ASEK37610

ACS37610 Evaluation Board User Guide

DESCRIPTION

This user guide documents the features, operation, and use of the ACS37610 current sensor with the ASEK37610 evaluation board. Allegro MicroSystems offers evaluation board units which offer a method for quickly evaluating the Allegro current sensor in a lab environment without needing a custom circuit board.

The evaluation board is used to evaluate the functionality of the ACS37610, an economical and precise solution for AC and DC current sensing in busbar and high-current PCB (printed circuit board) applications. Applied current through a busbar or PCB generates a magnetic field which is sensed by the Hall IC. The ACS37610 outputs an analog signal that varies linearly with the field sensed within the range specified. Differential sensing topology virtually eliminates error from common-mode stray magnetic fields. High isolation is achieved via the no-contact nature of this assembly.

This guide includes a schematic of the ASEK37610 EVB (evaluation board), reference documentation, measurement and operation techniques, printed circuit board (PCB) layouts, and a bill of materials (BOM). Table 1 below includes the test equipment document (TED) and description of each board for which this document is applicable.

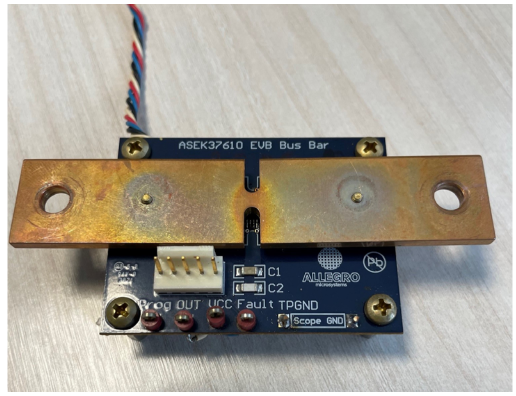

Figure 2: ASEK37610 Evaluation Board (board appearance will vary based on configuration)

Table of Contents

Table 1: ACS37610 Evaluation Board Configurations

Configuration Name	TED Number	Sensing Method	Key Benefits
ASEK37610, Board, EVB, 3.5 mm	TED-0003140	PCB Sensing	Reducing the width of the copper traces under the sensor (neckdown) increases the magnitude of the differential magnetic field measured by the ACS37610.
ASEK37610, Board, EVB, Q_RIFT_DC	TED-0003944	PCB Sensing	Good for high current PCB sensing (up to ≈300 to 400 A), high mechanical positioning tolerance.
ASEK37610, EVB, Busbar	TED-0003139	Busbar Current Sensing	Good for high current applications.
ASEK37610, ASEK-20 Daughterboard	TED-0003110	n/a	Daughterboard board used to communicate with ACS37610 sensor on ASEK37610 EVB.

FEATURES

The evaluation boards listed in Table 1 can be used for the evaluation of all gain options of the ACS37610, allowing for streamlined and fast evaluations of the device. The ASEK37610 evaluation boards feature test points for ease of access to the device pins. Several ASEK37610 evaluation boards are multilayer, allowing improved thermal performance, better power distribution, and higher signal integrity.

EVALUATION BOARD CONTENTS

ASEK37610, Board, EVB, 3.5 mm

The ASEK37610 evaluation board consists of eight layers; the top and bottom layers can be seen in the “Board Layouts” section below. The ASEK37610 PCB includes:

1. Footprint for 8-Pin TSSOP (DUT1)
2. Banana jacks (I_IN and I_OUT) for applied current
3. Header for wiring harness
4. Test points for fast connections

ASEK37610, Board, EVB, Q_RIFT_DC

The ASEK37610 evaluation board consists of six layers; the top and bottom layers can be seen in the “Board Layouts” section below. The ASEK37610 PCB includes:

1. Footprint for 8-Pin TSSOP (DUT1)
2. Banana jacks (I_IN and I_OUT) for applied current
3. Header for wiring harness
4. Test points for fast connection

ASEK37610, EVB, Busbar

The ASEK37610 EVB busbar evaluation board consists of two layers; the top and bottom layers can be seen in the “Board Layouts” section below. The ASEK37610 PCB includes:

1. Footprint for 8-Pin TSSOP
2. Holes for mounting the busbars
3. Header for wiring harness
4. Test points for fast connections
5. Test points ground for scope clips

