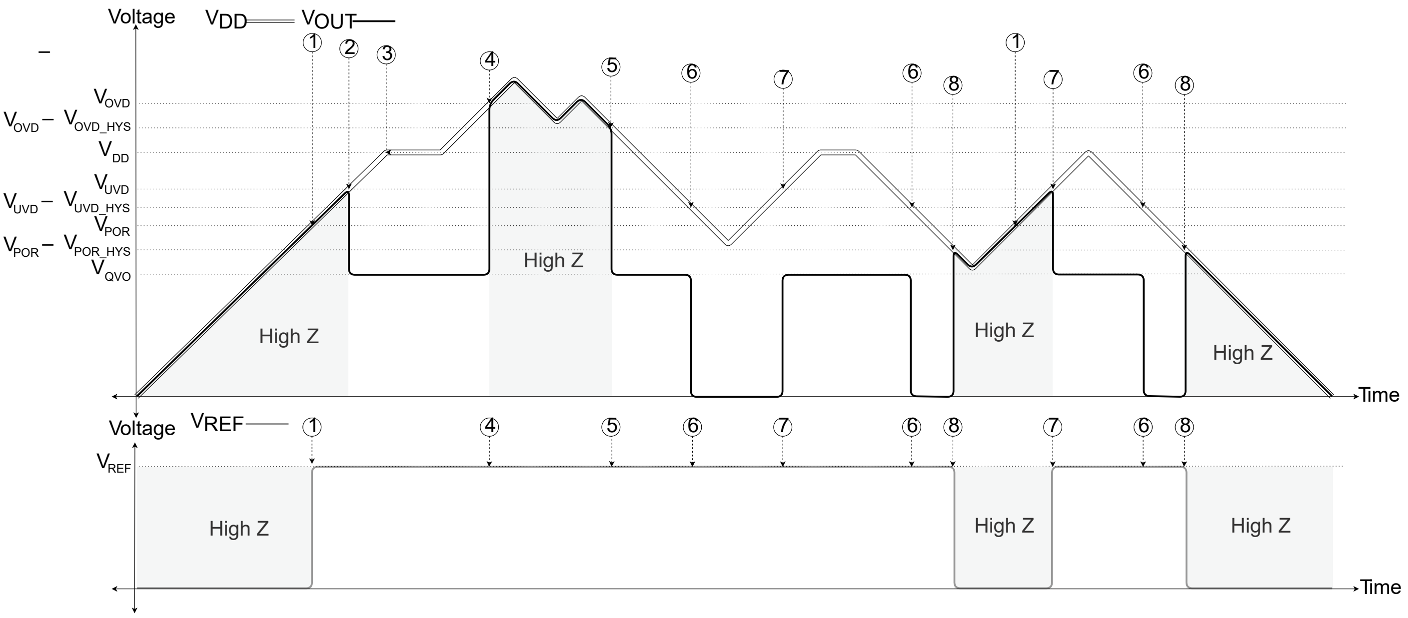


Figure 4: Power States Thresholds with V_{OUT} and V_{REF} Behavior, 5 V Device, R_{L_VOUT} = Pull-Up, UVD Enabled

