ASEK37630

ACS37630 Evaluation Board User Guide

DESCRIPTION

This user guide documents the features, operation, and use of the ACS37630 current sensor with the ASEK37630 evaluation board. Allegro MicroSystems offers evaluation board units that provide a method for quick evaluation of the Allegro current sensor in a lab environment, without the requirement for a custom circuit board.

The evaluation board is used to evaluate the functionality of the ACS37630, a cost-effective and precise solution for AC and DC current sensing in busbar and high-current printed circuit board (PCB) applications that use a U-shaped concentrator. Applied current through a busbar or PCB generates a magnetic field that is sensed by the Hall integrated circuit (IC). The ACS37630 outputs an analog signal that varies linearly with the field sensed within the range specified. The U-shaped concentrator simplifies the design and assembly of the module, so it is an attractive alternative to traditional C-shaped concentrators. High isolation is achieved via the non-contact nature of this assembly.

This guide includes a schematic of the ASEK37630 evaluation board, reference documentation, measurement and operation techniques, PCB layouts, and a bill of materials (BOM).

FEATURES

This evaluation board is designed for the 4 mV/G variant of the ACS37630 (sensor part number ACS37630LOLLU-004B5) with a full-scale output range of approximately ±860 A, or the 2.5 m V/G variant of the ACS37630 (sensor part number ACS37630LOLLU-2P5B5) with a full-scale output range of approximately ±1380 A. VCC, GND, and VOUT test points are available as header pins for ease of connection to lab equipment. Holes at either end of the busbar allow for M5 bolt connections to lugs and high-current cables.

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Table 1: ACS37630 Evaluation Board Configurations

Part Number	Sensor Included	Description
ACSEVB-Ucore01-37630-01	ACS37630LOLLU-004B5	Full evaluation board assembly with U-core, busbar, and 4 mV/G sensor
ACSEVB-Ucore01-37630-02	ACS37630LOLLU-2P5B5	Full evaluation board assembly with U-core, busbar, and 2.5 mV/G sensor

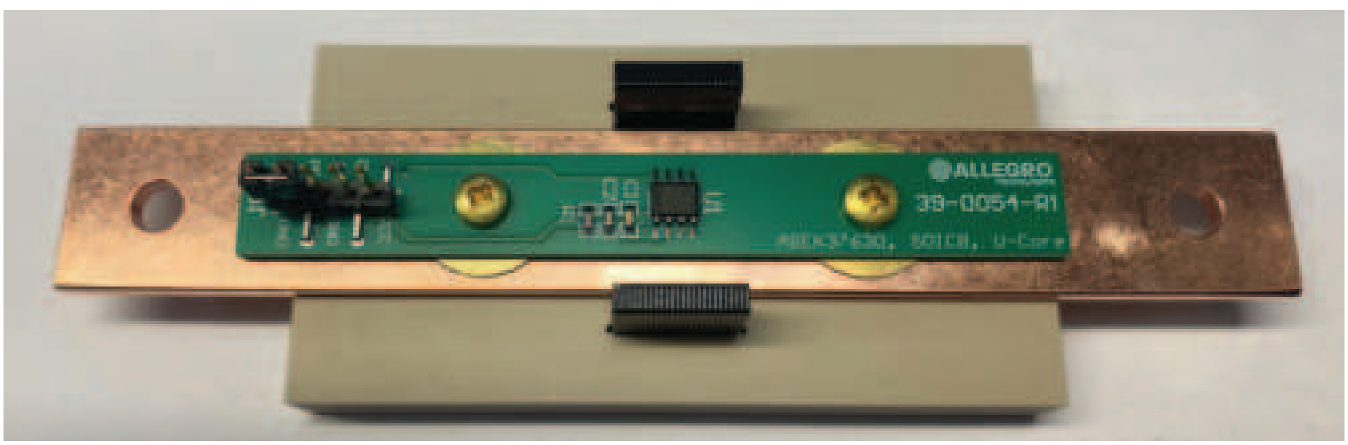

Figure 1: ASEK37630 Evaluation Board, Full Assembly with Busbar and U-Core

DESCRIPTION (continued)

Alternative U-Core Selection

This evaluation board assembly comes with a 20 mm-wide U-core supplied by Shanghai SEC Technology Co., Ltd (Sectech), giving full-scale output of ±860 A sensed current using a 4 mV/G sensor, or ±1380 A sensed current using a 2.5 mV/G sensor.

