User Manual

Using Allegro ASEK-30 with ACS37610 Samples Programmer

DESCRIPTION

Allegro provides tools to assist in the evaluation of its sensor products. This document provides information to establish the interface between the supported programming tools and the ACS37610 current sensor. Simple instructions are included to help users begin to use the hardware and software support tools.

EVALUATION TOOLS

- Programmer:
  - ASEK-30 is the evaluation programmer that provides the interface between the sensor and the software for essential communication and evaluation.

Figure 1: ASEK-30

- Accessories:
  - ASEK-30-INT-001 is the interface board that routes the required signals from the ASEK-30 to allow for easily accessible connections.

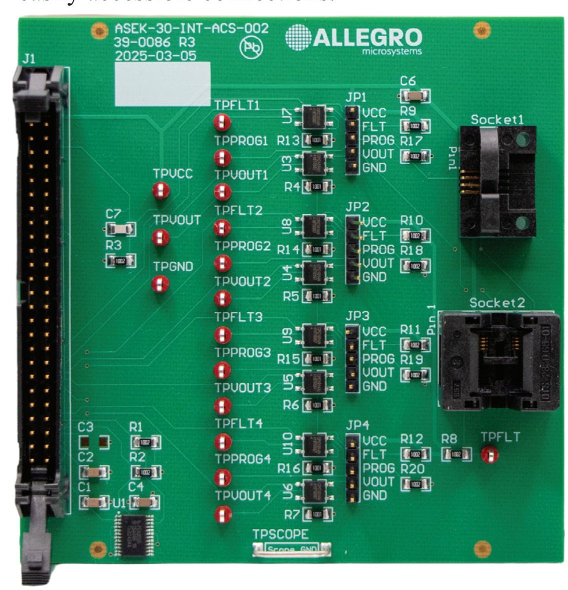


Figure 2: ASEK-30-INT-002

- Product datasheets available on the product web page:
  - ACS37610: https://www.allegromicro.com/en/products/sense/current-sensor-ics/sip-package-zero-to-thousand-amp-sensor-ics/acs37610
- Firmware loading document available on the Allegro software portal; registration is required.

ACQUIRING SOFTWARE

1. Register for software on the Allegro Software Portal.
2. Ensure that the ASEK-30 in use has the most recent firmware downloaded. Refer to the ASEK-30 firmware web page (https://registration.allegromicro.com/parts/ASEK-30), including the ASEK-30 quick guide in the support files section.
3. After registering and logging in to the software portal, the dashboard page is shown. Choose the find a part button highlighted in Figure 3.
4. Click the find a part button to navigate to the available parts and software page.
5. In the select by part number search bar (shown in Figure 4), search for ACS37610.
6. Click the view button located next to the ACS37610 search result, as shown outlined in Figure 5.
7. Click the download button next to the programming application ZIP file to open the programming application ZIP file, as highlighted in red in Figure 6.
8. Open and extract the downloaded ZIP file and save to a known location.
9. Open the extracted ZIP file, and open the folder Allegro ACS37610 Samples Programmer V# folder, where # is the version number.
10. Open the Allegro ACS37610 Samples Programmer application file (EXE file extension) to open the samples programmer.

Note that the ACS37610 information on software portal includes the Allegro ACS37610 busbar calculator and the ACS37610 printed circuit board (PCB) design tool. These are helpful tools related to busbar geometry and design and PCB design.