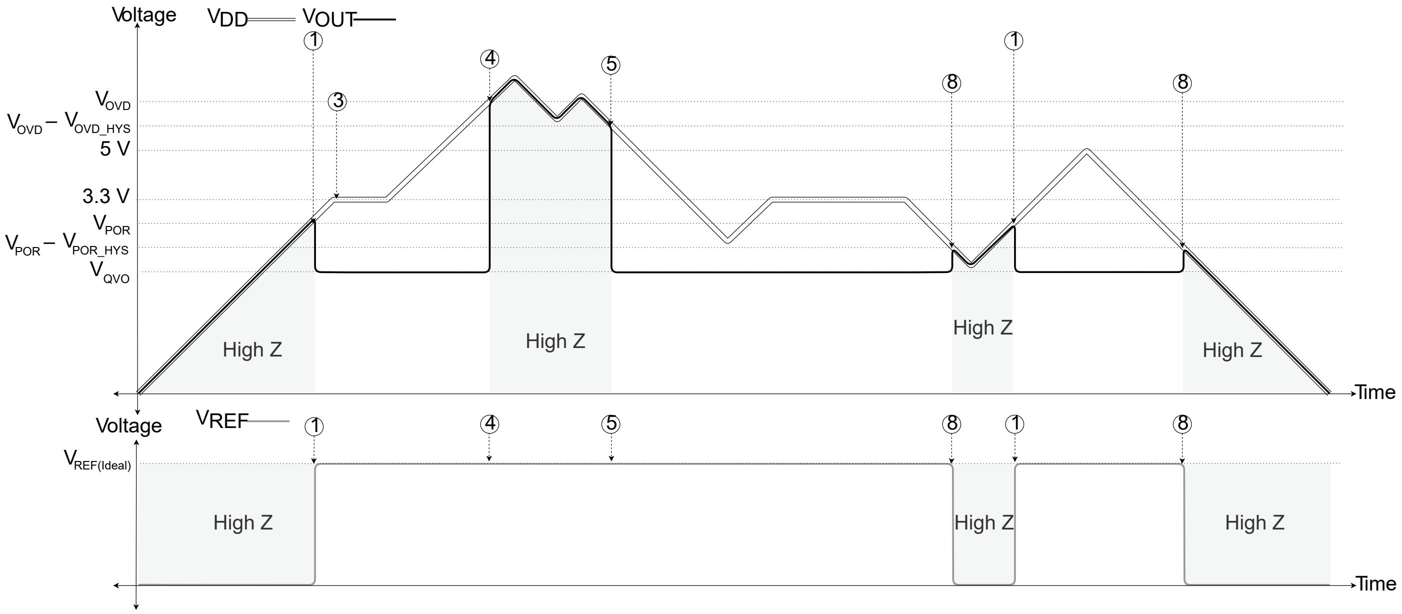


Figure 6: Power States Thresholds with V_{OUT} and V_{REF} Behavior, 3.3 V Device, R_L = Pull-Up, UVD Disabled

Timing Thresholds

POWER-ON DELAY (t_{PO})

When the supply is ramped to V_{UVD} [2], the device will require a finite time to power its internal components before the outputs are released from high Z and can respond to an input magnetic field. Power-On Time, t_{PO}, is defined as the time it takes for the output voltage to settle within ±10% of its steady-state value under an applied magnetic field, which can be seen as the time from [2] to [A] in Figure 7. After this delay, the output will quickly approach $V_{OUT(IP)} = Sens \times I_P + V_{REF}$.

OVERVOLTAGE AND UNDERVOLTAGE DETECTION TIME AND DETECTION RELEASE TIME (t_{OVD}/t_{OVD_R}, t_{UVD}/t_{UVD_R})

The enable time for OVD, t_{OVD}, is the time from V_{OVD} [4] to OVD flag [B]. The UVD enable time, t_{UVD}, is the time from $V_{UVD} - V_{UVD\_HYS}$ [6] to the UVD flag [D].

If V_{DD} ramps from $>V_{UVD} - V_{UVD\_HYS}$ [6] to $<V_{POR} - V_{POR\_HYS}$ [8] faster than t_{UVD}, then the device will not have time to report a UVD event before power off occurs.

The detection release time for OVD, t_{OVD_R}, is the time from $V_{OVD} - V_{OVD\_HYS}$ [5] to the OVD clear to normal operation [C]. The UVD disable time, t_{UVD_R}, is the time from V_{UVD} [7] to the point that the UVD flag clears and V_{OUT} returns to nominal operation [E]. The disable time does not have a counter for either OVD or UVD to release the output and resume reporting.

