

CB (SMT) Package Generic Evaluation Board User Guide

DESCRIPTION

Generic evaluation boards offer a method for quickly evaluating Allegro current sensors in a lab environment without needing a custom circuit board. This document describes the use of the CB Current Sensor Evaluation Board. This evaluation board (ACSEVB-CB5-SMT, TED-0004118) is intended for use with any CB package (five-pin custom Allegro current sensor package).

FEATURES

- Enhanced thermal performance:
 - Six-layer PCB with 2 oz copper weight on all layers
 - Nonconductive, filled via-in-pad used
 - High-performance FR4 material with 180°C glass transition temperature
- Flexible instrument connection:
 - Standard Keystone test points; SMA/SMB connector or two-pin header options are provided
- Sensor-integrated current-loop resistance can be measured directly on the evaluation board; voltage drop can be measured for approximating power loss in the package

EVALUATION BOARD CONTENTS

- Bare printed circuit board without populated components
 NOTE: It is up to the user to assemble the board with the desired current sensor. This board does not come populated with an Allegro current sensor.
- Recommended bill of materials (BOM) for all compatible current sensors are listed in the Bill of Materials section.

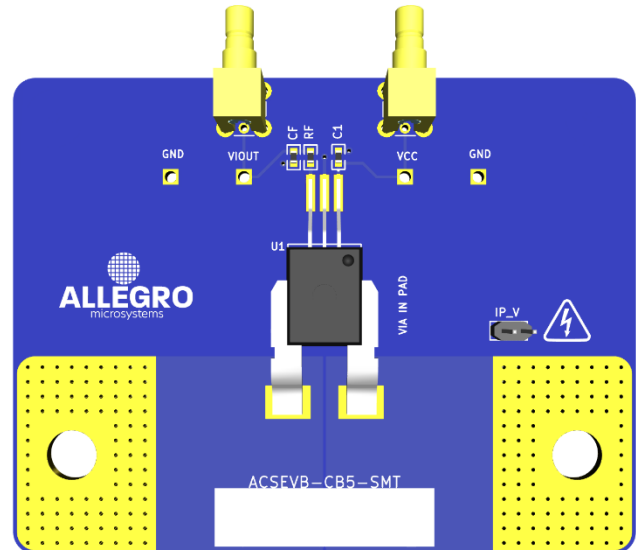


Figure 1: CB Evaluation Board

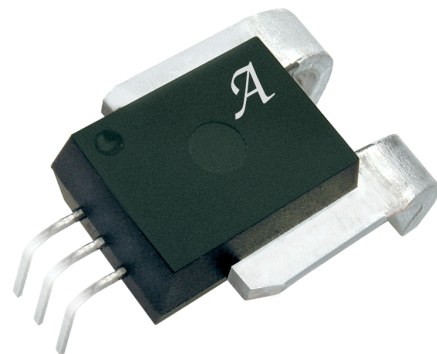


Figure 2: Custom Five-Pin Package (CB Package)

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USING THE EVALUATION BOARD

Evaluation Board Components

1. U1 is a CB package footprint (Pin 1 is on bottom left side, see the small white dot)
2. U1 pins allow the option to connect:
 - RPU: Pull-up resistor to VCC
 - RPD: Pull-down resistor to GND
 - C: Decoupling or load capacitor to GND
 - All passive components are 0603 package size
3. Keystone 5005 test points (e.g., Digikey# 36-5005-ND)
4. Standard SMB/SMA connector (e.g., Digikey# 1868-1429-ND)
5. Two-pin, 100 mil header connector option
NOTE: Either SMB or header can be assembled
6. Primary current cables mounting positions (positive current flow direction is left to right)
7. Two-pin, 100 mil header connector for voltage-drop measurement across the integrated current loop of the current sensor
8. RB1, RB2, RB3, and RB4: rubber bumper mounting positions (e.g., Digikey# SJ61A6-ND)

Evaluation Board Procedure

CONNECTING TO THE EVALUATION BOARD

The best way to connect measurement instruments to the evaluation board is to use SMB/SMA or Two-pin header connectors along with coaxial cables. This configuration is most resilient to external coupling and is the preferred measurement method, e.g., for high speed dI/dt transients.

Keystone test points are convenient for connection of any instrument; however, this method is recommended for DC setups only.