An exploded view of the complete ASEK37610, EVB, Busbar evaluation board is shown in Figure 1. See the Bill of Materials section below for a detailed explanation of the components. The ASEK37610, EVB, Busbar includes:

1. Current busbar
2. Busbar standoffs
3. Current connection screws
4. Washer
5. Nut
6. Busbar mounting screws
7. Standoff mounting screw
8. PCB standoff

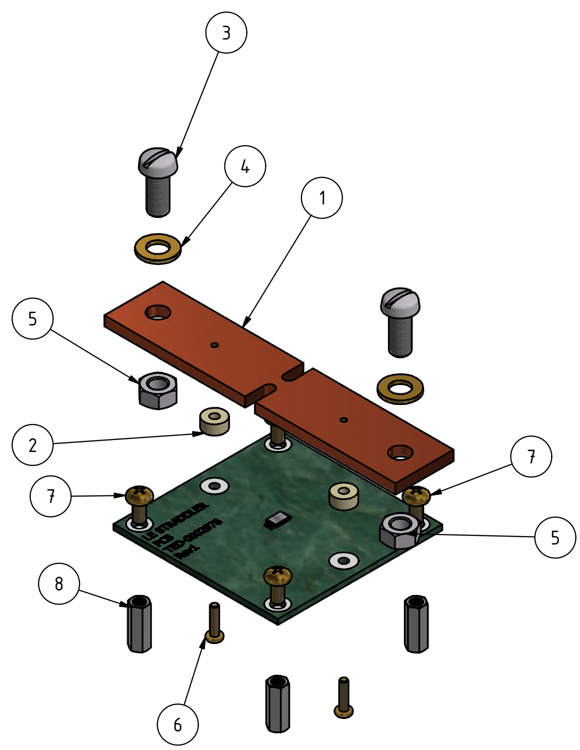

Figure 1: Exploded view of the ASEK37610, EVB, Busbar evaluation board

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USING THE EVALUATION BOARDS

Evaluation Board Connections

Note: Board appearance will be different based on the board configuration used. Concepts still apply. The supply voltage V_{CC} may be applied across the VCC and GND test points. The ACS37610 analog output V_{OUT} may be observed by attaching an oscilloscope probe or DMM to the OUT test point. The FAULT output may be observed by attaching an oscilloscope probe or DMM to the FAULT test point. These connections are shown on the ASEK37610 Busbar evaluation board for reference in Figure 3 below.

Figure 3: ASEK37610 Test Point Connections

High current may be applied directly to the busbar using the current connection screws. The high current connections are shown on the ASEK37610 evaluation board for reference below in Figure 4. If not using a busbar and using a PCB sensing ASEK37610 evaluation board, current connections will be applied to banana jacks (I_IN and I_OUT) on the PCB.

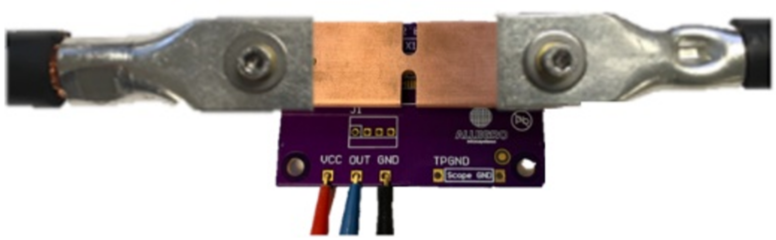

Figure 4: Primary Current Connections

Common Measurements

The ASEK37610 evaluation board is useful when measuring device characteristics such as quiescent output voltage, $V_{OUT(Q)}$, and sensitivity, sens.

To measure the ACS37610 quiescent output voltage, ensure the device is powered using the correct supply voltage, typically 3.3 V or 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 $V_{CC}/2$ (for bidirectional devices) and $V_{CC}/10$ (for unidirectional devices). For example, in the case of a bidirectional output device with nominal V_{CC} = 5 V, $V_{OUT(Q)}$ = 2.5 V.

