ALLEGRO'S LZ CURRENT SENSOR PACKAGE WITH HIGH ISOLATION AND OPTIMIZED THERMAL PERFORMANCE

Current Sensors System Engineering
Allegro MicroSystems

INTRODUCTION

Reinforced isolation and thermal management make the LZ current sensor package—Allegro's six-pin fused-lead small-outline integrated circuit (SOIC) package—a superior choice for many applications. The Grade 0 automotive-qualified LZ package makes it an ideal choice for electric-vehicle applications.

The LZ package shares the same footprint as a standard 8-pin SOIC (SOIC-8) package; however, the LZ package has lower conductor resistance and supports higher isolation ratings than current sensors in standard SOIC-8 packages, which allows it to be easily integrated into dense printed circuit board (PCB) layouts. Also, the LZ package uses flip-chip technology (see Figure 1) in which the die is located closer to the sensor Hall plates, thus increasing magnetic coupling and decreasing output noise.

HIGH-VOLTAGE ISOLATION

The LZ package boasts a 420 V_{RMS} reinforced voltage or an 840 V_{RMS} basic working voltage in a package that is smaller and more cost effective than a SOICW-16 package with comparable isolation ratings. For additional isolation characteristics and package characteristics, refer to Table 1 and Table 2.

Galvanic isolation is inherent in the sensor design. The current flows through the internal conductor of the LZ package, creating a magnetic field that couples the signal to the Hall sensor on the integrated circuit (IC) without any contact between the current and the IC.

Between the IC and the current conductor, an insulating polyimide film is applied to the current conductor as the primary layer of high-voltage insulation. An additional

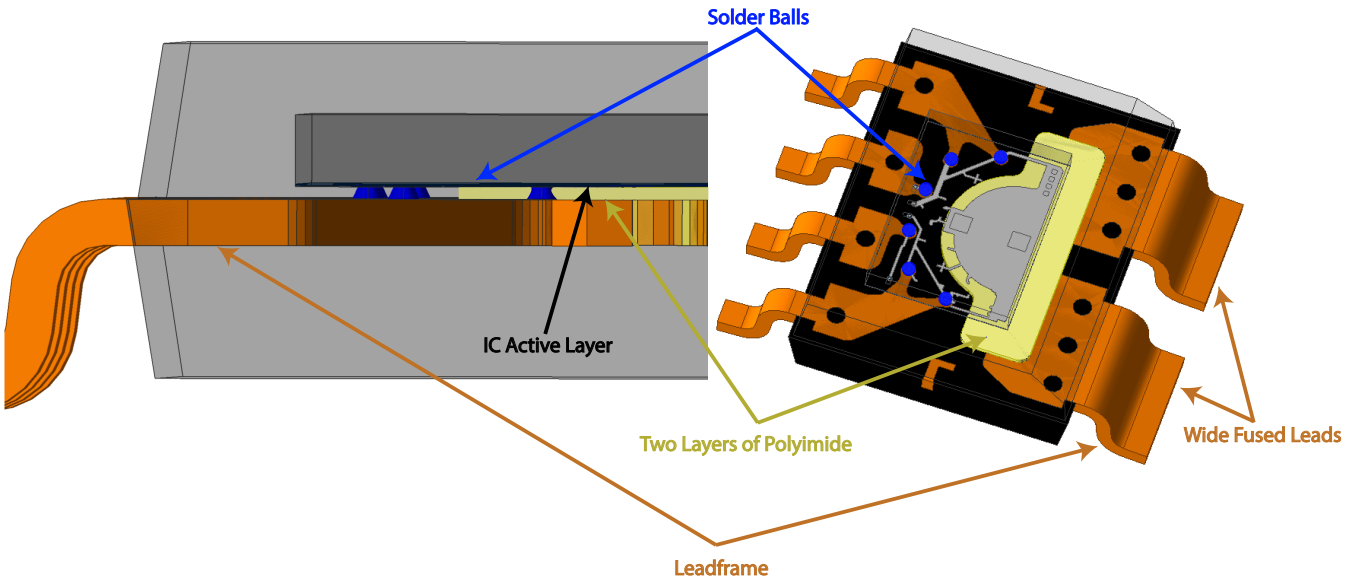

Figure 1: LZ internal package construction

polyimide layer is applied to the active side of the IC, which provides the secondary layer of insulation between the IC and the current conductor to achieve a reinforced rating.

Polyimide has excellent electrical insulation properties: It is more than 15 times better than the mold compound of the package in which the die and conductor are encapsulated.

Most current sensors use material group II mold compounds. The material group I compound used in the LZ package reduces external creepage requirements as defined by IEC-62368 for a particular working voltage. Therefore, this package, with only 4.2 mm of creepage, is able to achieve 840 V_{RMS} basic working voltage. The typical conformal coatings used to reduce creepage requirements are not required to achieve higher working voltages with this package.