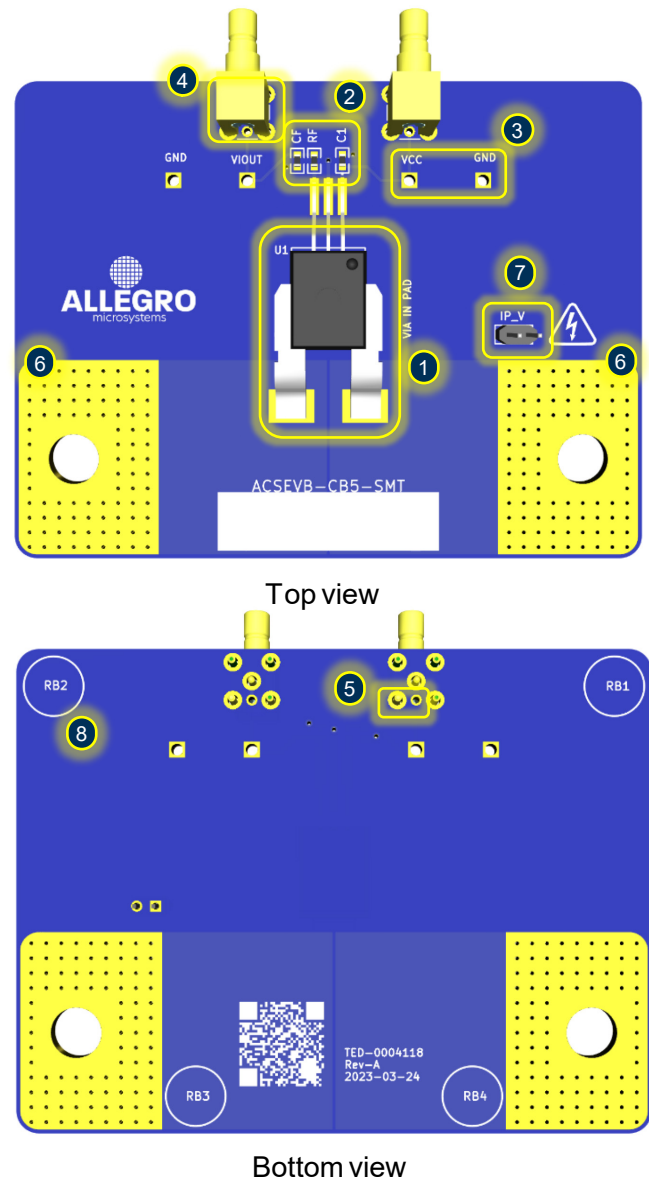


Figure 3: CB Current Sensor Evaluation Board Reference Image

EVALUATION BOARD PERFORMANCE DATA

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 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 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 heat-sinking to the PCB, while vias outside of the pads limit the current path to the top of the PCB trace and have worse heat-sinking capability when placed under the part (see Figure 4 and Figure 5). The ACSEVB-CB5 includes in-pad vias and is recommended to improve thermal performance.

NOTE: Designs with in-pad vias provides better thermal performance than without in-pad vias. The ACSEVB-CB5 uses in-pad vias.

The thermal capacity of the CB package should be verified by the end user in application-specific conditions. The maximum junction temperature, $T_{J(max)}$ (165°C), should not be exceeded. The temperature measured at the top of the package closely approximates the temperature of the die.