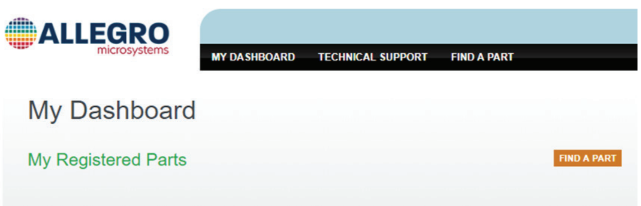


Figure 3: Find a Part Button Allows User to Register for Specific Devices

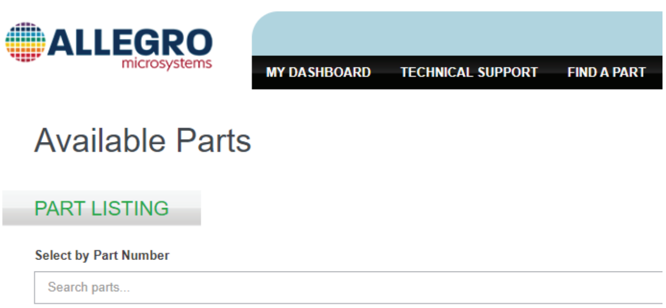


Figure 4: Select by Part Number on the Available Parts and Software Page

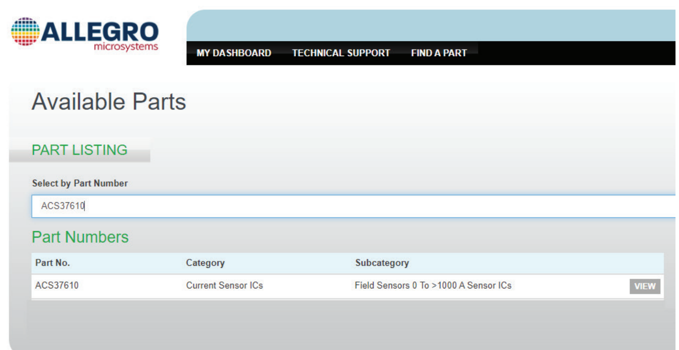


Figure 5: Select View Button Opens Selected Search Result

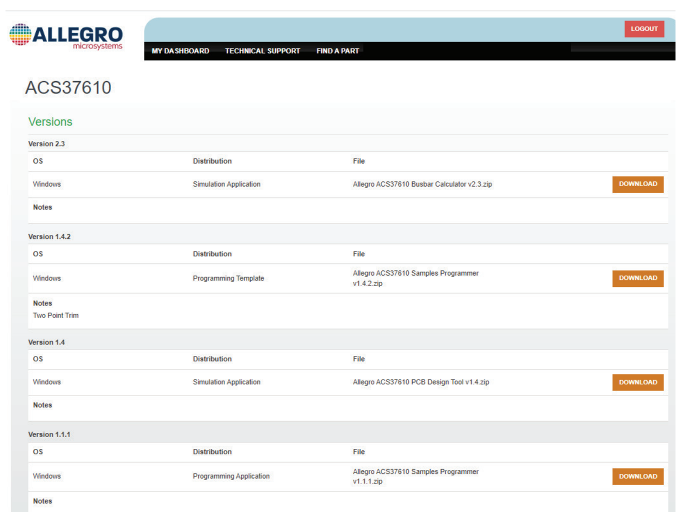


Figure 6: Download Button Opens Programming Application

Allegro MicroSystems
955 Perimeter Road
Manchester, NH 03103-3353 U.S.A.
www.allegromicro.com

Getting Started with Hardware

1. Connect one end of the USB communications cable to the USB port of a personal computer.
2. Connect the other end of the USB communications cable to the USB port located on the front panel of the ASEK-30 chassis.
3. Connect a ribbon cable to the J2 connector located on the left side of the ACS37610 daughterboard.
4. Connect the other end of the ribbon cable to the DEVICE CONNECTION port on the front panel of the ASEK-30 chassis.
5. Connect the DC power supply/cable to the 5 V port on the ASEK-30 chassis.
6. Plug the DC power supply into a 110/220 AC 60/50 Hz outlet with the appropriate power adapter.

Connecting the ASEK37610 Evaluation Board to the ASEK-30 Interface Board

To connect the ASEK37610 evaluation board to the interface board, perform the following:

1. Connect the VCC pin on the ASEK37610 evaluation board to the TPVCC pin on the interface board.
2. Connect the OUT pin on the ASEK37610 evaluation board to the TPGND pin on the interface board.
3. Connect the GND pin on the ASEK37610 evaluation board to the TPGND pin on the interface board.

The connection setup between the VCC, OUT, and GND pins of the ASEK-30 ACS37610 daughterboard and the interface board is shown in Figure 7.

Note that the setup and connection for the ASEK37610 busbar evaluation board (EVB) and PCB sensing options are identical.

