



INTEGRATED CURRENT SENSING WITHOUT A SHUNT IN A TINY 5-PIN SOT23-W PACKAGE

Integrated Conductor Current Sensor Systems Engineering
Allegro MicroSystems

INTRODUCTION

In the field of current sensing technology, Allegro MicroSystems continues to set the benchmark for innovation and performance. With the introduction of the 5-pin SOT23-W LH package, housing the industry's smallest leaded magnetic current sensors, the ACS37041 and ACS37042 enable improved efficiency and reliability while also allowing for a smaller bill of materials (BOM) compared to discrete shunt resistor and op-amp-based current sensing solutions. The ACS37041/2 features a voltage output that is galvanically isolated from the measured current. The ACS37041 features a 100 V_{RMS} functional insulation rating, while the ACS37042 is UL 62368 certified (certification pending) with a basic isolation rating of 285 V_{RMS}. The current conductor of the LH package has a low 1.6 mΩ resistance, ideal for low power dissipation constraints. Allegro's ACS37041/2 in the LH package (see Figure 1) addresses industry challenges by providing a smaller footprint, higher efficiency, and simpler integration.

This application note discusses the highlights of the LH package, showcasing how it outperforms traditional shunt current sensing solutions and brings unparalleled performance to a wide array of applications.

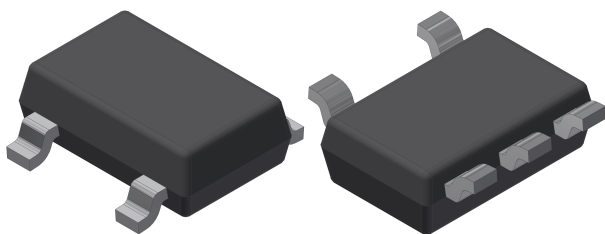


Figure 1: The Allegro LH integrated current sensor package: a compact 5-pin SOT23-W with 2 pins for the measured current and 3 additional signal pins.

INHERENT GALVANIC ISOLATION

The inherent galvanic isolation provided by the LH package adds an extra layer of safety and system protection, making it an ideal choice for applications requiring isolation between the higher voltage current path and the lower voltage output circuitry.

The package has one pin for the current going into the package, one pin for the current leaving the package, and three additional signal pins: GND, VOUT, and VDD. The primary current path is galvanically isolated from the three signal pins with a 100 V_{RMS} functional isolation for the ACS37041 and a 300 V_{RMS} basic isolation for the ACS37042. In the ACS37041/2, the current through the package is sensed using differential Hall plates and is reported as an analog signal at the VOUT pin. Despite its compact size, the LH package has been designed to measure currents of up to ±30 A.

This feature, combined with the package's compact footprint, positions the ACS37041/2 within the LH package as a superior alternative to discrete shunt resistor and op-amp-based current sensing solutions, offering improved efficiency, reliability, and a smaller overall system footprint.

HIGHLY COMPACT FOOTPRINT

The SOT23-W 5-pin LH package offers a small footprint, making it suitable for space-constrained applications without compromising on performance (see Figure 2). This small package is particularly beneficial in applications where space is at a premium, such as in densely packed PCBs found in automotive, industrial, and clean energy applications. The SOT23-W 5 pin configuration of the LH package allows it to maintain a similar footprint to traditional shunt amplifiers without the need for a shunt, yet it provides a complete current sensing solution that integrates seamlessly into a wide range of applications.