To measure device sensitivity, first ensure the evaluation board is powered using the VCC and GND test points. After confirming the device is powered, measure the device's quiescent output voltage. Apply a known current (I_P) to the device and measure the device output. Use the following equation below to calculate device sensitivity:

$$\text{sens}\left[\frac{\text{mV}}{A}\right] = \frac{V_{\text{OUT}}\,[\text{V}] - V_{\text{OUT (Q)}}\,[\text{V}]}{\text{IP [A]}} \times 1000$$

Equation 1: Measured Sensitivity Calculation for ACS37610

Calculating Full-Scale Current Range using CF and IC Sensitivity

The ACS37610 is currently offered in several different gain selects: 5 mV/G, 10 mV/G, and 20 mV/G. The full-scale current sensing range of the device depends on the sensitivity of the sensor and the design of the reference busbar or PCB. To calculate the maximum current sensing range, coupling factor and IC sensitivity must be known. The example below demonstrates how to calculate the maximum current sensing using a coupling factor of 0.21 G/A and a device sensitivity of 10 mV/G. The desired output voltage swing is 2000 mV.

$$2000\ \text{mV} \times \frac{\text{G}}{10\ \text{mV}} \times \frac{\text{A}}{0.21\ \text{G}} = 952\ \text{A}$$

Equation 2: Full-Scale Current Calculation for ACS37610

For the above example, the maximum current sensing range would be 952 A.

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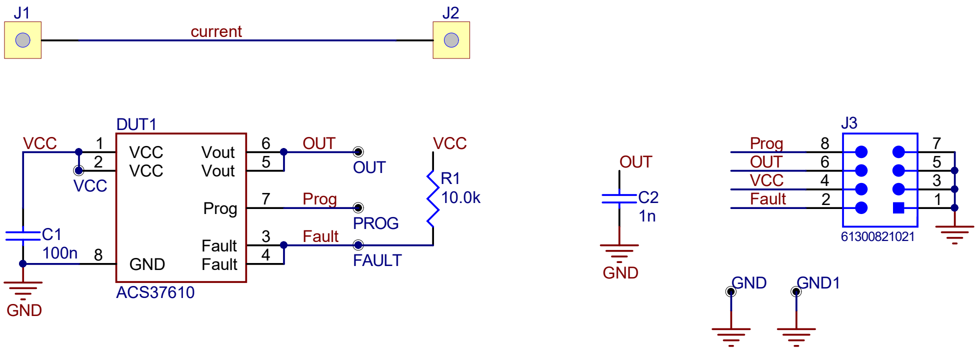
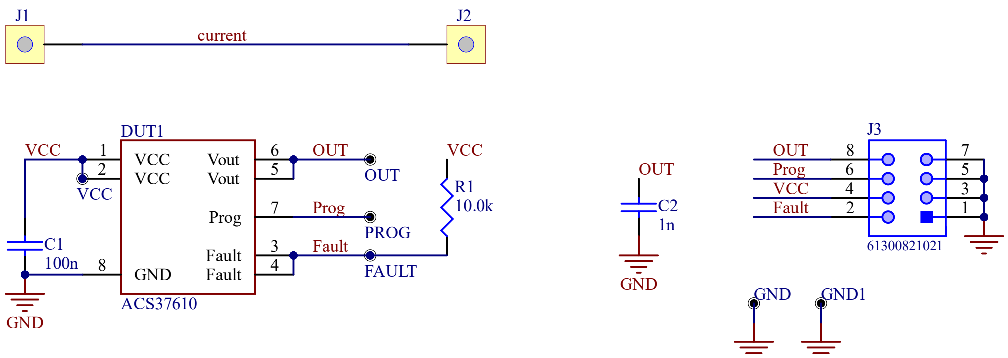
BOARD SCHEMATICS

