

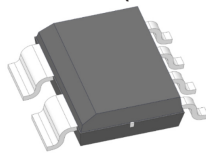
450 kHz, High Accuracy Current Sensor With FAULT or Reference Output in SOIC-6 Package

FEATURES AND BENEFITS

- High operating bandwidth and fast response time
 - 450 kHz bandwidth
 - 1.3 μ s response time
- High-accuracy current measurements
 - $\pm 1.5\%$ 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 ($0.68\text{ m}\Omega$) for better power efficiency (low dissipation)
- Highly isolated compact surface-mount package
 - $3500\text{ V}_{\text{RMS}}$ withstand voltage
 - $840\text{ V}_{\text{RMS}} / 1188\text{ V}_{\text{DC}}$ basic isolation voltages
 - $420\text{ V}_{\text{RMS}} / 594\text{ V}_{\text{DC}}$ reinforced isolation voltages
- AEC-Q100 Grade 0, automotive qualified

PACKAGE: CUSTOM 6-PIN 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 $0.68\text{ m}\Omega$ 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 $1.3\text{ }\mu\text{s}$ 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 $3500\text{ V}_{\text{RMS}}$ of isolation between the primary and secondary signal leads of the package. This rating provides basic working voltage of $840\text{ V}_{\text{RMS}}$ and reinforced working voltage of $420\text{ V}_{\text{RMS}}$.

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.

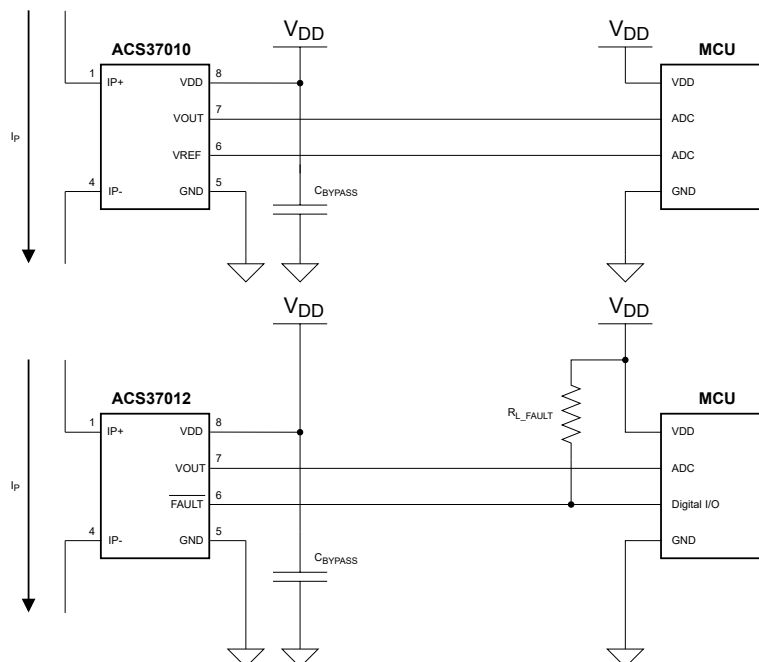


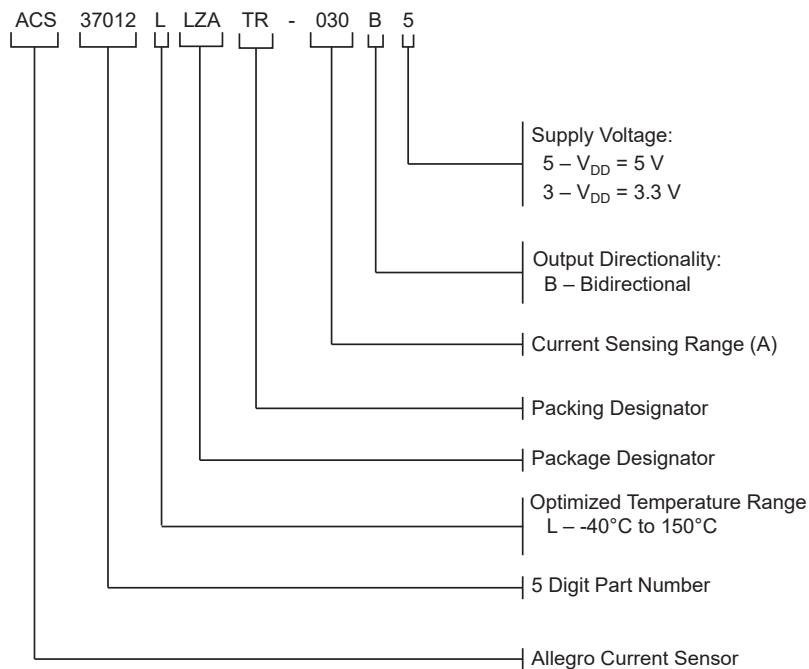
Figure 1: Typical Application Circuit

ACS37010 and ACS37012

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

SELECTION GUIDE

| Part Number | Current Sensing Range, I _{PR} (A) | Sensitivity (mV/A) | V _{DD} (V) | V _{Qvo} (V) | Pin 6 Function | Optimized Temperature Range, T _A (°C) | Packing | | |
|----------------------|--|--------------------|---------------------|----------------------|----------------|--|-------------------------------------|--|--|
| ACS37010LLZATR-030B5 | ±30 | 66.7 | 5 | 2.5 | VREF | −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 | FAULT | | | | |
| ACS37012LLZATR-030B3 | ±30 | 44 | 3.3 | 1.65 | | | | | |
| ACS37012LLZATR-050B5 | ±50 | 40 | 5 | 2.5 | | | | | |
| ACS37012LLZATR-050B3 | ±50 | 26.4 | 3.3 | 1.65 | | | | | |



ACS37010 and ACS37012

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ABSOLUTE MAXIMUM RATINGS

| 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 | $T_{J(max)}$ | | - | 165 | °C |