Table 1: Isolation Characteristics [1]

Characteristic	Symbol	Notes	Value	Units
Withstand Strength	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 with IEC 61000-4-5, 1.2 µs (rise)/50 µs (width)	5000	V_{PK}
Working Voltage for Basic Isolation	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	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] In case of conflict between device datasheet and this application note, refer to the device datasheet.

Table 2: 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	–	–

THERMAL PERFORMANCE

The current conductor of the LZ package has a very low 0.68 mΩ resistance, primarily due to wide, fused conductor leads that minimize heat loss in the package. The die temperature increase versus DC current in the conductor at 25°C and 125°C ambient temperature on the Allegro evaluation board is shown in Figure 2. This performance is better than some much-larger SOICW-16 packages with higher conductor resistance. In addition to creating less heat, the fused leads help to dissipate heat to the PCB more efficiently.

Allegro current sensor ICs have a maximum junction temperature of 165°C, which allows them to be used with higher power or at higher temperature than most competing devices with 150°C maximum junction temperature. The polyimide film also acts as a thermal insulator that protects the die from the heat generated in the current conductor.

Connections are made from the leads to the secondary side via solder balls. The solder balls help to dissipate heat from the junctions to the PCB, which further reduces the junction temperature.

CONCLUSION

With a standard SOIC-8 footprint, the LZ package makes an excellent choice for high-power applications where system designers seek a compact, integrated, current-sensing solution for automotive, industrial, and consumer applications that require safety isolation. Devices housed in the LZ package include ACS37010/ACS37012 [1] and ACS37030/ACS37032. [2] For more information, refer to the device datasheet.

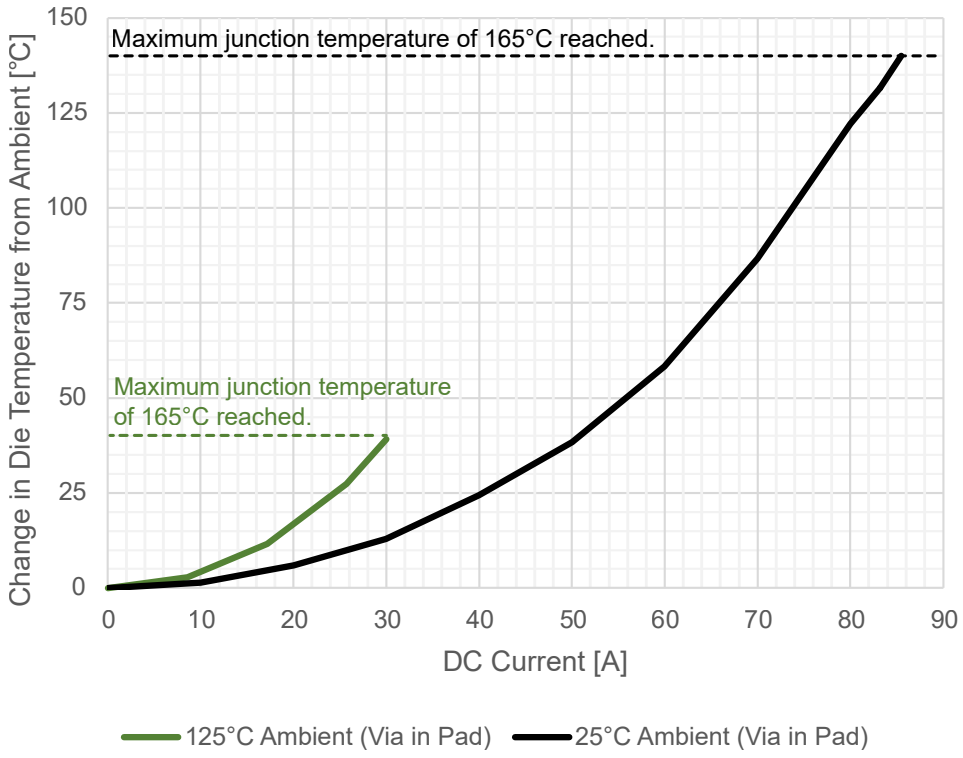

Figure 2: LZ performance at ambient temperatures of 25°C and 125°C

[1] https://www.allegromicro.com/en/products/sense/current-sensor-ics/zero-to-fifty-amp-integrated-conductor-sensor-ics/acs37010

[2] https://www.allegromicro.com/en/products/sense/current-sensor-ics/zero-to-fifty-amp-integrated-conductor-sensor-ics/acs37030-2

Revision History

Number	Date	Description
–	May 13, 2024	Initial release

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