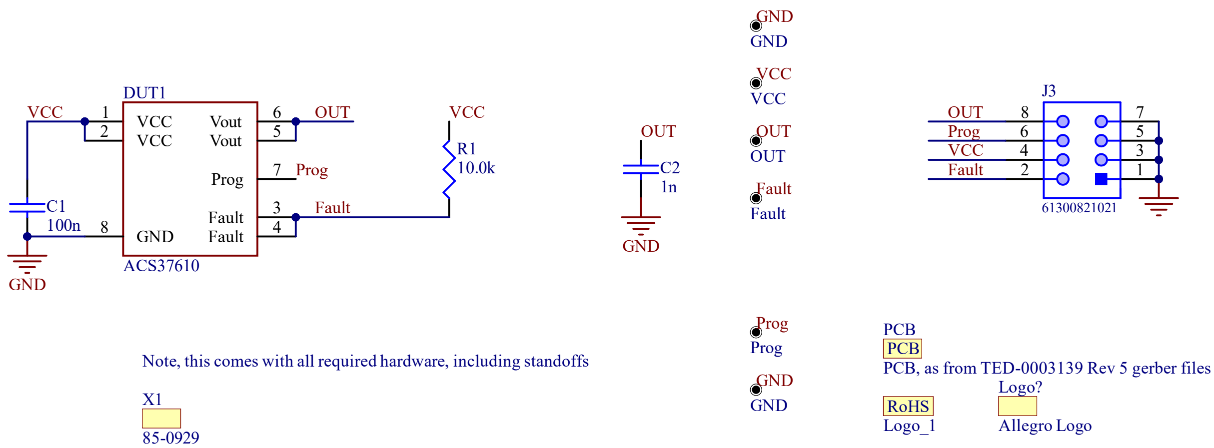
ASEK37610, Board, EVB, 3.5 mm



ASEK37610, Board, EVB, Q_RIFT_DC



ASEK37610, EVB, Busbar



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BOARD LAYOUTS

ASEK37610, Board, EVB, 3.5 mm

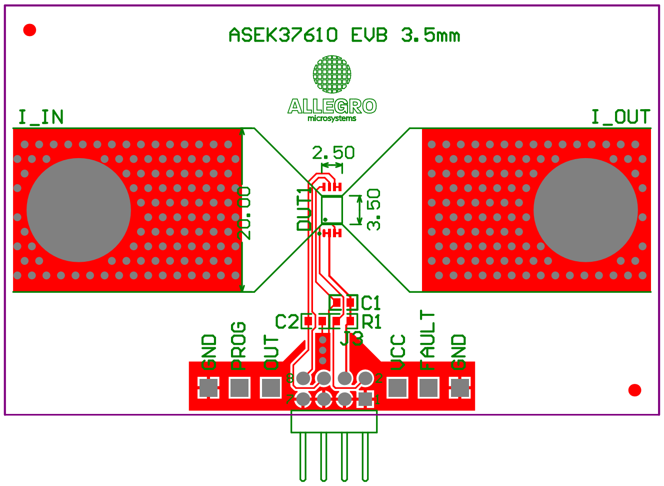

Figure 5: ASEK37610, Board, EVB, 3.5 mm Top Layout

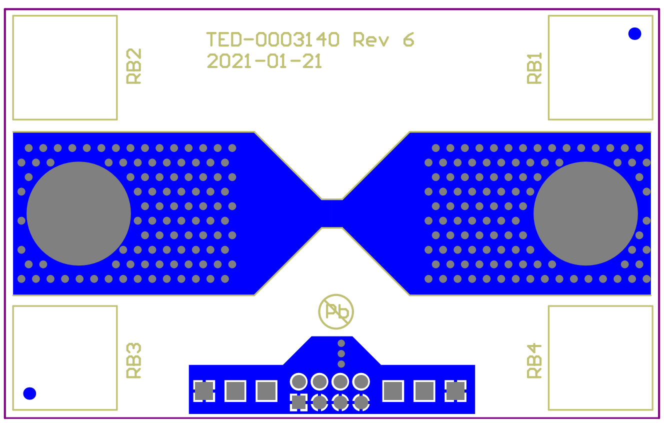

Figure 6: ASEK37610, Board, EVB, 3.5 mm Bottom Layout

ASEK37610, Board, EVB, Q_RIFT_DC