ISOLATION CHARACTERISTICS

| Characteristic | Symbol | Notes | Value | Units |
|---|---------------|---|-------|----------------------|
| Withstand Voltage ^{[1][2]} | V_{ISO} | Agency rated for 60 seconds per UL 62368-1 (edition 3) | 3500 | V_{RMS} |
| Impulse Withstand | $V_{IMPULSE}$ | Tested ± 5 pulses at 2/minute in compliance to IEC 61000-4-5, 1.2 μs (rise) / 50 μs (width) | 5000 | V_{PK} |
| Working Voltage for Basic Isolation ^[2] | V_{WVBI} | Maximum approved working voltage for basic (single) isolation according to UL 62368-1 (edition 3) | 1188 | V_{PK} or V_{DC} |
| | | | 840 | V_{RMS} |
| Working Voltage for Reinforced Isolation ^[2] | V_{WVRI} | Maximum approved working voltage for reinforced isolation according to UL 62368-1 (edition 3) | 594 | V_{PK} or V_{DC} |
| | | | 420 | V_{RMS} |
| Clearance | D_{CL} | Minimum distance through air from IP leads to signal leads | 4.2 | mm |
| Creepage | D_{CR} | Minimum distance along package body from IP leads to signal leads | 4.2 | mm |
| Distance Through Insulation | DTI | Minimum internal distance through insulation | 54 | μm |
| Comparative Tracking Index | CTI | Material Group I | >600 | V |

[1] 100% production-tested for 1 second in accordance with UL 62368-1 (edition 3).

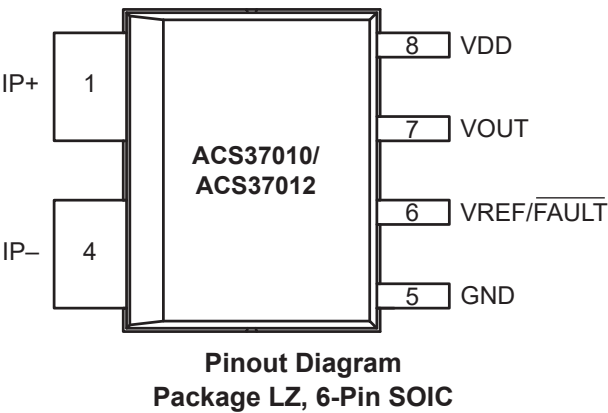
[2] Certification pending.

ACS37010
and ACS37012

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PACKAGE CHARACTERISTICS

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



Terminal List Table

| Number | Name | Description |
|--------|----------------|--|
| 1 | IP+ | Terminal for current being sensed |
| 4 | IP– | Terminal for current being sensed |
| 5 | GND | Device ground terminal |
| 6 | VREF/ FAULT | Zero current voltage reference (ACS37010) or overcurrent fault output (ACS37012) |
| 7 | VOUT | Analog output representing the current flowing through IP |
| 8 | VDD | Device power supply terminal |