The internal width of the U-core is by far the most important factor influencing the coupling factor and, thus, the field at the sensor. To achieve a desired current sensing range, see the rough estimate of sensor gain performance for various core sizes shown in Table 2. Combinations that correspond to the Allegro evaluation boards are highlighted in green.

NOTE: For the higher current ranges in the table, a larger core thickness is required to avoid saturation. For application-specific concentrator design support, contact an Allegro representative.

High-quality U-cores of various shapes and sizes are available from Sectech. For more information, contact sales@sectech.com.cn.

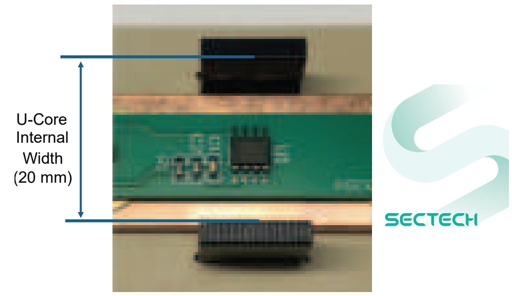

Table 2: Full-Scale Current vs. U-Core Width and Sensor Gain

U-Core Internal Width (mm)	Full-Scale Current (A, approximate) [1]		
	4 mV/G	2.5 mV/G	1.5 mV/G
10	±480	±770	±1280
15	±620	±990	±1650
20	±860	±1380	±2290
25	±1120	±1790	±2990

[1] This table provides a rough guideline. Coupling factor is also (weakly) affected by the other physical dimensions of the U-core, the material properties, and the location of the sensor within the U-shape. For application-specific simulation support, contact an Allegro representative.

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USING THE EVALUATION BOARDS

Assembly

The ASEK37630 assembly is shown in Figure 2. The complete bill of materials (BOM) is provided in the Bill of Materials section.

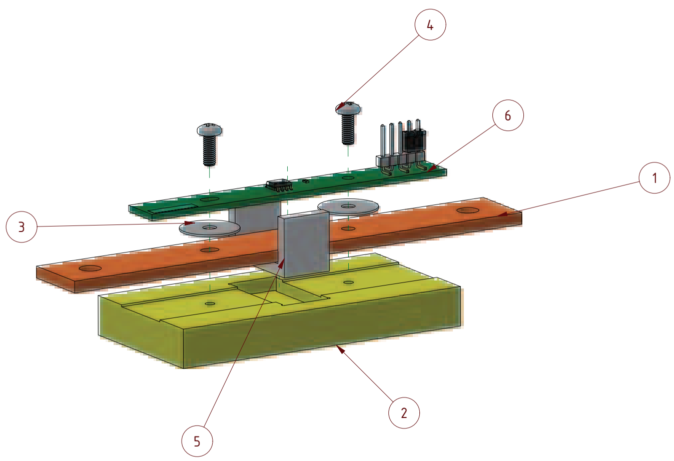


Figure 2: ASEK37630 Assembly—Exploded View

Connections

Supply 5 V to the VCC pin, connect ground to the GND pin, and connect measurement hardware (oscilloscope or multimeter) to the VOUT pin. Connect a high-current supply to both ends of the busbar. For best accuracy, use a four-point measurement on VOUT-GND: This provides a precise output voltage that is unaffected by contact resistance.

While customer programming is not currently supported on the ACS37630, a PROG pin header with a jumper that shorts it to GND is included in the PCB design and is available for troubleshooting use in collaboration with Allegro engineering support.

Common Measurements

The ASEK37630 evaluation board is useful when measuring device characteristics such as quiescent output voltage, $V_{OUT(Q)}$, and sensitivity, Sens.