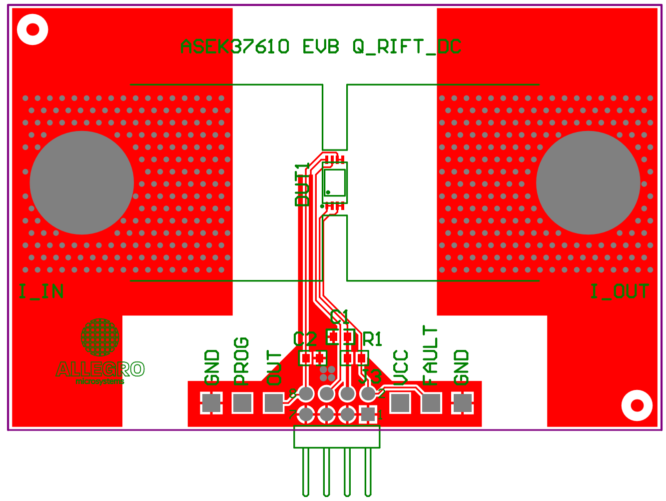

Figure 7: ASEK37610, Board, EVB, Q_RIFT_DC Top Layout

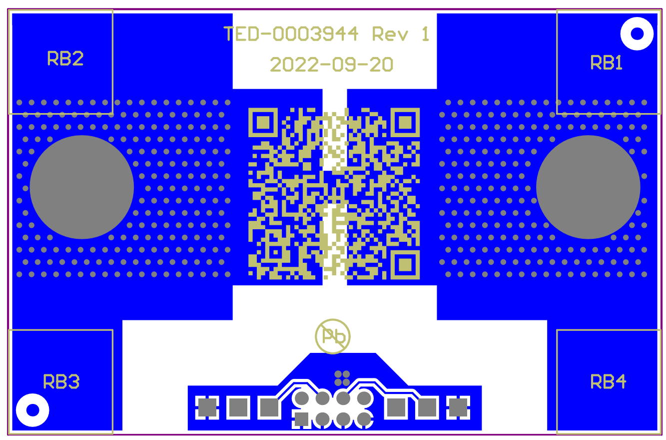

Figure 8: ASEK37610, Board, EVB, Q_RIFT_DC Bottom Layout

ASEK37610, EVB, Busbar

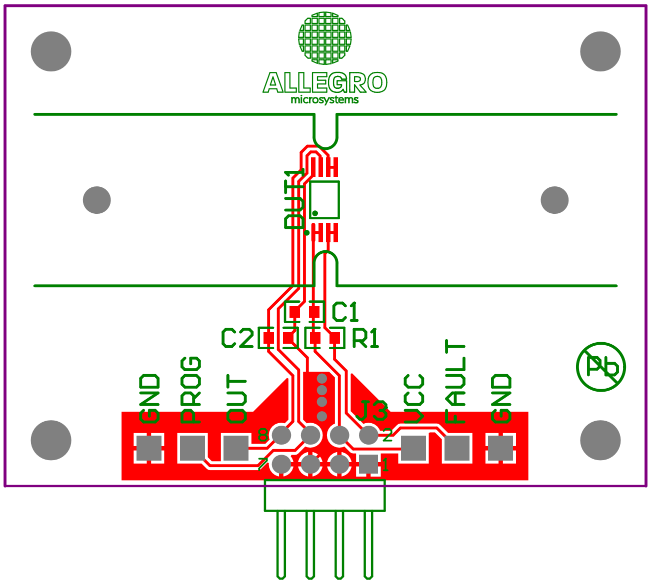

Figure 9: ASEK37610, EVB, Busbar Top Layout

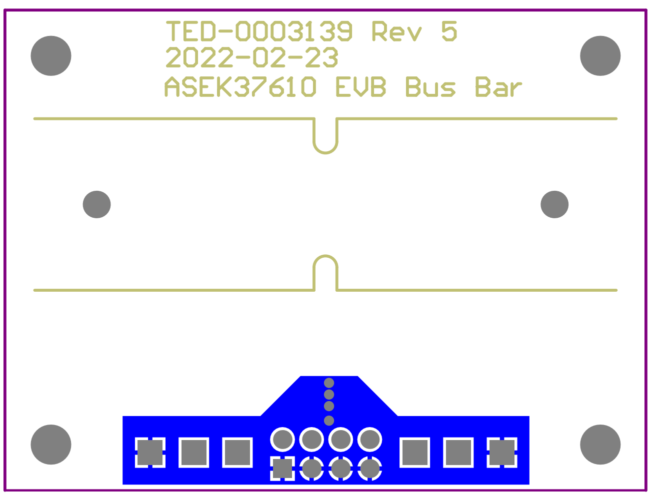

Figure 10: ASEK37610, EVB, Busbar Bottom Layout

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BILL OF MATERIALS (BOM)