FUNCTIONAL BLOCK DIAGRAM

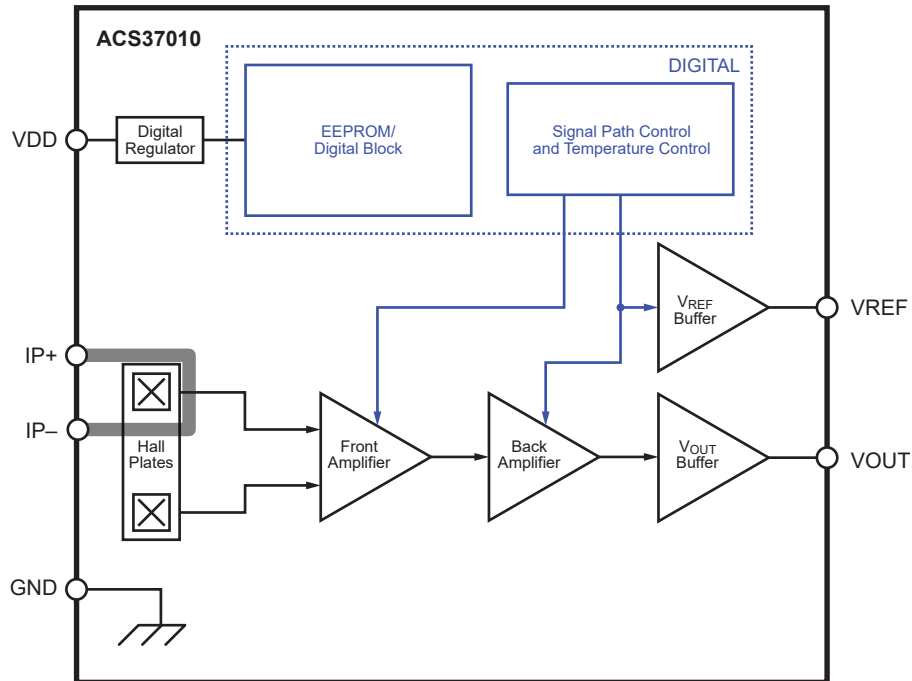


Figure 2: ACS70310 Functional Block Diagram

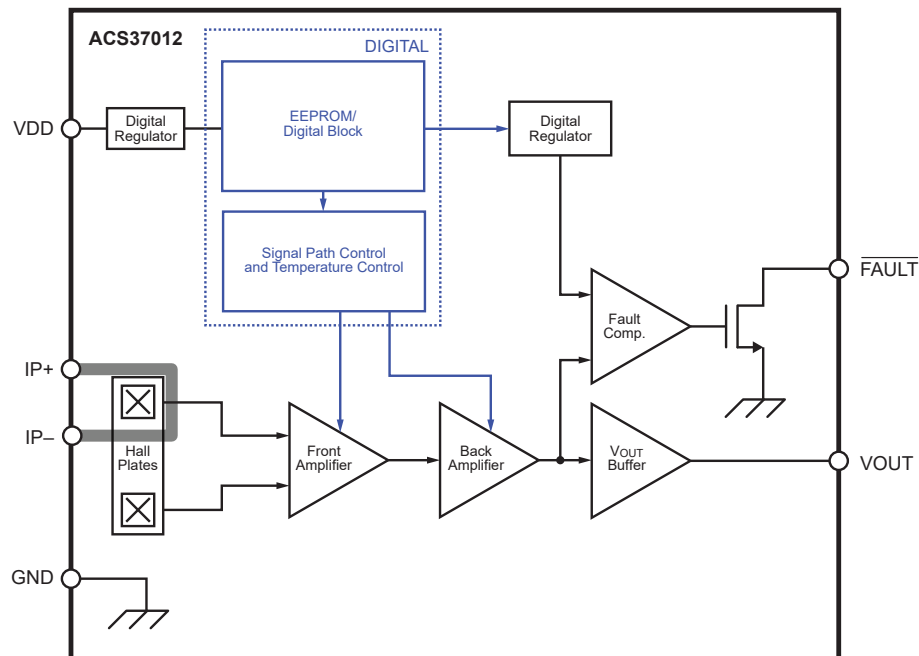


Figure 3: ACS37012 Functional Block Diagram

ACS37010 and ACS37012

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

COMMON ELECTRICAL CHARACTERISTICS: Valid over full operating temperature range, $T_A = -40^{\circ}\text{C}$ to 150°C , $C_{\text{BYPASS}} = 100 \text{ nF}$, and $V_{\text{DD}} = 5 \text{ V}$ 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 |
| VOUT Capacitive Load | $C_{\text{L_VOUT}}$ | VOUT to GND | – | – | 6 | nF |
| Supply Bypass Capacitor | C_{BYPASS} | VDD to GND | 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 | $V_{\text{POR_HYS}}$ | | 250 | 300 | 500 | mV |
| Power-On Time | t_{PO} | $T_A = 25^{\circ}\text{C}$ | – | 65 | – | μs |
| Undervoltage Detection Threshold [1] | V_{UVD} | $T_A = 25^{\circ}\text{C}$, VDD falling 1 V/ms | 3.8 | 4.1 | 4.25 | V |
| Undervoltage Detection Hysteresis [1] | $V_{\text{UVD_HYS}}$ | | 200 | 250 | 400 | mV |
| Undervoltage Detection Time [1] | t_{UVD} | $V_{\text{DD}} < V_{\text{UVD}}$ | – | 70 | 200 | μs |
| Undervoltage Detection Release Time [1] | $t_{\text{UVD_R}}$ | $V_{\text{DD}} > (V_{\text{UVD}} + V_{\text{UVD_HYS}})$ | – | 6 | – | μs |
| Overvoltage Detection Threshold | V_{OVD} | $T_A = 25^{\circ}\text{C}$, VDD rising 1 V/ms | 6.1 | 6.3 | 6.5 | V |
| Overvoltage Detection Hysteresis | $V_{\text{OVD_HYS}}$ | $T_A = 25^{\circ}\text{C}$ | 400 | 500 | 600 | mV |
| Overvoltage Detection Time | t_{OVD} | $V_{\text{DD}} > V_{\text{OVD}}$ | – | 70 | 200 | μs |
| Overvoltage Detection Release Time | $t_{\text{OVD_R}}$ | $V_{\text{DD}} < (V_{\text{OVD}} - V_{\text{OVD_HYS}})$ | – | 3 | – | μs |
| Rise Time | t_{R} | $T_A = 25^{\circ}\text{C}$, $C_{\text{L_VOUT}} = 6 \text{ nF}$, $C_{\text{BYPASS}} = 1 \mu\text{F}$ | – | 1 | 2.5 | μs |
| Response Time | t_{RESP} | $T_A = 25^{\circ}\text{C}$, $C_{\text{L_VOUT}} = 6 \text{ nF}$, $C_{\text{BYPASS}} = 1 \mu\text{F}$ | – | 1.3 | 2.5 | μs |
| Propagation Delay | t_{PD} | $T_A = 25^{\circ}\text{C}$, $C_{\text{L_VOUT}} = 6 \text{ nF}$, $C_{\text{BYPASS}} = 1 \mu\text{F}$ | – | 0.7 | 1.5 | μs |
| Bandwidth | BW | $T_A = 25^{\circ}\text{C}$, Small Signal –3 dB, $C_{\text{L_VOUT}} = 6 \text{ nF}$, $C_{\text{BYPASS}} = 1 \mu\text{F}$ | – | 450 | – | kHz |
| Noise Density | N_{D} | $T_A = 25^{\circ}\text{C}$, $C_{\text{L_VOUT}} = 6 \text{ nF}$, $C_{\text{BYPASS}} = 1 \mu\text{F}$, 5 V variant | – | 150 | – | $\mu\text{A}/\sqrt{\text{Hz}}$ |
| | | $T_A = 25^{\circ}\text{C}$, $C_{\text{L_VOUT}} = 6 \text{ nF}$, $C_{\text{BYPASS}} = 1 \mu\text{F}$, 3.3 V variant | – | 230 | – | $\mu\text{A}/\sqrt{\text{Hz}}$ |
| Output Saturation Voltage | $V_{\text{SAT_H}}$ | $R_{\text{L_VOUT}} = 10 \text{ k}\Omega$ to GND | $V_{\text{DD}} - 0.25$ | – | – | V |
| | $V_{\text{SAT_L}}$ | $R_{\text{L_VOUT}} = 10 \text{ k}\Omega$ to VDD | – | – | 0.15 | V |
| VOUT Short-Circuit Current | $I_{\text{SC_VOUT}}$ | $T_A = 25^{\circ}\text{C}$, VOUT shorted to GND | – | 25 | – | mA |
| | | $T_A = 25^{\circ}\text{C}$, VOUT shorted to VDD | – | –25 | – | mA |
| Common Mode Field Sensitivity | CMFS | | – | 4 | – | mA/G |

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ACS37010 and ACS37012

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

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

| Characteristics | Symbol | Test Conditions | Min. | Typ. | Max. | Unit |
|--|------------------------|--|------|------|------|---------------------------------|
| REFERENCE OUTPUT CHARACTERISTICS (VREF) ^[2] | | | | | | |
| 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) ^[3] | | | | | | |
| 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} ^[4] |
| 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] Only enabled on 5 V devices.

^[2] ACS37010 only.

^[3] ACS37012 only.

^[4] Where I_{OC} is the specific point at which the OCF trigger will occur.

ACS37010 and ACS37012

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

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

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

^[2] 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.

ACS37010 and ACS37012

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

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

^[2] 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.

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

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

^[2] 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.

ACS37010 and ACS37012

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

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

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

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

^[2] 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.

ACS37010 and ACS37012

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

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

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

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

^[2] 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.

ACS37010 and ACS37012

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

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

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

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

^[2] 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.

ACS37010 and ACS37012

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

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

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

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

^[2] 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.