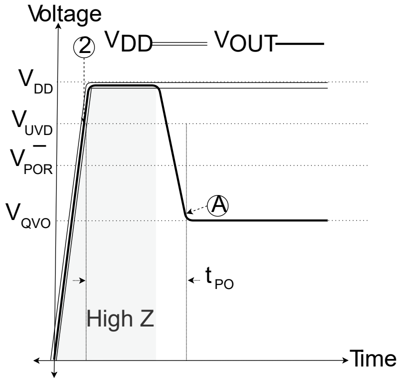


Figure 7: t_{PO} behavior UVD enabled, R_{L_VOUT} = Pull-Up

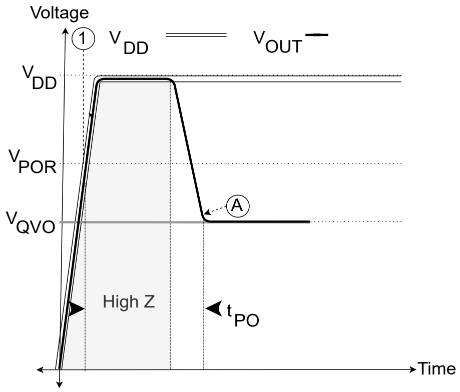


Figure 8: t_{PO} behavior UVD disabled, R_{L_VOUT} = Pull-Up

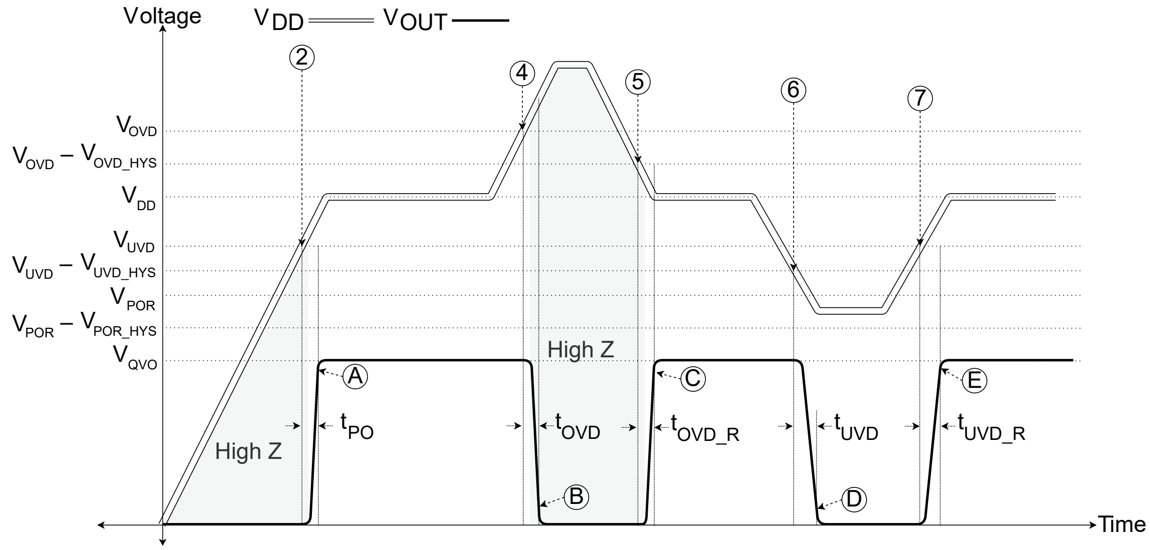


Figure 9: t_{PO}, and t_{OVD}/t_{OVD_R}, and t_{UVD}/t_{UVD_R} with R_{L_VOUT} = Pull-Up

DEFINITIONS OF OPERATING AND PERFORMANCE CHARACTERISTICS

Quiescent Voltage Output (V_{QVO})

Quiescent Voltage Output, or V_{QVO}, is defined as the voltage on the output, V_{OUT}, when zero amps are applied through I_P.

Quiescent Voltage Output Error(V_{QVO_E})

Quiescent Voltage Output Error, or V_{QVO_E}, is defined as the drift of V_{QVO} from room to hot or room to cold (25°C to 150°C or 25°C to –40°C, respectively). To improve overtemperature performance, the temperature drift is compensated with Allegro factory trim to remain within the limits across temperature.