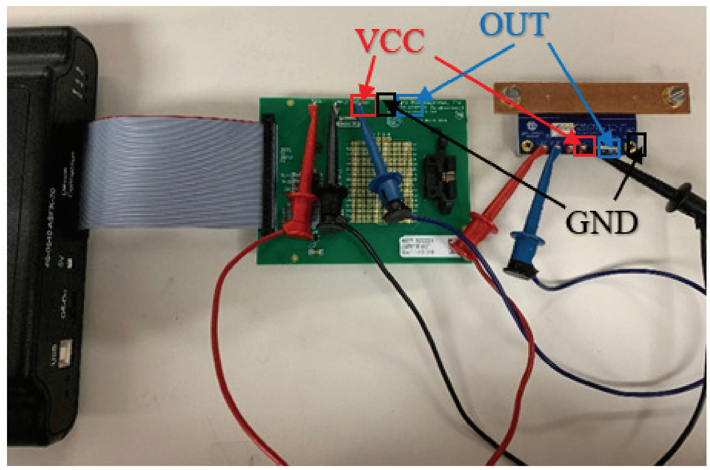
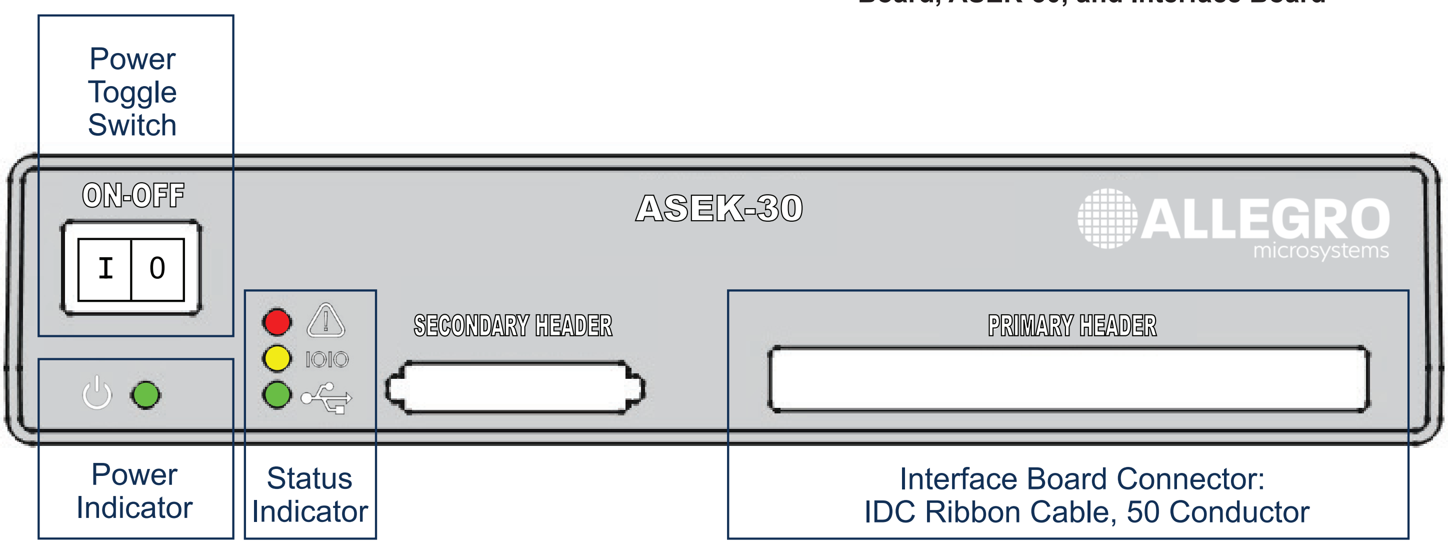


Figure 7: Connections Between ACS37610 Evaluation Board, ASEK-30, and Interface Board



= Hardware status indicator | IOIO = ASEK-30 microcontroller status indicator | = USB communications status indicator

Figure 8: Front Panel of ASEK-30

Allegro MicroSystems
955 Perimeter Road
Manchester, NH 03103-3353 U.S.A.
www.allegromicro.com

Using the Programmer

CONNECTING TO THE ASEK-30

When the programmer opens, the window shown in Figure 9 is displayed.