ACS37010 and ACS37012

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

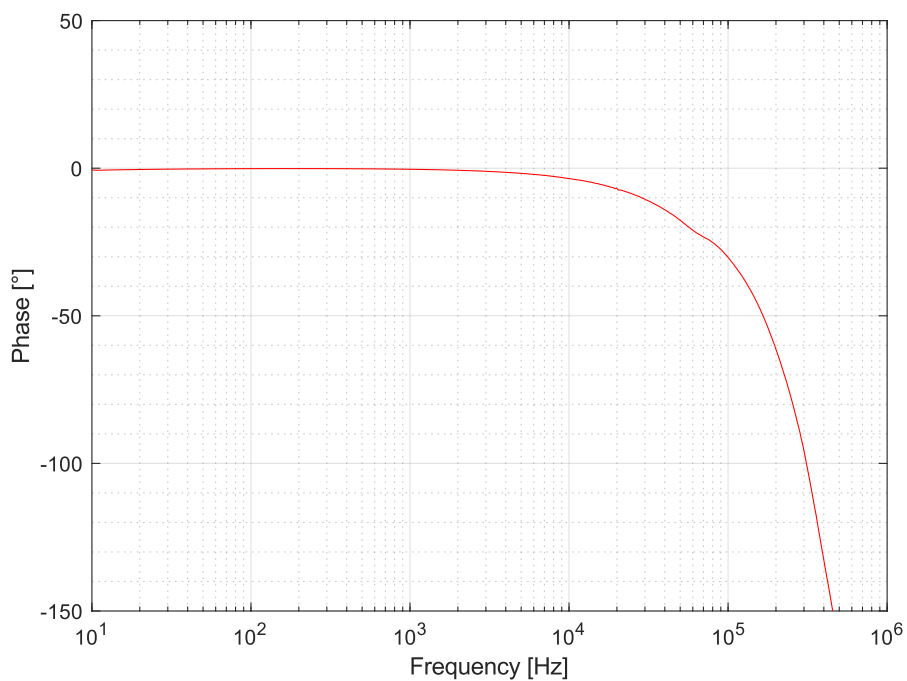
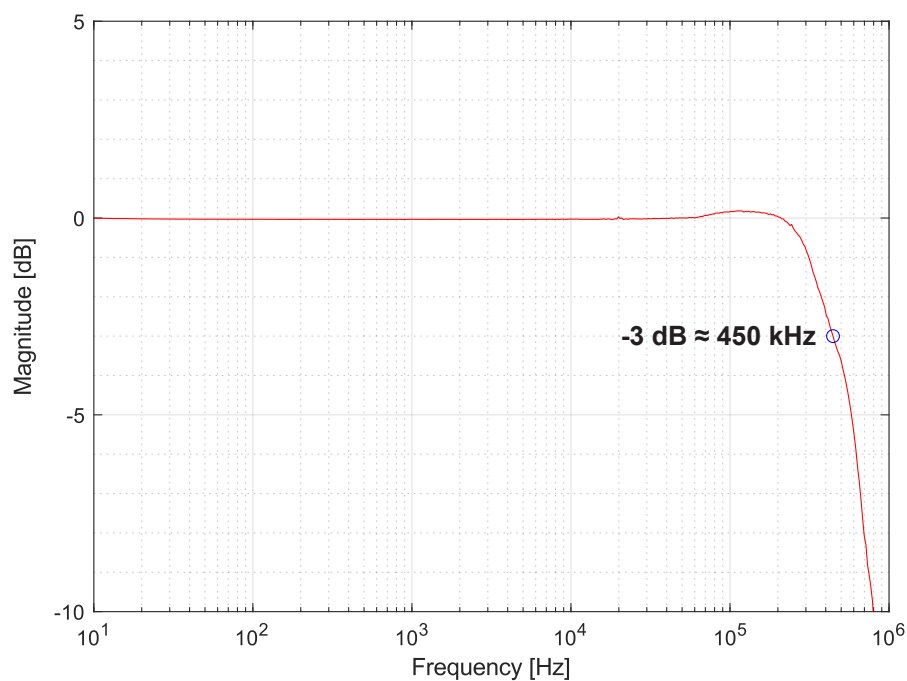
ACS37012LLZATR-050B3 PERFORMANCE CHARACTERISTICS: Valid over full operating temperature range,
 $T_A = -40^\circ\text{C}$ to 150°C , $C_{\text{BYPASS}} = 100\text{ nF}$, and $V_{\text{DD}} = 3.3\text{ V}$, unless otherwise specified

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

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

^[2] 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.

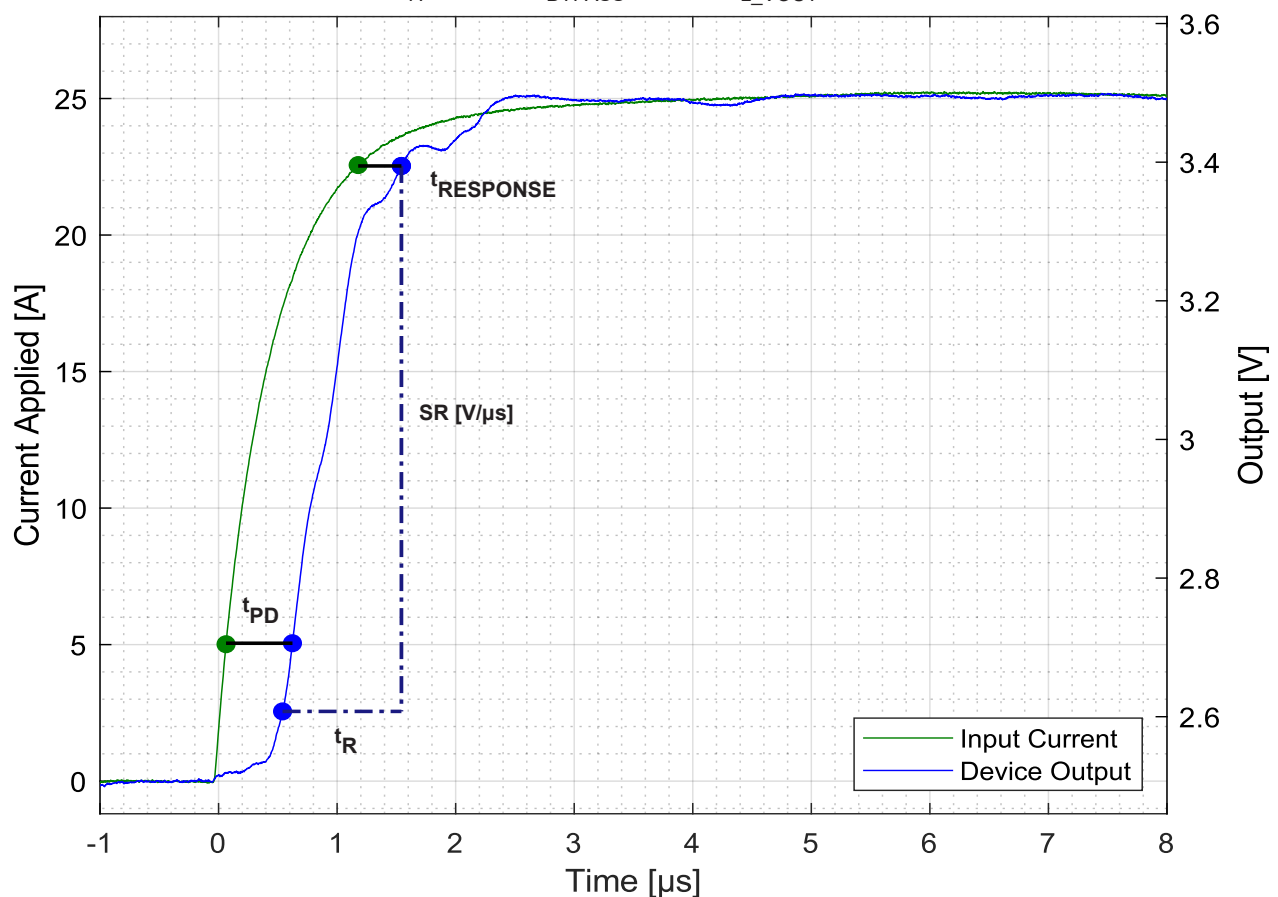
Output Slew Rate (SR)