Table 2: ASEK37610, Board, EVB, 3.5mm Board Bill of Materials

Designator/PCB Label	Quantity	Description	Manufacturer	Manufacturer Part Number
DUT1	1	IC, TSSOP-8, sensor	Allegro	ACS37610LLUA-10B5
C2	1	Capacitor, 0603, mono, C0G, 50 V, 1 nF	AVX	06035A102JAT2A
C1	1	Capacitor, 0603, mono, X7R, 50 V, 100 nF	AVX	06035C104K4T2A
R1	1	Resistor, 0603, 100 mW, thick film, 1%, 10.0 kΩ	Panasonic	ERJ-3EKF1002V
J1	1	Do not install		
J2	1	Do not install		
J3	1	Connector header through hole, right angle 8 position 0.100" (2.54 mm)	Würth Elektronik	61300821021
GND1	1	Test point, thro, compact, for 62 mil PCB, red	Keystone	5005
FAULT, GND, OUT, PROG, VCC	5	Test point, thro, compact, for 62 mil PCB, red	Keystone	5005
RB1, RB2, RB3, RB4	4	Bumpon, rubber, 0.5 inch square, black	3M	SJ-5518 (black)
F1, F2	2	Nothing to install — fiducial mark for PCB		
PCB	1	PCB, as from TED-0003140 Rev 6 gerber files	Allegro	TED-0003140

Table 3: ASEK37610, Board, EVB, Q_RIFT_DC Board Bill of Materials

Designator/PCB Label	Quantity	Description	Manufacturer	Manufacturer Part Number
DUT1	1	IC, TSSOP-8, sensor	Allegro	ACS37610LLUA-20B5
C2	1	Capacitor, 0603, mono, C0G, 50 V, 1 nF	AVX	06035A102JAT2A
C1	1	Capacitor, 0603, mono, X7R, 50 V, 100 nF	AVX	06035C104K4T2A
R1	1	Resistor, 0603, 100 mW, thick film, 1%, 10.0 kΩ	Yageo	RC0603FR-0710KL
J1	1	Do not install		
J2	1	Do not install		
J3	1	Connector header through hole, right angle 8 position 0.100" (2.54 mm)	Würth Elektronik	61300821021
FAULT, GND, GND1, OUT, PROG, VCC	6	Test point, thro, compact, for 62 mil PCB, red	Keystone	5005
RB1, RB2, RB3, RB4	4	Bumpon, rubber, 0.5 inch square, black	3M	SJ-5518 (black)
F1, F2	2	Nothing to install — fiducial mark for PCB		
PCB	1	PCB, ASEK37610, Board, EVB, Q_RIFT_DC	Allegro	TED-0003944-R1-PCB

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Table 4: ASEK37610, EVB, Busbar Board Bill of Materials

Designator/PCB Label	Quantity	Description	Manufacturer	Manufacturer Part Number
DUT1	1	IC, TSSOP-8, sensor	Allegro	ACS37610LLUA-10B5
X1	1	LE Straddler Busbar Demo	Allegro	85-0929
C2	1	Capacitor, 0603, mono, C0G, 50 V, 1 nF	AVX	06035A102JAT2A
C1	1	Capacitor, 0603, mono, X7R, 50 V, 100 nF	AVX	06035C104K4T2A
R1	1	Resistor, 0603, 100 mW, thick film, 1%, 10.0 kΩ	Panasonic	ERJ-3EKF1002V
J3	1	Connector header through hole, right angle 8 position 0.100" (2.54 mm)	Würth Elektronik	61300821021
FAULT, GND, OUT, PROG, VCC	6	Test point, thro, compact, for 62 mil PCB, red	Keystone	5005
PCB	1	PCB, as from TED-0003139 Rev 5 gerber files	Allegro	TED-0003139

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Related Documentation

The ACS37610 product datasheet is available for download on the Allegro website. In addition, several application notes and related information is available. This information is listed in the table below.