To measure the ACS37630 quiescent output voltage, ensure the device is powered using the correct supply voltage, typically 5 V. Using an oscilloscope to view the output waveform, or a multimeter to view the output voltage level, verify the VOUT pin on the evaluation board is V CC/2 = 2.5 V. The deviation from this ideal value is defined as offset error:

Equation 1: Offset Error (mV) Calculation

$$Offset\ [mV] = \left(V_{OUT(Q)}[V] - \frac{V_{CC}[V]}{2}\right) \times 1000$$

To measure device sensitivity, first ensure the device is powered using the correct supply voltage. Apply a known current (IP) through the busbar; and, while the current is flowing, measure V_{OUT} again. Then, measure $V_{OUT(Q)}$ again, and calculate device sensitivity as:

Equation 2: Measured Sensitivity Calculation for ACS37630

$$Sens\ \left[\frac{mV}{A}\right] = \frac{V_{OUT}\ [V] - V_{OUT(Q)}[V]}{I_p\ [A]} \times 1000$$

Offset error can be converted from mV to A as:

Equation 3: Offset Error (A) Calculation

$$Offset\ [A] = \frac{Offset\ [mV]}{Mean\ (Sens\ [\frac{mV}{A}])}$$

where mean(Sens) is the average measured sensitivity over the full current range.

If only one sensitivity measurement is taken, it is recommended that the measurement be performed at a relatively high current to minimize the impact of U-core remanence error.

The total output error in percent full-scale (%FS) is calculated as:

Equation 4: Total Error (%FS) Calculation

$$E_{total}\ [\%FS] = \frac{(V_{OUT}(I)\ [V] - Fit(V_{OUT}(I))\ [V])}{2\ [V\ FS]} \times 100\ [\%]$$

where Fit(V_{OUT}(I)) is a linear fit to a series of measurements of V_{OUT} vs. current at room temperature.

PERFORMANCE DATA

Typical performance data using the evaluation board with a 4 mV/G sensor is shown in Figure 3 and Figure 4. Performance might vary slightly due to device-to-device variations and small variations in placement of assembly components relative to one another.

The offset error measured relative to $V_{CC}/2$ when current is not flowing is shown in Figure 3. The source of most of the offset error is remanence from the concentrator, which depends on the history of the previously applied current. The effect of the remanence from the concentrator depends on material properties and concentrator design; it is largely temperature-independent. The additional 2 to 3 mV shift in the hysteresis loops as temperature changes is a result of the offset error of the sensor itself.

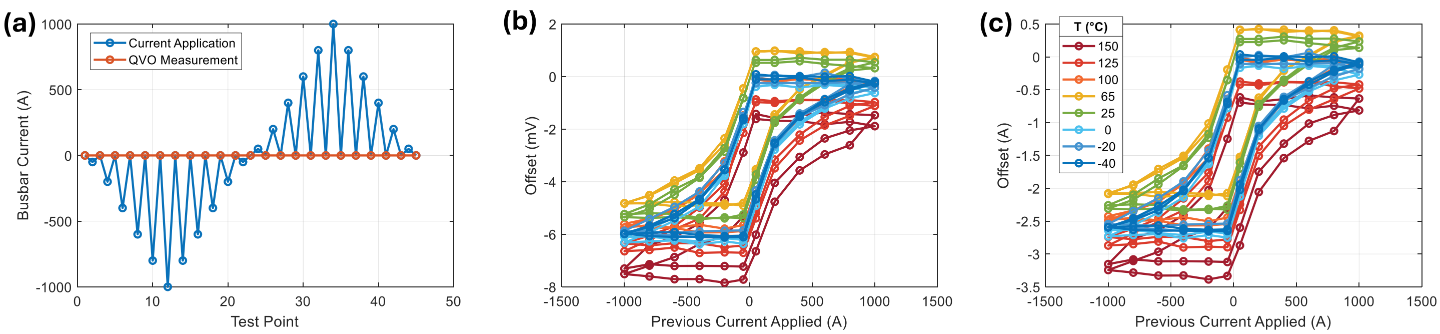
V_{OUT} (measured at all test points shown in Figure 3(a)) is plotted as a function of applied current in Figure 4(a).

NOTE: All temperature plots are overlaid, but the differences are too small to distinguish at this scale.

Sensitivity calculated using Equation 2 is shown in Figure 4(b). (The apparent low sensitivity at low current is related to the current history and concentrator remanence.)