Reference Voltage Output (V_{REF})

The Reference Voltage Output, or V_{REF}, reports the quiescent voltage output for the output channel, V_{OUT}. The internally generated V_{REF} is used in a pseudo-differential mode to remove errors due to the reference shifts or noise on the ground line.

Reference Voltage Temperature Drift (V_{REF_E})

Reference Voltage Output Error, or V_{REF_E}, is defined as the drift of V_{REF} from room to hot or room to cold (25°C to 150°C or 25°C to –40°C, respectively).

Offset Error (V_{OE})

Offset Error, or V_{OE}, is defined as the difference between V_{QVO} and V_{REF}. V_{OE} includes $V_{QVO\_E} - V_{REF}$ from room to hot or room to cold (25°C to 150°C or 25°C to –40°C, respectively).

Output Saturation Voltage (V_{SAT_H} /V_{SAT_L})

Output Saturation Voltage, or V_{SAT}, is defined as the voltage that the V_{OUT} does not pass as a result of an increasing magnitude of current. V_{SAT_H} is the highest voltage the output can drive to, while V_{SAT_L} is the lowest. Note that changing the sensitivity does not change the V_{SAT} points.

Sensitivity (Sens)

Sensitivity, or Sens, is the ratio of the output swing versus the applied current through the primary conductor, I_P. This current causes a voltage deviation away from V_{QVO} on the V_{OUT} output until V_{SAT}. The magnitude and direction of the output voltage swing is proportional to the magnitude and direction of the applied current. This proportional relationship between output and input is Sensitivity and is defined as:

$$Sens = \frac{V_{\mathrm{OUT(IP_1)}} - V_{\mathrm{OUT(IP_2)}}}{IP_1 - IP_2}$$

where IP_1 and IP_2 are two different currents, and where $V_{OUT(IP1)}$ and $V_{OUT(IP2)}$ are the voltages of the device at those applied currents.

Sensitivity Error (E_{SENS})

Sensitivity Error, or E_{SENS}, is the error of Sensitivity from room to hot or room to cold (25°C to 150°C or 25°C to –40°C, respectively). Sensitivity error is compensated with Allegro factory trim.

Error Components Including Lifetime Drift (E_{SENS_LTD}/V_{QVO_LTD}/V_{REF_LTD}/V_{OE_LTD})

Lifetime drift characteristics are based on a statistical combination of production distributions and worst-case distribution of parametric drift of individuals observed during AEC-Q100 qualification. Solder reflow induces stress on the ACS37010/2 device causing parametric shifts and lifetime drift limits apply immediately after solder reflow as well as long term use.

Power Supply Sensitivity Error (E_{SENS_PS})

Power Supply Sensitivity Error, or E_{SENS_PS}, is defined as the percent sensitivity error measured between V_{DD} and V_{DD} ±10%. For a 5 V device, this is 5 to 4.5 V and 5 to 5.5 V. For a 3.3 V device, this is 3.3 to 3 V and 3.3 to 3.6 V.

Power Supply Offset Error (V_{OE_PS})

Power Supply Offset Error, or V_{OE_PS}, is defined as the offset error in mV between V_{DD} and V_{DD} ±10% V_{DD}. For a 5 V device, this is 5 to 4.5 V and 5 to 5.5 V. For a 3.3 V device, this is 3.3 to 3 V and 3.3 to 3.6 V.

OVERCURRENT FAULT (OCF) BEHAVIOR

The overcurrent fault (OCF) function (ACS37012 only) pulls the open-drain FAULT pin low when the applied current exceeds a preset threshold (I_{OCR}). On the ACS37012, this threshold is internally set to 100% of the full-scale rated current. This flag trips symmetrically for positive and negative applied currents.

The implementation for the OCF circuitry is accurate over temperature and does not require further temperature compensation.