The rate of change [$\text{V}/\mu\text{s}$] 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 = $1 \mu\text{s}$

Test Conditions: $T_A = 25^\circ\text{C}$, $C_{\text{BYPASS}} = 1 \mu\text{F}$, $C_{\text{L_VOUT}} = 6 \text{ nF}$



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 V_{REF} is mentioned, this only applies to the ACS37010.

POWER-ON OPERATION

UVD Enabled

When UVD is enabled, as V_{DD} ramps up, the ACS37010 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 ACS37010 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 $V_{POR} - V_{POR_HYS}$ [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 V_{DD} 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.

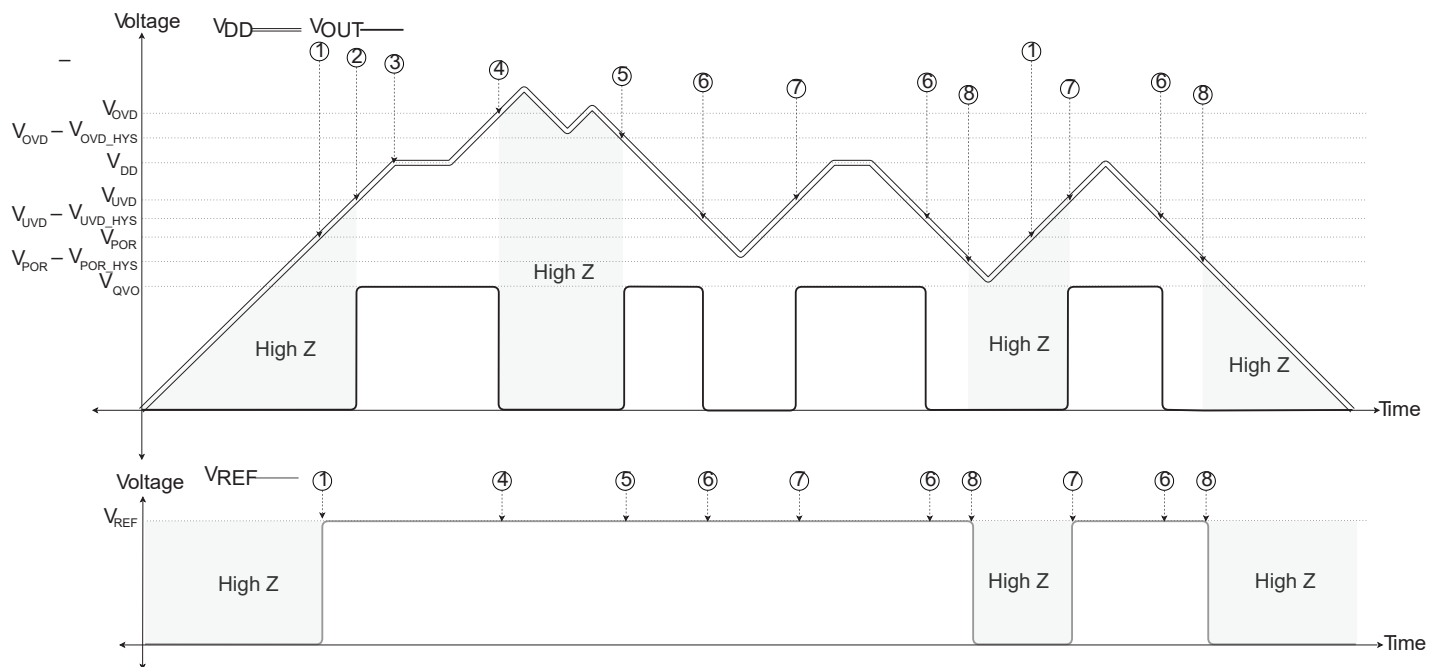


Figure 5: Power States Thresholds with V_{OUT} Behavior for a 5 V Device, R_{L_VOUT} = Pull-Down, UVD Enabled