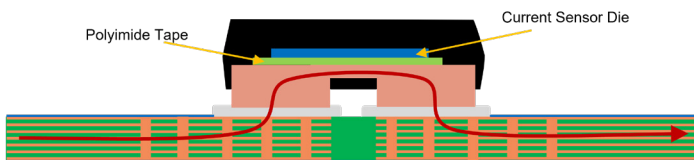


Figure 4: Vias Under Copper Pads Example

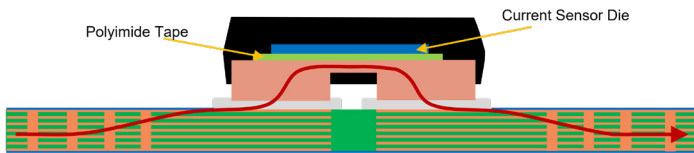


Figure 5: No Vias Under Copper Pads Example

SCHEMATIC

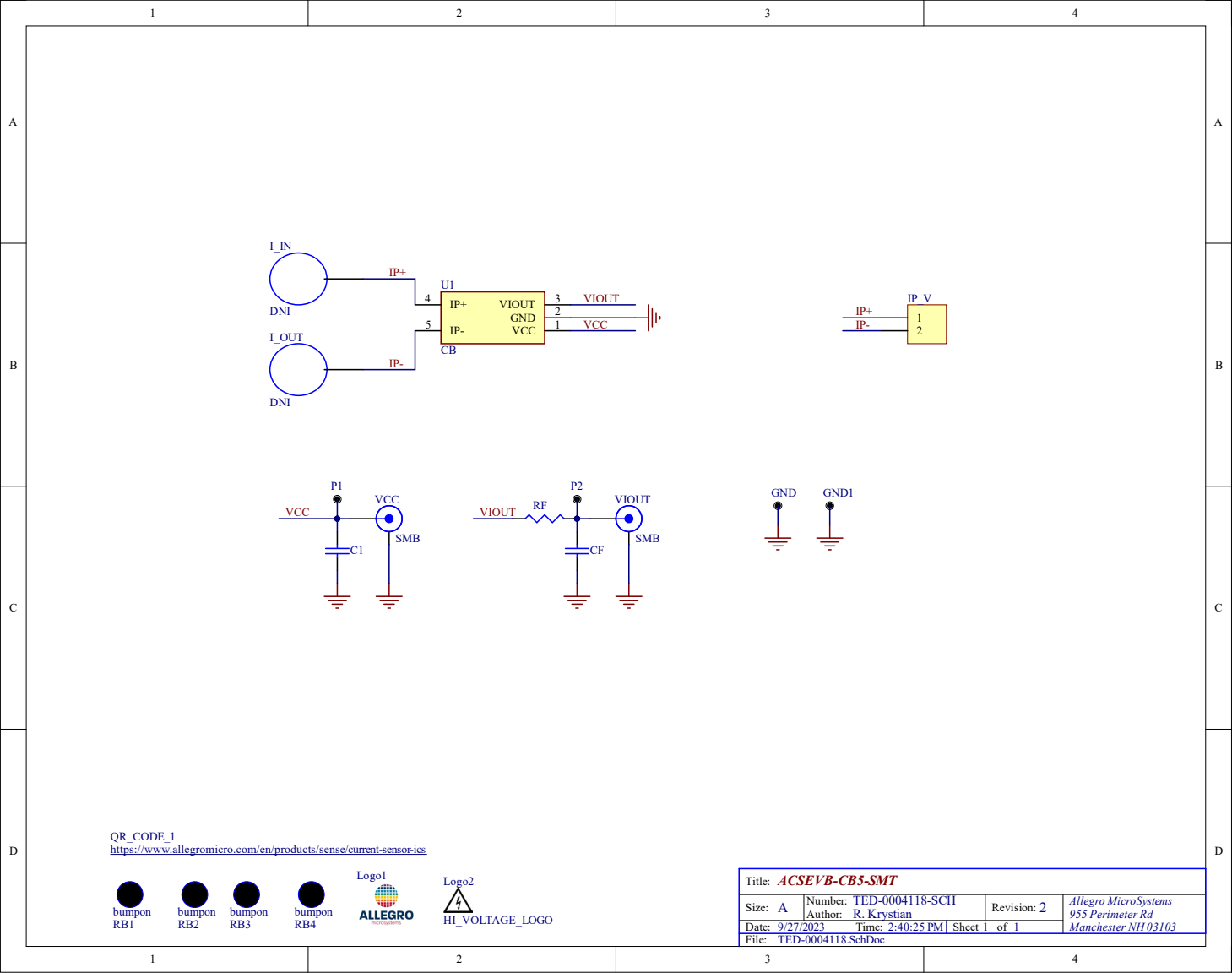


Figure 7: CB Generic Evaluation Board Schematic

LAYOUT

The CB current sensor evaluation board features test points that allow the current-sensor integrated current-loop resistance to be measured directly from the evaluation board. The voltage-drop sensing is routed in the first internal layer (as to not reduce the isolation specification of the package). As a consequence, the voltage drop includes the parasitic resistance of the vias between the top layer and the first interior layer.