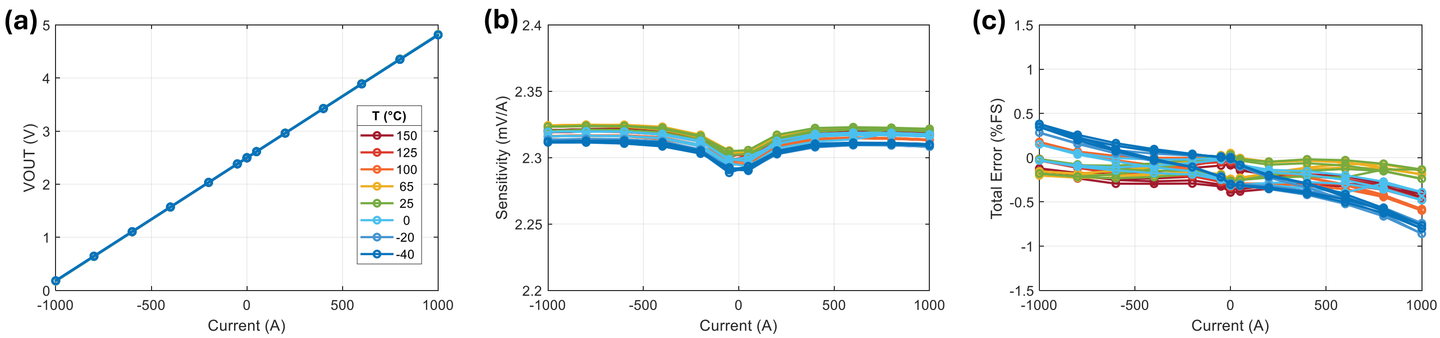
Because it is difficult to separate the effects of remanence and device sensitivity, it often makes sense to evaluate the total error, as shown in Figure 4(c), where the measured output is compared to an ideal linear output having a sensitivity of 2.325 mV/A:

- At high current, the error is dominated by the sensitivity drift over temperature of the sensor itself.
- At low current, the error depends on a combination of concentrator hysteresis and sensor offset error.



(a) History of current applied to obtain data in plots (b) and (c)
(b) Resultant offset error in mV (see Equation 1), where current is not applied (shown as a function of temperature and current history)
(c) Resultant offset error in amperes (see Equation 3) (shown as a function of temperature and current history)

Figure 3: Example Current Application History and Resultant Hysteresis Loops Using 4 mV/G Sensor



(a) V_{OUT} at all test points plotted as a function of applied current
(b) Sensitivity calculated using Equation 2
(c) Total error including offset and sensitivity (see Equation 4) over current and temperature

Figure 4: Example Sensitivity Calculations and Measurements, and Total Error Compared to Ideal