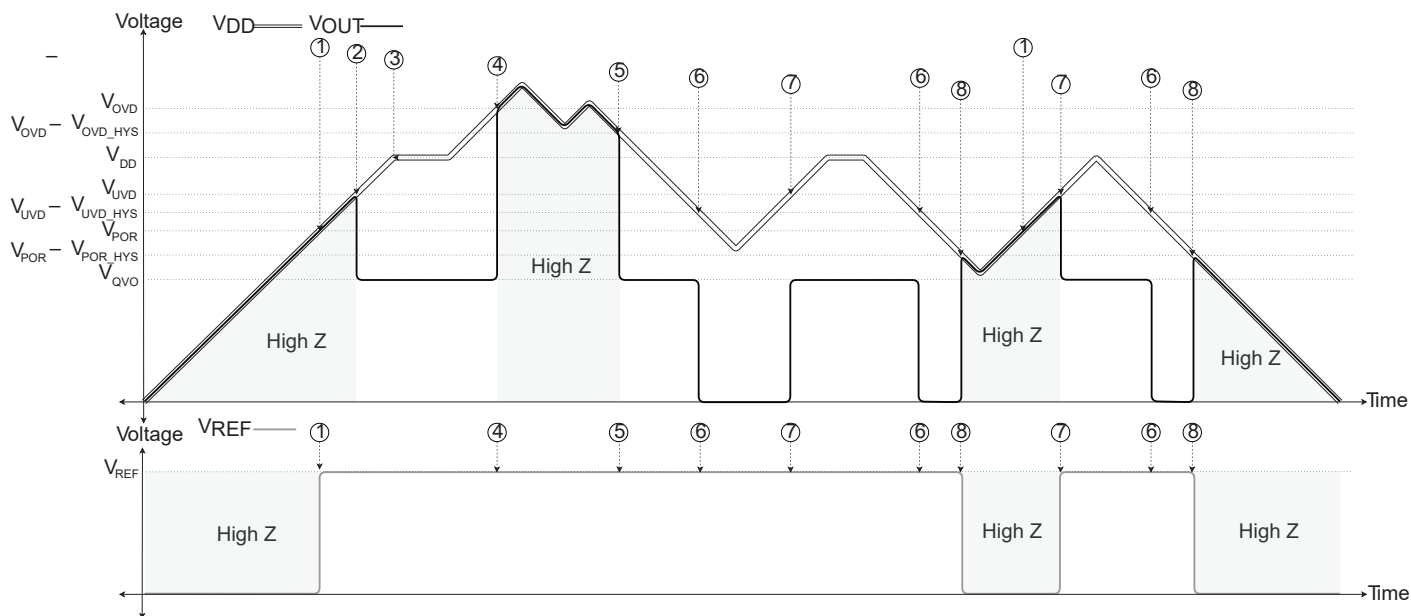


Figure 4: Power States Thresholds with V_{OUT} and V_{REF} Behavior, 5 V Device, R_{L_VOUT} = Pull-Up, UVD Enabled

ACS37010
and ACS37012

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

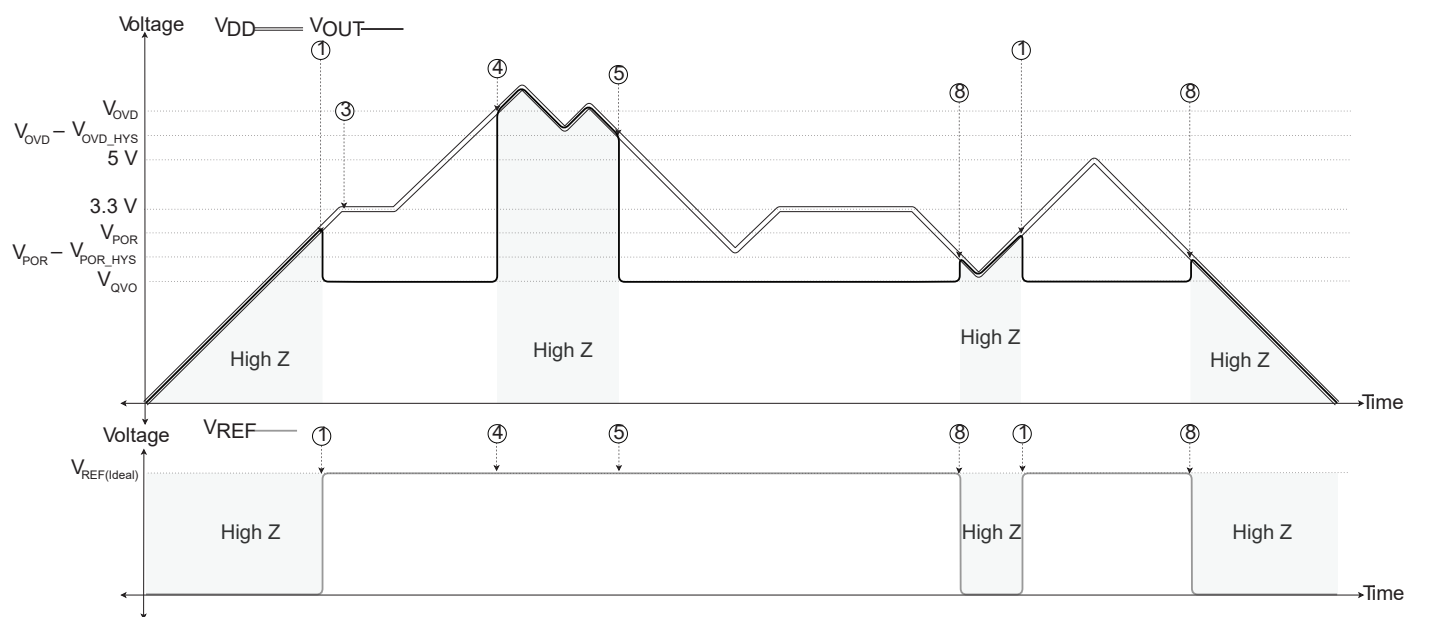


Figure 6: Power States Thresholds with V_{OUT} and V_{REF} Behavior, 3.3 V Device, R_L = Pull-Up, UVD Disabled

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 $\pm 10\%$ 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 $V_{OUT(IP)} = \text{Sens} \times I_P + V_{REF}$.

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.