Table 5: Related Documentation and Application Notes

Documentation	Summary	Location
ACS37610 Product Datasheet	Product datasheet defining common electrical characteristics and performance characteristics.	ACS37610 Product Page
ACS37610 Purchasing	Purchasing homepage.	ACS37610 Product Page
ACS37610 Gerber Files	Schematic files containing demo board layers.	ACS37610 Product Page
ACS37610 Samples Programmer Software	Programming software for download.	https://registration.allegromicro.com/login
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://www.allegromicro.com/-/media/files/application-notes/an296169-acs720-bandwidth-testing.pdf
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://www.allegromicro.com/-/media/files/application-notes/an296162_a1367_current-sensor-eddy-current-core.pdf
ACS37610 Busbar Geometry and Design Techniques (AN296194)	Application note offering guidelines for selecting the optimum combination of ACS37610 and busbar geometry for a given current sensor application and its specific requirements.	https://www.allegromicro.com/-/media/files/application-notes/an296194-acs37610-busbar.pdf?sc_lang=en
Notched Busbar Design Guidelines For Coreless ACS37610 Differential Current Sensor (AN296231, P0110)	Application note focusing on how a busbar should be designed to achieve optimum performance with the ACS37610 coreless current sensor.	https://www.allegromicro.com/-/media/files/application-notes/an296231-acs37610-busbar-notch-guidelines.pdf?sc_lang=en
Overcurrent Fault Detection Using ACS37610 Coreless Current Sensor	Application note explaining how the Overcurrent-Fault (OCF) feature of Allegro ACS37610 device can be used in application to reliably detect overcurrent conditions and how it can be configured to optimize accuracy and cover different application needs.	https://www.allegromicro.com/-/media/files/application-notes/an296241-overcurrent-fault-detection-acs37610.pdf?sc_lang=en
Transient Current Behavior in Applications Using the Allegro Coreless ACS37610 Differential Current Sensor (AN296258, P0207)	Application note explaining how the conductor design can impact the response time of the current measurement for coreless current sensing applications and provides examples of response time to transient current for two types of conductors.	https://www.allegromicro.com/-/media/files/application-notes/an296258-acs37610-transient-current-behavior.pdf?sc_lang=en
Allegro Hall-Effect Sensor ICs	Application note providing a basic understanding of the Hall effect and how Allegro designs and implements Hall technology in packaged semiconductor monolithic integrated circuits.	https://www.allegromicro.com/-/media/files/application-notes/an27701-hall-effect-ic-application-guide.pdf?sc_lang=en
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://www.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://www.allegromicro.com/-/media/files/application-notes/an29610-hall-effect-current-sensing-in-electric-and-hybrid-vehicles.pdf?sc_lang=en

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Documentation	Summary	Location
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://www.allegromicro.com/en/insights-and-innovations/technical-documents/hall-effect-sensor-ic-publications/achieving-closed-loop-accuracy-in-open-loop-current-sensors
Guidelines For Designing a Busbar with Notch for Allegro's Coreless ACS37610/12 Differential Current Sensor	Application note offering guidelines for achieving optimum busbar and notch designs using the Allegro ACS37610/12 coreless current sensor.	https://www.allegromicro.com/-/media/files/application-notes/an296188-acs37612-guidelines-for-designing-a-busbar-web.pdf
PCB Ground Plane Optimization for Coreless Current Sensor Applications	Application note discussing PCB ground plane optimization for Coreless Current Sensor Applications.	https://www.allegromicro.com/en/insights-and-innovations/technical-documents/hall-effect-sensor-ic-publications/an296277-pcb-ground-plane-optimization-for-coreless-current-sensor-applications
Allegro ACS37610/12 Busbar Calculator	GUI designed to aid in busbar design and application.	https://allegromicro.com/busbar/
Allegro ACS37610/12 PCB Design Tool	GUI designed to aid in PCB current sensing design and application.	https://www.allegromicro.com/-/media/files/design-tools/acs37612-pcb-design-tool.zip?sc_lang=en

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Busbar Design Recommendations GUI

For busbar design recommendations, refer to “Guidelines for Designing a Busbar with Notch for Allegro’s Coreless AS37612 Differential Current Sensor” (https://www.allegromicro.com/-/media/allegro/allegromicro/files/application-notes/an296188-ACS37610-guidelines-for-designing-a-busbar-web.ashx) along with Allegro’s interactive busbar design tool in the ACS37610 Samples Programmer on ACS37610 webpage (https://allegromicro.com/en/products/sense/current-sensor-ics/sip-package-zero-to-thousand-amp-sensor-ics/ACS37610). See Figure 21 below for an illustration of the busbar design GUI.