To connect the ASEK-30, select the setup panel, then select the communication setup option. The dialog box shown in Figure 10 is displayed. In the drop-down menu next to COM port, select the correct COM port. If the COM port is not known, perform the following:

1. Unplug the USB cable from the ASEK-30.
2. Click the refresh button in the communication setup dialog window.
3. Open the COM port drop-down menu.
4. Note which ports are listed in the menu.
5. Plug the USB cable into the ASEK-30.
6. Click the refresh button.
7. Open the COM port pop-up menu.
8. Note the COM port listed in the menu that was not previously listed in the menu; this is the port connected to the ASEK-30.
9. Select the port connected to the ASEK-30.

Once the correct COM port is selected and the ASEK-30 is connected to the PC, use the information displayed next to the communication panel to verify the status of the ASEK-30:

- Active status indicates the ASEK-30 is powered and is responding.
- Inactive status indicates the ASEK-30 is not responding or is not in the powered-on state. If this is the case, click the refresh button and ensure the ASEK-30 chassis is plugged into the PC and the chassis is in the powered-on state.

To exit the dialog box, click the OK button.

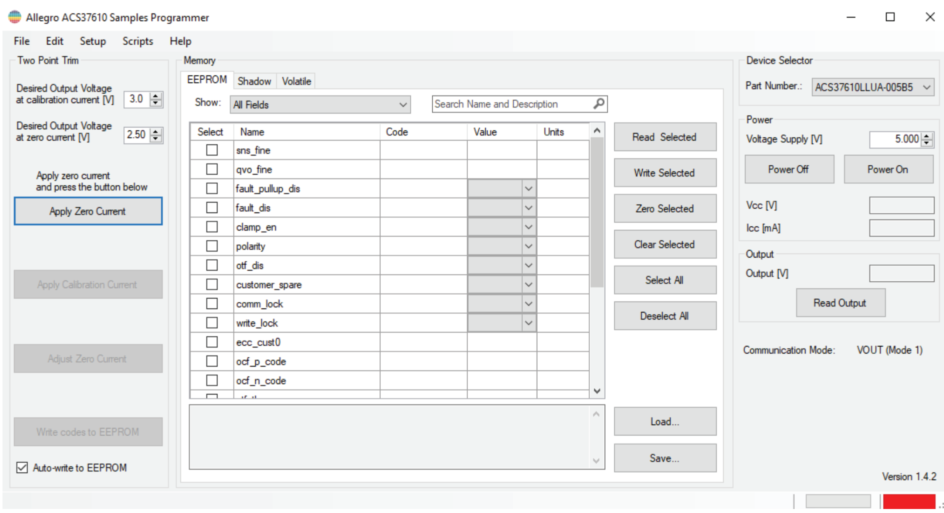


Figure 9: ACS37610 Programmer Application

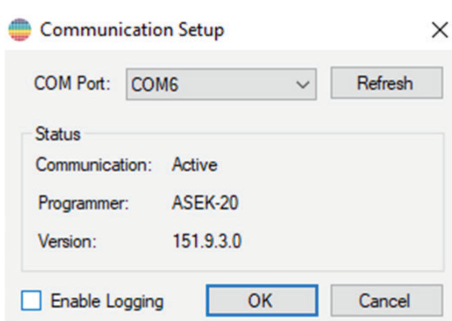


Figure 10: Communication Setup Dialog Box

Status Bar

The status of communication with the ASEK is indicated in the status bar, which is located on the bottom right of the programmer window and is highlighted green (or red) as shown in Figure 11:

If the status bar display is red (not shown), the communication is not active

If the status bar display is green (shown), the application is communicating with the ASEK.

The COM port that is currently set is overlaid on the colored rectangle. To open the communication setup dialog window, click on this colored rectangular COM port.

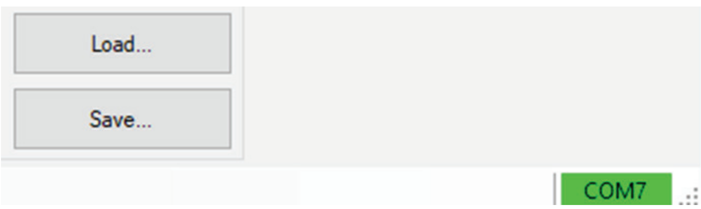


Figure 11: Status Bar on Bottom Right of GUI

Power-On and Power-Off of the Part

To power-on the part using the ASEK-30, click the power on button located on the right side of the programmer, outlined in red in Figure 12.