OVERCURRENT ERROR (I_{OC_E})

Overcurrent Error, or I_{OC_E}, is the error between the ideal I_{OC} and the measured I_{OC}.

OVERCURRENT HYSTERESIS (I_{OC_HYS})

Overcurrent Hysteresis, or I_{OC_HYST}, is defined as the magnitude of current in percentage of the FS that must drop before a fault assertion will be cleared. This can be seen as the separation between the voltages [9] to [10] in Figure 10.

OVERCURRENT FAULT RESPONSE TIME (t_{OC_RESP})

Overcurrent Response Time, or t_{OC_RESP}, is defined as the time from when the input reaches the operating point [9] until the OCF pin falls below V_{FAULT_L} [G].

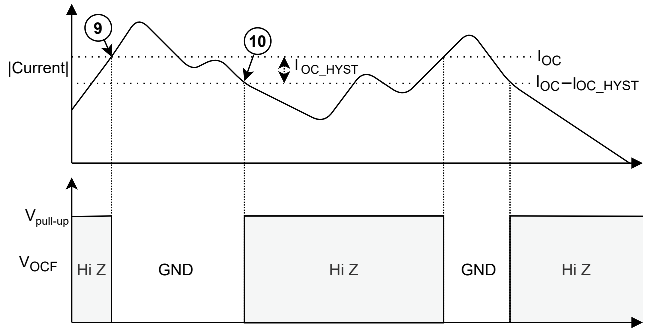


Figure 10: Fault Thresholds and OCF Pin Functionality

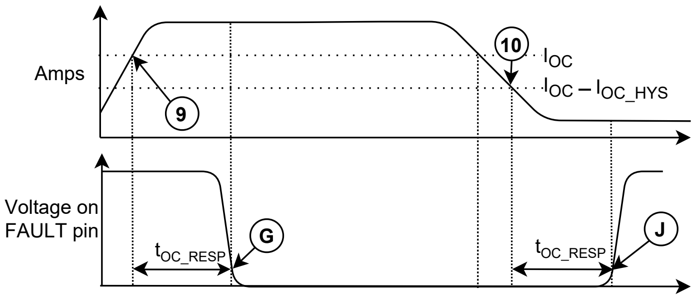


Figure 11: Fault Hold with Clear Fault After Hold Time

THERMAL PERFORMANCE

Thermal Rise vs. Primary Current

Self-heating due to the flow of current in the package IP conductor should be considered during the design of any current sensing system. The sensor, printed circuit board (PCB), and contacts to the PCB will generate heat and act as a heat sink as current moves through the system.

The thermal response is highly dependent on PCB layout, copper thickness, cooling techniques, and the profile of the injected current. The current profile includes peak current value, current on-time, and duty cycle.

Placing vias under the copper pads of the Allegro current sensor evaluation board minimizes the current path resistance and improves heatsinking to the PCB, while vias outside of the pads limit the current path to the top of the PCB trace and have worse heatsinking under the part (see Figure 12 and Figure 13).

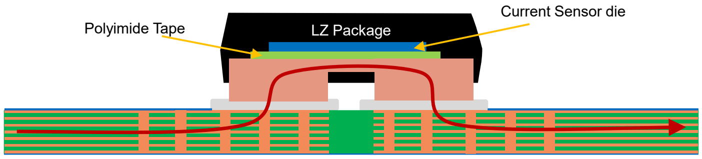


Figure 12: Vias Under Copper Pads, LZ Package

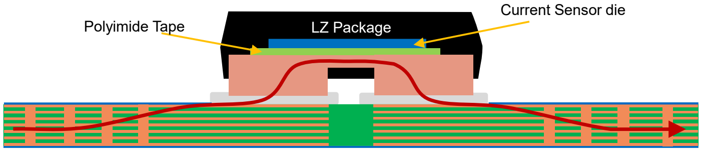


Figure 13: No Vias Under Copper Pads, LZ Package

The plot in Figure 14 shows the measured rise in steady-state die temperature of the LZ package versus DC continuous current at an ambient temperature, T_A, of 25°C for two board designs: filled vias under copper pads and no vias under copper pads (vias outside pad). Note the thermal offset curves may be directly applied to other values of T_A. Using in-pad vias has better thermal performance than no in-pad vias.