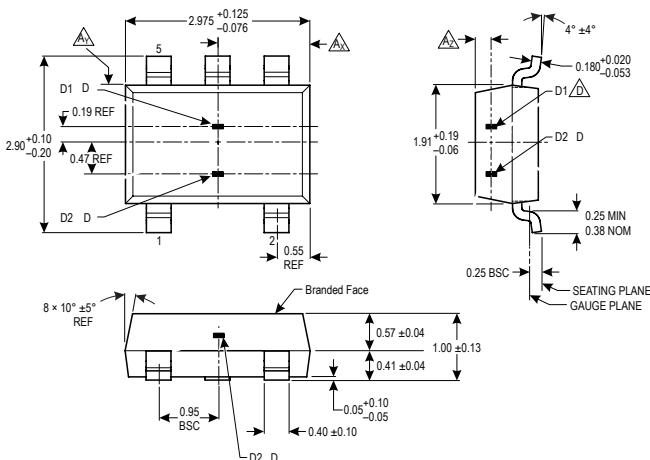


Figure 2: LH package 5-Pin SOT23-W package drawing showing dimensions

A SINGLE PACKAGE SOLUTION: INTEGRATED SHUNT-LESS SENSING

As with any integrated-conductor current sensor by Allegro, the ACS37041/2 is a system IC that is a complete and easy-to-use full sensing solution. All parts are factory-calibrated to achieve high accuracy and feature built-in signal conditioning, including temperature and stress compensation.

Current shunt solutions require multiple components and take up significant board space. These factors inevitably add weight and size, as well as design complexity, which leads to increased cost and production time. The compact LH package integrates the current sensing path, eliminating the need for bulky shunt resistors and complex amplifier circuits. The ACS37041/2 provides a single-package solution that simplifies design, reduces BOM, and enhances overall system reliability.

HIGH EFFICIENCY AND LOW POWER LOSS

The LH package design not only offers a solution that is highly efficient in terms of space utilization but also ensures minimal power dissipation due to its low 1.6 mΩ resistance. Handling up to 30 A in a 2.975 mm × 2.9 mm footprint requires high efficiency for the primary current and the LH package delivers just that.

On the Allegro evaluation board ACSEVB-LH5, with six layers of two ounce copper, the sensor can continuously measure more than 30 A at room temperature, without any forced cooling (Figure 3). The LH package is automotive grade 1 meaning the ACS37041/2 can be used in a wide array of temperatures

from -40°C to 125°C. Thermal performance varies based on ambient temperature. In addition, the thermal response is highly dependent on PCB layout, copper thickness, active/passive cooling, and thermal management techniques.

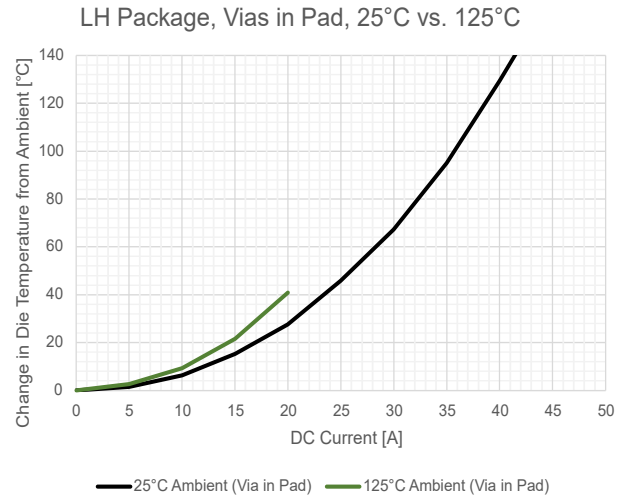


Figure 3: Temperature increase of ACS37041/2 in the LH package versus applied continuous DC current at two ambient temperatures, $T_A = 25^\circ\text{C}$ and $T_A = 125^\circ\text{C}$, as measured on Allegro evaluation board ACSEVB-LH5.

A fusing event can happen when the current flowing through the package significantly exceeds the conductor's rated current for a sustained period. When a fusing event occurs, the LH package is designed to fuse and melt open the conductor, interrupting the current flow to prevent damage to the system. The fused lead can then be observed with optical inspection. Because the fuse event can be identified by looking at the outside of the package, it is easy to determine that a fusing event has occurred and thus prevents further and potentially more invasive inspection.

CONCLUSION

The ACS37041/2 in the LH package is an innovative, industry-leading current sensor providing high efficiency and reliability. This isolated, shunt-less device offers a simplified design approach compared to traditional discrete solutions, reducing BOM, overall system complexity, and size. With its compact footprint, high accuracy, and minimal power loss, this single-package solution reduces board space and component count, which makes it ideal for space-constrained application. To learn more about the ACS37041 and ACS37042, or to order evaluation boards, design tools, and samples, visit www.allegromicro.com/en/Insights-and-Innovations/Allegro-Technology/eliminate-the-shunt.

Revision History

Number	Date	Description
-	October 31, 2024	Initial release

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