Once the part is in the powered on state, the fields for V_{CC} [V] and I_{CC} [mA] become populated with the measured values. Verify that the voltage is as desired and that device power consumption is approximately 10 to 17 mA.

To read the output of the ACS37610, click the read output button, outlined in green in Figure 12. Verify the output [V] cell displays a reasonable number—approximately 2.5 V with zero external field applied if testing a bidirectional part with 5 V typical V_{CC}.

To power-off the part, click the power off button, outlined in blue in Figure 12 (to the left of the power on button). When the power-off button is clicked, I_{CC} reduces to approximately 0 mA.

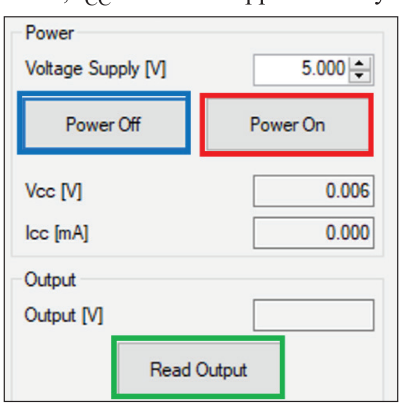


Figure 12: Buttons for Power On, Power Off, and Read Output

Read and Write to the Part

Before reading and writing to the part, the part must be connected and powered on using the programmer GUI.

Before experimenting with programming, it is strongly recommended for the user to save the memory to a tabular file. This allows the user to return the device to the original factory-programmed state, if necessary.

To read a field: In the select panel, select the checkbox located to the left of the register name, then click the read selected button.

To write to a field: In select panel, select the checkbox located to the left of the desired register name, change the value of the code field to the desired value, click enter, then click the write selected button.

To verify that the field was written to the device, perform the following:

1. Click the clear selected button. This causes the values in the code and value cells to disappear.
2. Click the read selected button. This causes the values that were written in the code and value cells to reappear and allows the user to verify that the values are written to the part correctly.

References to DLLs

If using Visual Studio to build the application, the first step is to add references to the dynamic-link libraries (DLLs). All DLLs require a reference to ASEKBase.dll as follows:

1. In the solution explorer, right-click on the project icon.
2. From the menu, select the add reference option.
3. In the add reference dialog, use the browse tab to navigate to the ASEKBase.dll
4. Select ASEKBase.dll
5. Click on the OK button.

To add ASEK20.dll and ASEK20_ACS37610.dll, perform the same actions.

For additional information, reference the CHM help file which is provided with the samples programmer.

DEVICE PROGRAMMING

- The serial interface uses Manchester protocol to communicate.
- Device programming can be achieved with bidirectional communication on VOUT or on the dedicated PROG pin.
- The device has an internal charge pump to generate the EEPROM pulses.
- The PROG pin can be left unconnected or tied to GND or VCC when not used.

Serial Communication

The serial interface allows an external controller to read and write to registers, including EEPROM, in the device using a point-to- point command/acknowledge protocol. The device does not initiate communication; it only responds to commands from the external controller. Each transaction consists of a command from the controller. If the command is a write, the device does not acknowledge the command. If the command is a read, the device responds by transmitting the requested data. Two modes are available for device communication.

Mode 1, Programming on VOUT Pin (see Figure 13)

Voltage is raised on V_{CC} (V_{OVDE}) for at least t_{OVDE} followed by the access code on VOUT to enable bidirectional programming on VOUT. If the COM_LOCK bit is set (value is 1), bidirectional programming on VOUT is disabled. If COM_LOCK bit is not set (value is 0), there is no timeout limit to send the access code as long as V_{CC} remains in excess of V_{OVDE} for at least t_{OVDE}. The start of any Manchester command should begin with holding the output low for t_{BIT} to ensure the reset of the Manchester state machine. If an incorrect access code is sent, VOUT remains in the typical analog mode (responds to magnetic stimulus) and the device remains locked for communication on VOUT until a power reset occurs.