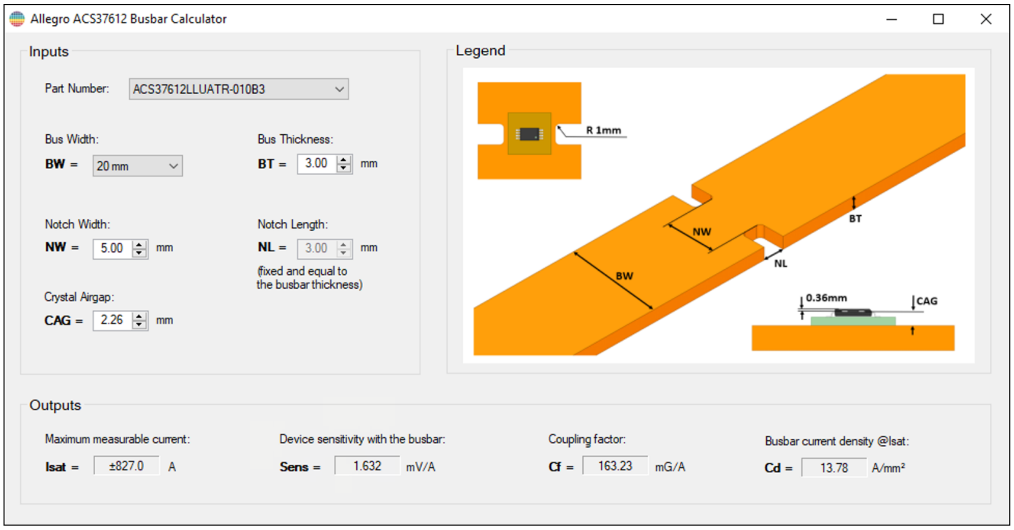

Figure 11: ACS37610 Busbar Calculator GUI

Inputs to the GUI include part number, bus width, bus thickness, notch width, and air gap.

For PCB sensing design recommendations, refer to the Coreless PCB Calculator, located under “Design Support Tools” on the ACS37610 webpage (https://allegromicro.com/en/products/sense/current-sensor-ics/sip-package-zero-to-thousand-amp-sensor-ics/ACS37610). See Figure 22 below for reference.

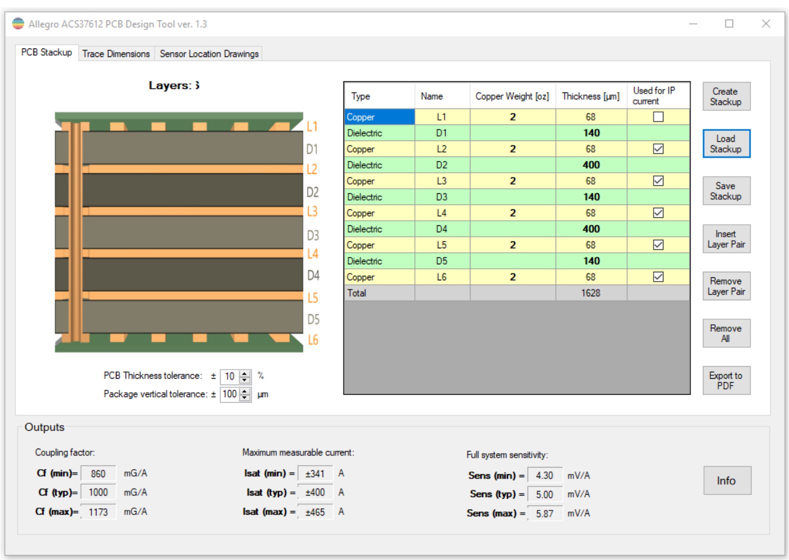

Figure 12: Relationship between Air Gap and Coupling Factor

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Revision History

Number	Date	Description
–	June 12, 2023	Initial release
1	May 22, 2025	Removed programming information into separate Using Allegro ASEK-30 with ACS37610 Samples Programmer User Manual available for download

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