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SCHEMATIC

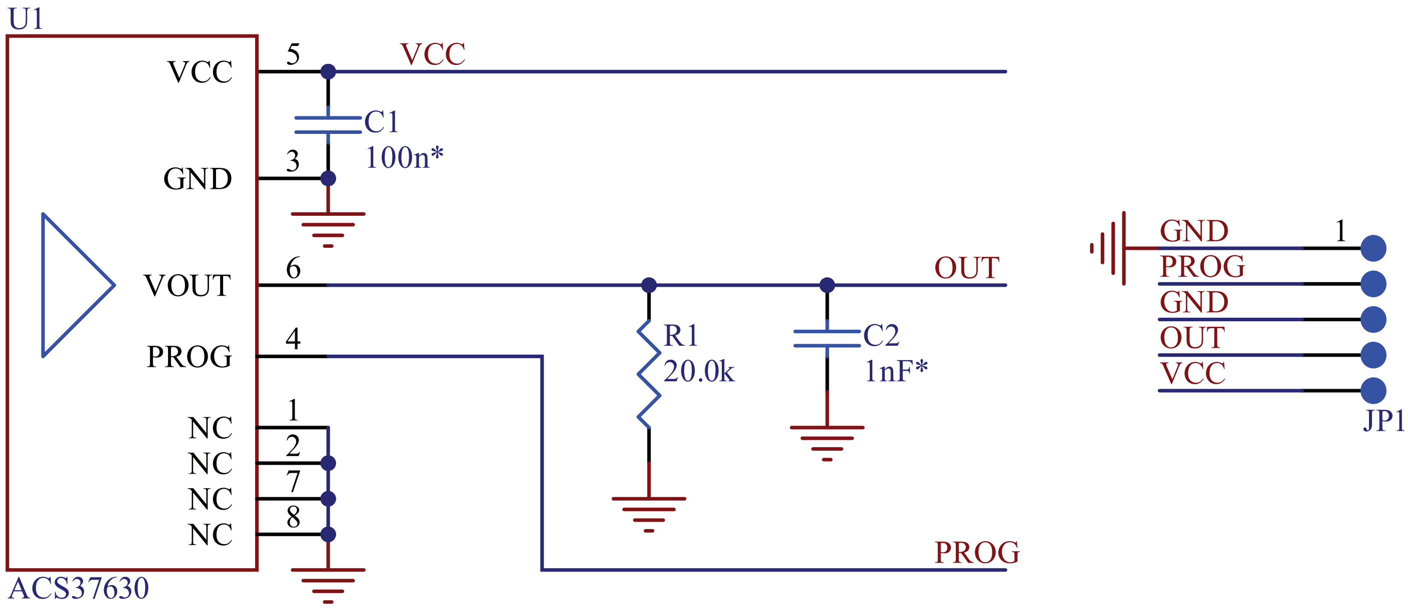

Figure 5: PCB Board Schematic

LAYOUT

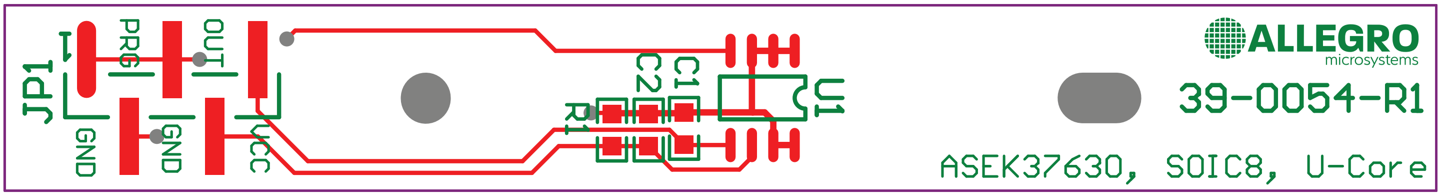

Figure 6: PCB Layout (Top Layer)

Figure 7: PCB Layout (Bottom Layer)

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BILL OF MATERIALS

Table 3: ASEK37630 Evaluation Board Bill of Materials

Designator/PCB Label	Quantity	Description	Manufacturer	Manufacturer Part Number
1	1	Busbar	Allegro	39-0050-002-DWG
2	1	Base holder	Allegro	39-0050
3	2	Spacer	Allegro	39-0050-005-DWG
4	2	Brass pan head Phillips	Mcmaster	96741A118
5	1	U-core	Sectech	Sectech-U26-15-13
6	1	PCB	Allegro	39-0054-001-R1
U1	1	IC, SOIC-8, current sensor	Allegro	ACS37630LOLLU-004B5 or ACS37630LOLLU-2P5B5
C2	1	Capacitor, 0603, 16 V, 1 nF, X8R, 150°C rated	Kemet	C0603C102J8HACTU
C1	1	Capacitor, 0603, monolithic, 16 V, X8R, 100 nF, 150°C rated	Vishay	VJ0603Y104JXXAC
R1	1	Resistor, 0603, 100 mW, thick film, 1%, 20 kΩ	Yageo	RC0603FR-0720KL
JS2	1	Jumper, 2-pin shunt, gold plating, 125°C rated	Molex	90059-0013
JP1	1	Jumper, 5-pin male, gold plating, 150°C rated	Sullins	GBC05SFBN-M30

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APPLICATION SUPPORT

For application support, visit https://www.allegromicro.com/en/about-allegro/contact-us/technical-assistance and navigate to the appropriate region.

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Revision History

Number	Date	Description
–	March 27, 2025	Initial release

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