When writing into nonvolatile memory (EEPROM), V_{CC} must not exceed 5 V to ensure safe EEPROM writing. To achieve this, two methods can be used:

<u>Method 1 (to write EEPROM in Mode 1):</u>

1. Lock VOUT into communication mode such that VCC can return to the typical supply voltage (5 V / 3.3 V), as follows:
   A. Set V_{CC} to V_{OVDE} (OVD).
   B. Send the access code and COMM_EN.
   C. Set V_{CC} back to the typical level (5 V / 3.3 V).
   D. Send EEPROM write commands.
   E. Power-cycle the device to re-enable analog output on VOUT.

<u>Method 2 (to write EEPROM in Mode 1)</u>

1. Ensure the PROG pin is not connected to GND (can be left floating or connected to VCC)
2. Reduce V_{CC} back to the typical supply voltage (5 V / 3.3 V) after sending the EEPROM write sequence, as follows:
   A. Set V_{CC} to V_{OVDE} (OVD).
   B. Send the access code.
   C. Send the EEPROM write commands.
   D. Set V_{CC} to the typical level (5 V / 3.3 V).
   E. Wait 20 ms for EEPROM write.

With method 2, the PROG pin must not be connected to GND (can be left floating or connected to VCC). When not used, it is recommended to tie the PROG pin to VCC (for broken GND feature).

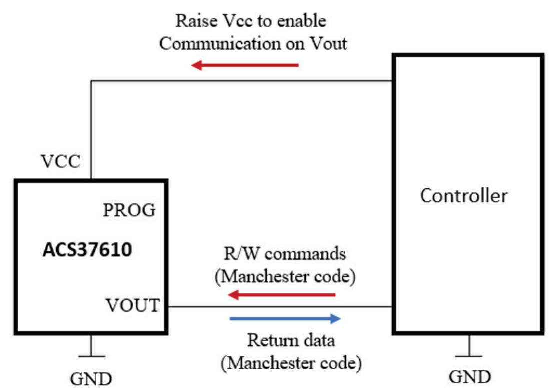


Figure 13: Programming Connection—Mode 1

Mode 2, Programming on PROG Pin (see Figure 14)

V_{CC} remains at 5 V (at less than V_{OVDE}), and bidirectional programming is achieved on the PROG pin by sending an access code (independent of the COM_LOCK value). A pull-up is not required on the PROG pin.

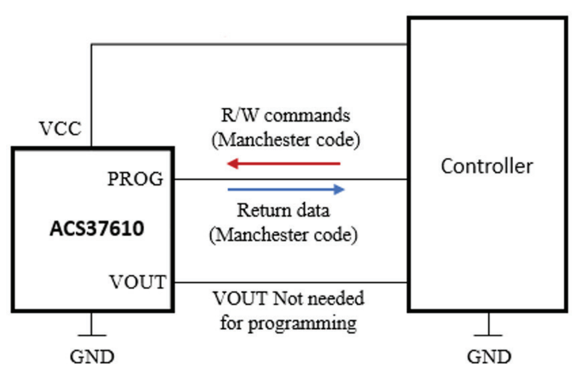


Figure 14: Programming Connections—Mode 2

Allegro MicroSystems
955 Perimeter Road
Manchester, NH 03103-3353 U.S.A.
www.allegromicro.com

Programming Guidelines

INITIATING COMMUNICATIONS

The controller must open the serial communication with the device by sending an access code. The access code can be sent at any time on the PROG pin to enable communication via the PROG pin. For VOUT communication, an OVD event must be sent followed by the access code on VOUT. An OVD event must be maintained during the first full transaction.

Register Address	Address (Hex)	Data (Hex)
Customer Access	0x31	0x2C413736
Customer Access + COM_ENABLE	0x31	0x2C413737

There are two built-in memory-locking functions that can be implemented in conjunction with the access code:

1. The EEPROM COMM_LOCK bit can be set to make the ACS37610 only use the PROG pin for serial communication. When COMM_LOCK is set to 1, the OVLO condition is ignored, and the PROG pin is always selected.
2. After EEPROM has been programmed by the user, the lock bit can be used to permanently disable the ability to write to any EEPROM register. To do so, set the WRITE_LOCK bit to 1. VCC then power-cycles. A write command to the volatile register remains possible.