The plot in Figure 15 shows the measured rise in steady-state die temperature of the LZ package versus DC continuous current at an ambient temperature of 25°C and an ambient temperature of 125°C. The evaluation boards used have filled vias under the copper pads.

The thermal capacity of the ACS37010/12 in the LZ package should be verified by the end user in the application specific conditions. The maximum junction temperature, $T_{J(max)}$ (165°C), should not be exceeded. Measuring the temperature of the top of the package is a close approximation of the die temperature.

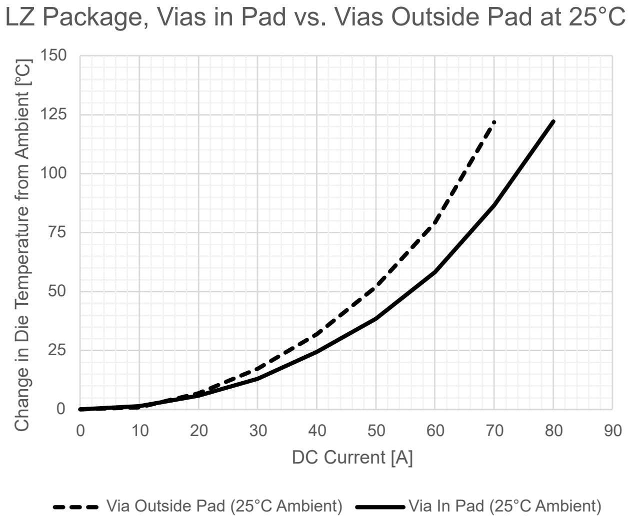


Figure 14: LZ Package Comparison with and without In-Pad Vias at Ambient Temperature

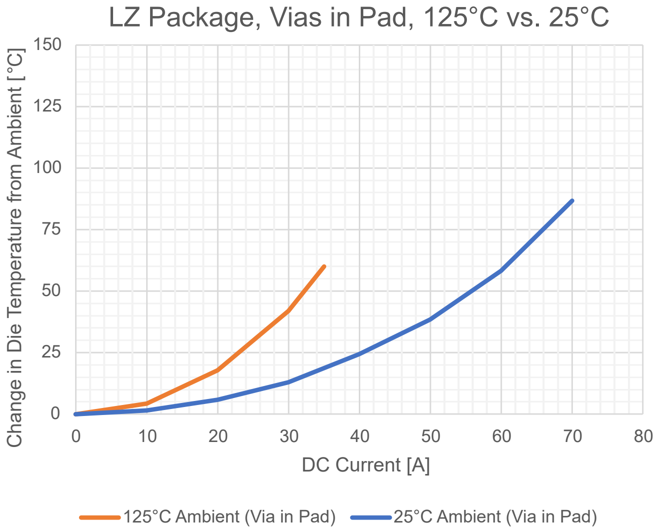


Figure 15: LZ Package Comparison at 125°C and 25°C, Vias in-Pad

Safe Operating Region

Current applied to the IP pins of the ASC37010/12 in the LZ package will heat the package, as illustrated above. The amount of heating will depend on the current applied and duration. Figure 16 shows the range of applied current and duration of current which will not cause any detrimental effects on the part.

If enough energy is applied, the copper IP lead will melt and fuse open. This is shown by the blue line, Time to Fuse.

The maximum junction temperature is 165°C, above which the PN junctions on the die could be damaged if the maximum junction temperature is exceeded for extended periods of time. This could result in changes in the product performance or create long-term reliability risks. The region in which this occurs is shown by the green line, Time to 165°C.

The LZ package has a polyimide insulation barrier to enable high working voltages. Extended heating of the polyimide film will cause deterioration of the material, reducing the insulation effectiveness of the package. This is shown by the red line, Time to Insulation Degradation.