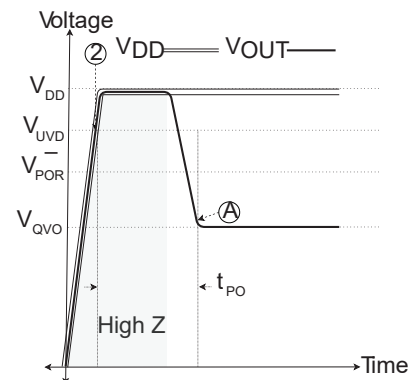


Figure 7: t_{PO} behavior UVD enabled, $R_{L_VOUT} = \text{Pull-Up}$

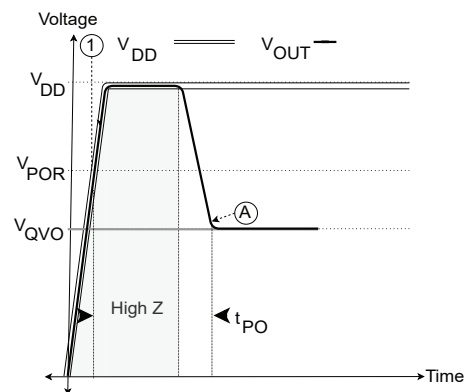


Figure 8: t_{PO} behavior UVD disabled, $R_{L_VOUT} = \text{Pull-Up}$

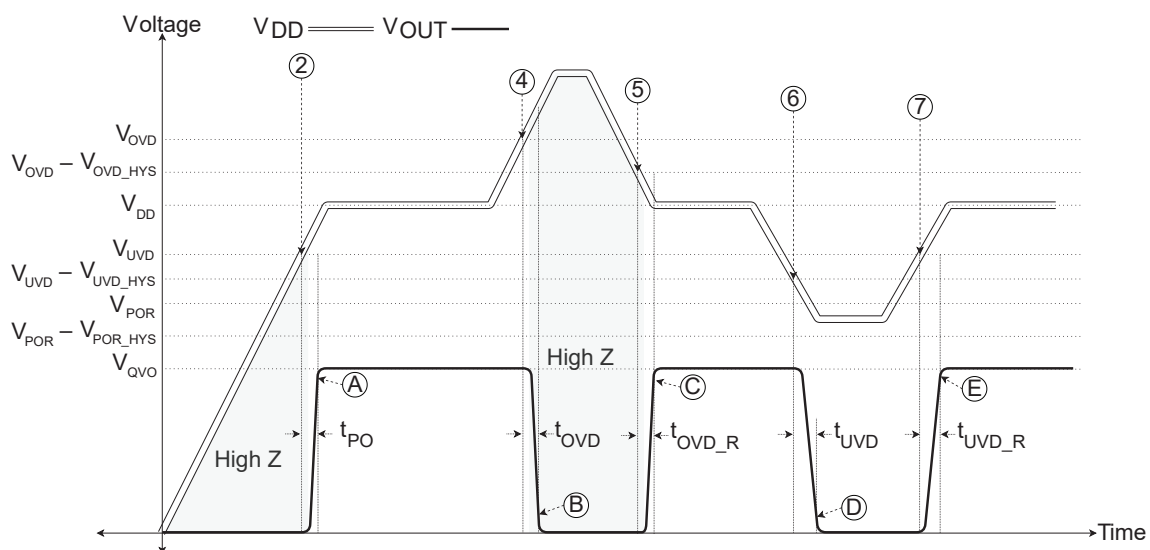


Figure 9: t_{PO} , and t_{OVD}/t_{OVD_R} , and t_{UVD}/t_{UVD_R} with $R_{L_VOUT} = \text{Pull-Up}$

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:

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

where IP_1 and IP_2 are two different currents, and where $V_{OUT(IP_1)}$ and $V_{OUT(IP_2)}$ 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 $V_{DD} \pm 10\%$. 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 $V_{CC} \pm 10\% V_{DD}$. 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 fullscale 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_HYS} , 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].

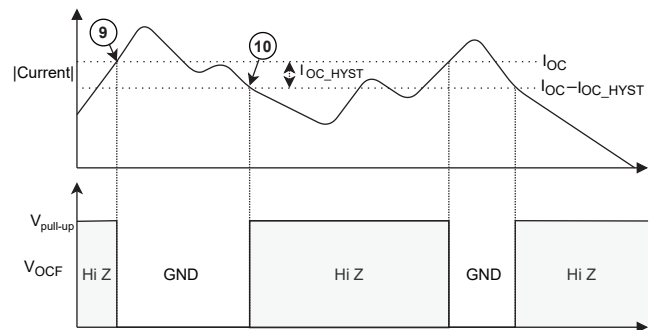


Figure 10: Fault Thresholds and OCF Pin Functionality

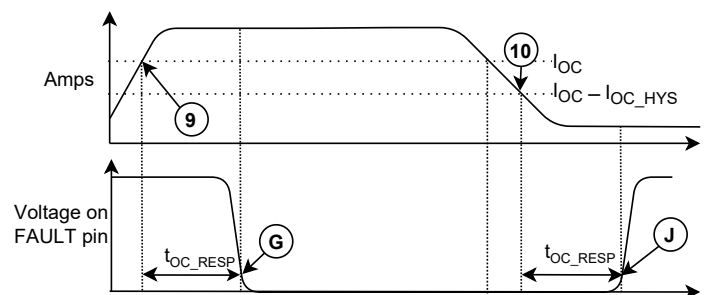


Figure 11: Fault Hold with Clear Fault After Hold Time

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).

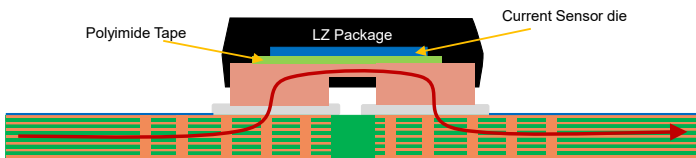


Figure 12: Vias Under Copper Pads, LZ Package

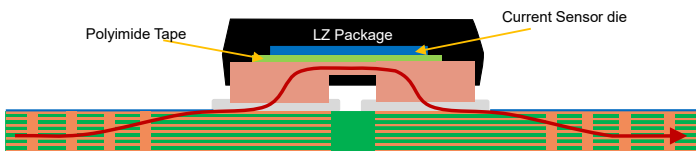


Figure 13: No Vias Under Copper Pads, LZ Package

The plot in Figure 14 shows the measured rise in steady-state die temperature of the ACS37010/2 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. 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.