Communications Protocol

The serial interface uses a Manchester-encoding-based protocol per G.E. Thomas (0 = rising edge, 1 = falling edge), with address and data transmitted most significant bit (MSB) first. Four commands are recognized by the device: write access code, write to volatile memory, write to nonvolatile memory (EEPROM), and read. In response to a read command, one frame type, read acknowledge, is sent by the device

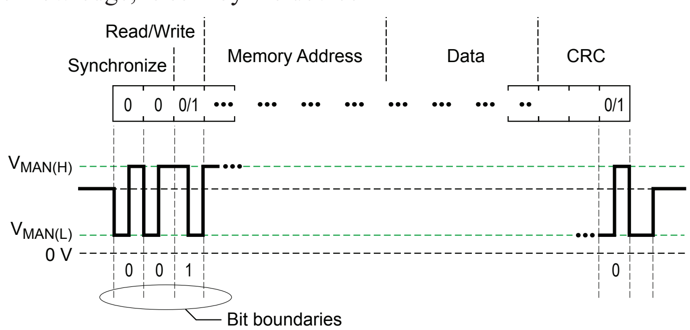


Figure 15: General Format for Serial Interface Commands

Read (Controller to Device)

The fields for the read command are:

- Sync (2 zero bits)
- Read/Write (1 bit)
- Address (6 bit)
- CRC (cyclic redundancy checksum) (3 bits)

The sequence for a read command is shown in Figure 16.

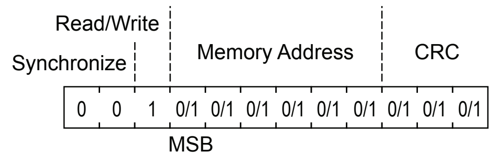


Figure 16: Read Sequence

Read Acknowledge (Device to Controller)

The fields for the data return frame are:

- Sync (2 zero bits)
- Data (32 bits):
  - □ [31:28] Not relevance
  - □ [27:26] ECC (error correction code) pass/fail
  - □ [25:0] Data
- CRC (3 bits)

The read acknowledge sequence is shown in Figure 17.

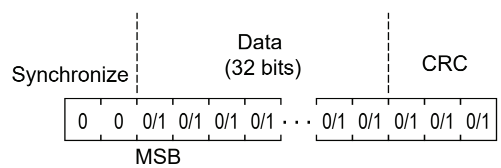


Figure 17: Read Acknowledge Sequence

Write (Controller to Device)

The fields for the write command are:

- Sync (2 zero bits)
- Read/Write (1 bit, must be 0 for write)
- Address (6 bits)
- Data (32 bits):
  - □ [31:26] Not relevant
  - □ [25:0] Data
- CRC (3 bits)

The sequence for a write command is shown in Figure 18. Bits [31:26] are not relevant because the device automatically generates 6 ECC bits based on the content of bits [25:0]. These ECC bits become stored in EEPROM at locations [31:26].

Allegro MicroSystems
955 Perimeter Road
Manchester, NH 03103-3353 U.S.A.
www.allegromicro.com

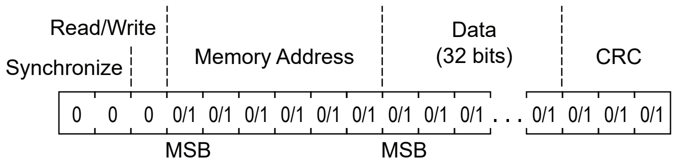


Figure 18: Write Sequence

Write Access Code (Controller to Device)

The fields for the access code command are:

- Sync (2 zero bits)
- Read/Write (1 bit, must be 0 for write)
- Address (6 bits)
- Data (32 bits)
- CRC (3 bits)

The sequence for an access code command is shown in Figure 19.

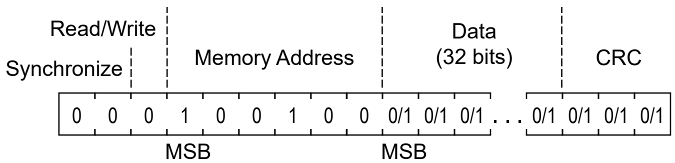


Figure 19: Write Access Code

Allegro MicroSystems
955 Perimeter Road
Manchester, NH 03103-3353 U.S.A.
www.allegromicro.com

ACS37610 Calibration

V_{REF}, offset voltage (QVO), and sensitivity of the ACS37610 are factory-trimmed. For optimal system accuracy, it is recommended that an end-of-line calibration be performed.