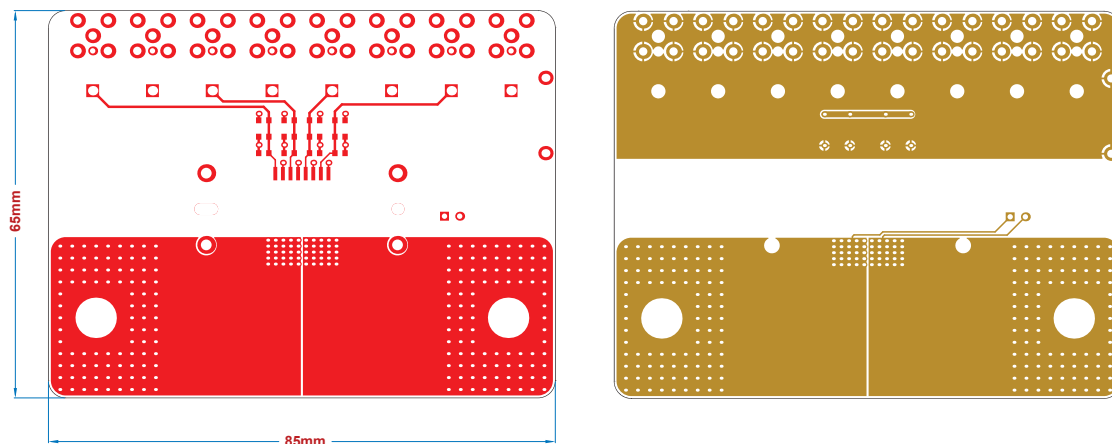


Figure 8: CB Generic Evaluation Board Top Layer (left) and Interior Layer 1

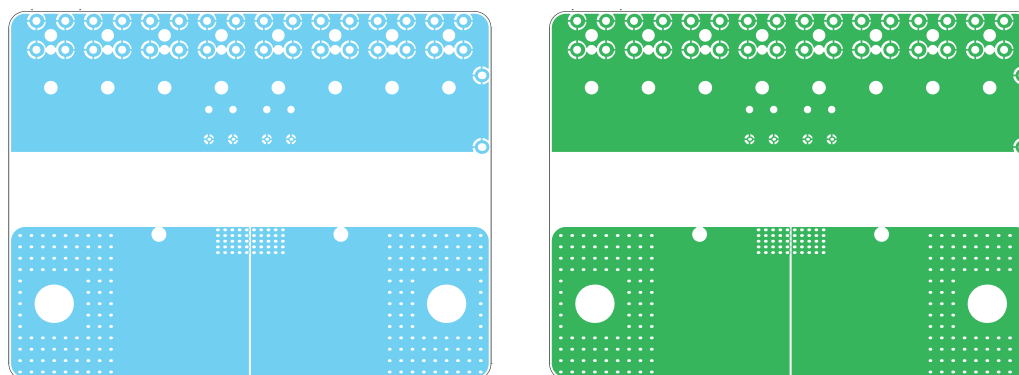


Figure 9: CB Generic Evaluation Board Interior Layer 2 (left) and Interior Layer 3

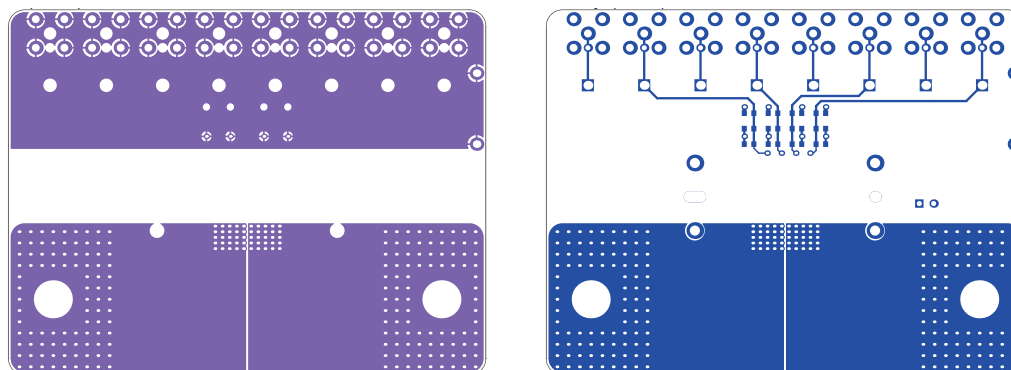


Figure 10: CB Generic Evaluation Board Interior Layer 4 (left) and Bottom Layer

BILL OF MATERIALS

Components listed are based on the typical application circuit given in the respective device datasheet.