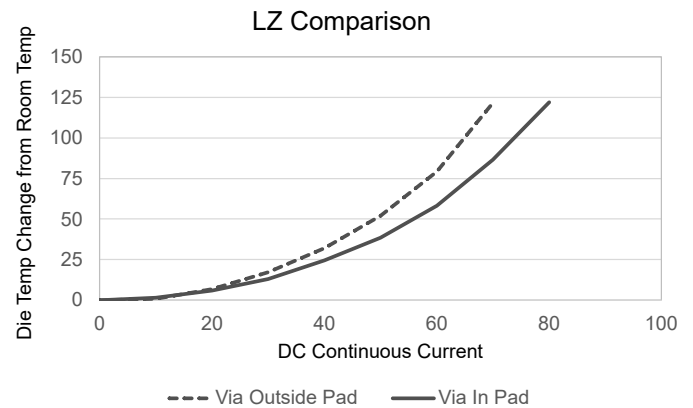


Figure 14: LZ Package Comparison with and without In-Pad Vias

The thermal capacity of the ACS37010/2 should be verified by the end user in the application’s 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.

Evaluation Board Layout

Thermal data shown in Figure 14 was collected using the ASEK37010 Evaluation Board (TED-0004110, LC/LZ Current Sensor Evaluation Board). This board includes six layers. The ASEK37010 evaluation board is shown in Figure 12.

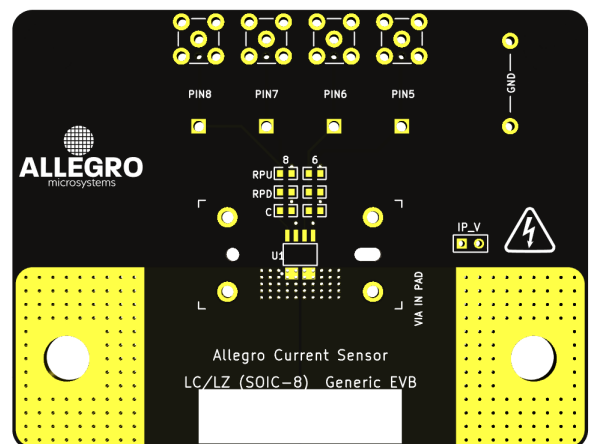


Figure 15: LZ Package Allegro Evaluation Board

Gerber files for the ASEK37010 evaluation board are available for download from the Allegro website. See the technical documents section of the ACS37010/2 webpage.

PACKAGE OUTLINE DRAWING

For Reference Only – Not for Tooling Use

(Reference DWG-000385, 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

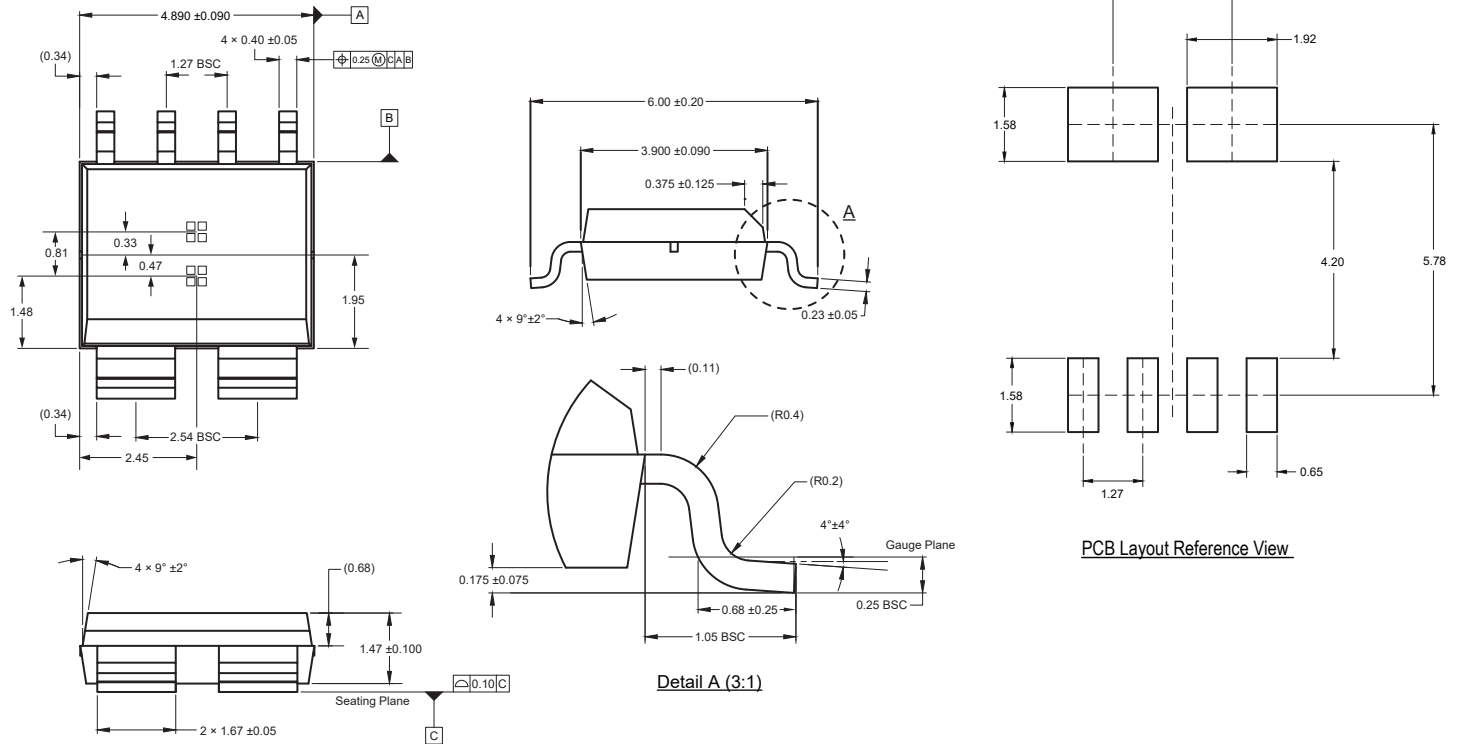


Figure 16: Custom 6-Pin SOIC (Suffix LZ)

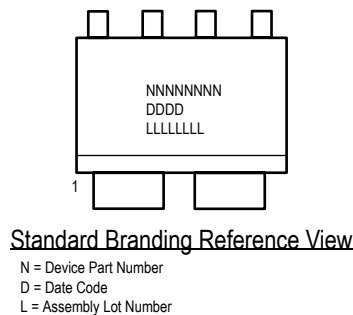


Figure 17: LZ Package Branding

ACS37010 and ACS37012

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

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 |

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