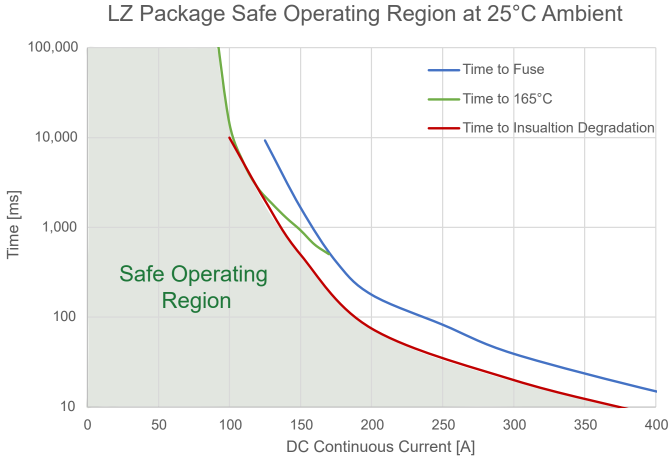


Figure 16: LZ Package Safe Operating Region

Evaluation Board Layout

Thermal data shown in Figure 16 was collected using the LC/LZ Current Sensor Evaluation Board (ACSEVB-LC8-LZ6, TED-0004110). This board includes six layers and the evaluation board is shown in Figure 17.

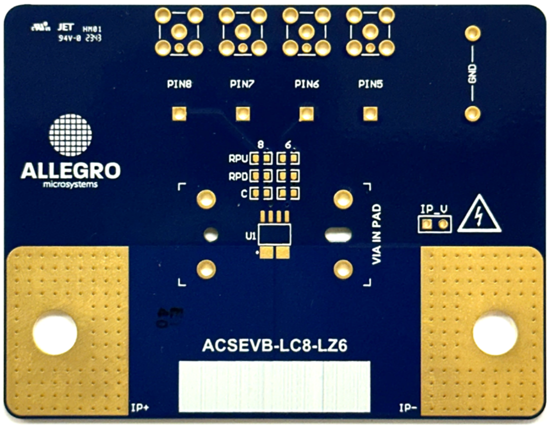
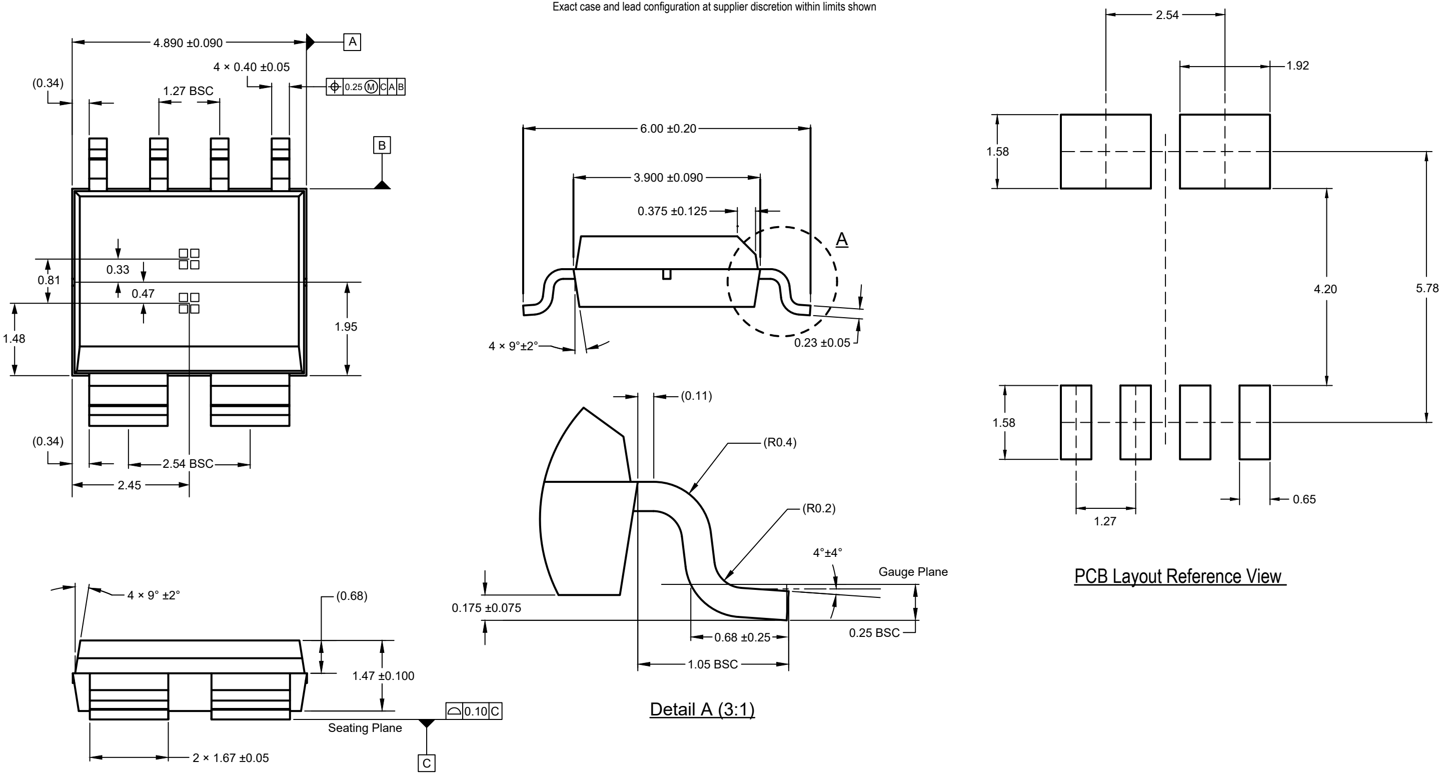