Table 1: Evaluation Board Bill of Materials

CB-PACKAGE [1] ASSEMBLY VARIANT

Pin	Terminal	Components
1	VCC	Device power supply terminal, connected to supply voltage
2	GND	Device ground terminal, connected to GND
3	VOUT	Analog output signal, optional load capacitance or load resistance for noise management depending on the application
4	IP+	Positive terminals for current being sensed; fused internally
5	IP–	Negative terminal for current being sensed; fused internally

[1] e.g., ACS772, ACS773, or ACS770

RELATED LINKS AND APPLICATION SUPPORT

Table 2: Related Documentation and Application Support

Documentation	Summary	Location
Allegro Current Sensors Web Page	Product datasheet defining common electrical characteristics and performance characteristics	https://www.allegromicro.com/en/products/sense/current-sensor-ics
Allegro Current Sensor Package Documentation	Schematic files, step files, package images	https://www.allegromicro.com/en/design-support/packaging
An Effective Method for Characterizing System Bandwidth in Complex Current Sensor Applications	Application note describing methods used by Allegro to measure and quantify system bandwidth	https://allegromicro.com/en/insights-and-innovations/technical-documents/hall-effect-sensor-ic-publications/an-effective-method-for-characterizing-system-bandwidth-an296169
DC and Transient Current Capability/Fuse Characteristics of Surface Mount Current Sensor ICs	DC and Transient Current Capability/Fuse Characteristics of Surface Mount Current Sensor ICs	https://www.allegromicro.com/en/Insights-and-Innovations/Technical-Documents/Hall-Effect-Sensor-IC-Publications/DC-and-Transient-Current-Capability-Fuse-Characteristics.aspx
High-Current Measurement with Allegro Current Sensor IC and Ferromagnetic Core: Impact of Eddy Currents	Application note focusing on the effects of alternating current on current measurement	https://allegromicro.com/en/insights-and-innovations/technical-documents/hall-effect-sensor-ic-publications/an296162_a1367_current-sensor-eddy-current-core
Secrets of Measuring Currents Above 50 Amps	Application note regarding current measurement greater than 50 A	https://allegromicro.com/en/insights-and-innovations/technical-documents/hall-effect-sensor-ic-publications/an296141-secrets-of-measuring-currents-above-50-amps
Allegro Hall-Effect Sensor ICs	Application note describing Hall-effect principles	https://allegromicro.com/en/insights-and-innovations/technical-documents/hall-effect-sensor-ic-publications/allegro-hall-effect-sensor-ics
Hall-Effect Current Sensing in Electric and Hybrid Vehicles	Application note providing a greater understanding of hybrid electric vehicles and the contribution of Hall-effect sensing technology	https://allegromicro.com/en/insights-and-innovations/technical-documents/hall-effect-sensor-ic-publications/hall-effect-current-sensing-in-electric-and-hybrid-vehicles
Hall-Effect Current Sensing in Hybrid Electric Vehicle (HEV) Applications	Application note providing a greater understanding of hybrid electric vehicles and the contribution of Hall-effect sensing technology	https://allegromicro.com/en/insights-and-innovations/technical-documents/hall-effect-sensor-ic-publications/hall-effect-current-sensing-in-hybrid-electric-vehicle-hev-applications
Achieving Closed-Loop Accuracy in Open-Loop Current Sensors	Application note regarding current-sensor IC solutions that achieve near closed-loop accuracy using open-loop topology	https://allegromicro.com/en/insights-and-innovations/technical-documents/hall-effect-sensor-ic-publications/achieving-closed-loop-accuracy-in-open-loop-current-sensors
Allegro Current Sensor ICs Can Take the Heat! Unique Packaging Options for Every Thermal Budget	Application note regarding current sensors and package selection based on thermal capabilities	https://www.allegromicro.com/-/media/files/application-notes/an296190-current-sensor-thermals.pdf?sc_lang=en
Explanation Of Error Specifications For Allegro Linear Hall-Effect-Based Current Sensor ICs and Techniques for Calculating Total System Error	Application note describing error sources and their effect on the current sensor output	https://www.allegromicro.com/-/media/files/application-notes/an296181-ac72981-error-calculation.pdf?sc_lang=en

Revision History

Number	Date	Description
–	December 4, 2023	Initial release

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