Figure 17: LZ Package Allegro Evaluation Board

Design support files for the ACSEVB-LC8-LZ6 evaluation board are available for download from the Allegro website. See the technical documents section of the ACS37010/12 webpage for more information.

PACKAGE OUTLINE DRAWING

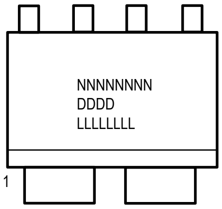
For Reference Only – Not for Tooling Use
(Reference DWG-0000385, Rev. 1)
PRELIMINARY
NOT TO SCALE
Dimensions in millimeters
Dimensions exclusive of mold flash, gate burrs, and dambar protrusions
Exact case and lead configuration at supplier discretion within limits shown



Detail A (3:1)

PCB Layout Reference View

Figure 18: Custom 6-Pin SOIC (Suffix LZ)



Standard Branding Reference View

N = Device Part Number
D = Date Code
L = Assembly Lot Number

Figure 19: LZ Package Branding

Revision History

Number	Date	Description
–	March 13, 2023	Initial release
1	March 29, 2023	Updated Error Components Including Lifetime Drift sections of Performance Characteristic tables (Pages 7, 8)
2	May 16, 2023	Added ACS37010LLZATR-030B5 and ACS37010LLZATR-030B3 part variants (all pages)
3	May 31, 2023	Added AEC-Q100 qualification to Features and Benefits (page 1)
4	November 9, 2023	Added ACS37012 variant
5	January 26, 2024	Added UL certification number (page 1), footnote 1, and Thermal Characteristics table (page 3); removed footnote 2 (page 3); corrected figure caption (page 5); updated Thermal Performance section (pages 24-25)
6	March 19, 2025	Minor editorial updates (all pages), added ACS37012LLZATR-030U5 part variant (page 2), improved isolation characteristics (page 3), corrected pinout and terminal list table (page 4), added footnotes [1] and [3] (page 7), added footnote [2] and clarified test conditions (page 8-15)

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