The recommended order of system trims during calibration is sensitivity followed by QVO. It is expected that the factory-trimmed value for V_{REF} sufficiently precludes the need for an end-of-line V_{REF} trim. Each parameter has coarse and fine trims; however, during calibration, adjustment should be needed for the fine trims only. The fine trims for QVO and sensitivity are each controlled by a 9-bit two's complement trim code: VOFF_FINE and SENS_FINE, respectively. The step size of a single least significant bit (LSB) adjustment for each of these trims is shown in Table 2. To allow margin for temperature and supply variation, it is recommended that the codes used be restricted to 0 through 223 and 288 through 511. The transfer function for each of the trimmable parameters is shown in Figure 20 and Figure 21.

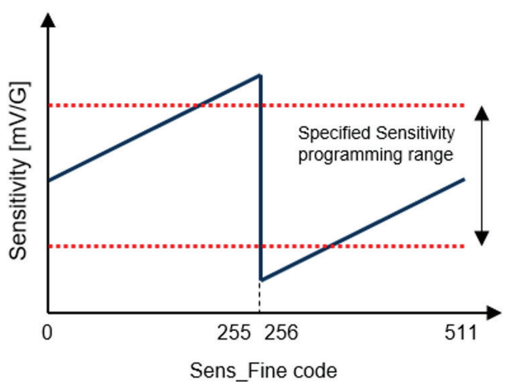


Figure 20: Sensitivity Trim Range

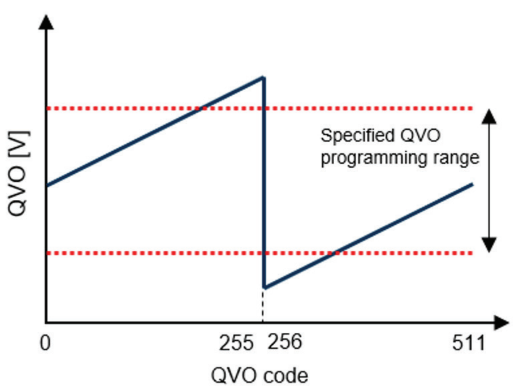


Figure 21: QVO Trim Range

SENSITIVITY TRIM

Prior to beginning the trims, measure V_{OUT} with zero field applied. Retain this value as V_{QVO}. Once that measurement is made, sensitivity should be trimmed first. It is recommended to trim sensitivity prior to offset because the sensitivity trim may impact the offset. Use the following procedure to trim sensitivity:

1. Read the contents of the SENS_FINE register and apply the maximum magnetic field to the device. The maximum magnetic field is determined by the maximum magnetic field that is expected to be observed by the device in the end application. Alternatively, a scaled-down magnetic field can be applied during end-of-line testing and the result can be scaled appropriately.
2. Measure V_{OUT}. This is V_{MAX}.
3. Compare $V_{MAX} – V_{QVO}$ to the target full-scale output voltage swing for maximum magnetic field, V_{FS}. $V_{\Delta SENS} = V_{FS} – (V_{MAX} – V_{QVO})$.
4. Adjust SENS_FINE to trim sensitivity as:
   $SENS\_FINE = SENS\_FINE + V_{\Delta SENS}/SENS_{STEP}$
   where $SENS_{STEP}$ is the sensitivity trim step size.
5. Repeat steps 2 through 4 until $V_{\Delta SENS} < 0.5 \times SENS_{STEP}$.

OFFSET VOLTAGE (QVO) TRIM

Assuming the desired value of V_{OUT} when magnetic field is not applied is to be equal to V_{REF}, use the following procedure to trim QVO:

1. Read the contents of the QVO_FINE register.
2. Measure V_{OUT} when magnetic field is not applied.
3. Adjust QVO_FINE to set QVO to the desired voltage (2.5 V for bidirectional, 0.5 V for unidirectional).

ADDED MEMORY LOCK PROTECTION

Once calibration is complete, it is strongly recommended that ANALOG_LOCK (register bit 0x0F[24]) and UNLOCK_CODE (register bit 0x0F[25]) be set to 1 to lock the memory and ensure against accidental programming in the field.

ALLEGRO microsystems
Allegro MicroSystems
955 Perimeter Road
Manchester, NH 03103-3353 U.S.A.
www.allegromicro.com

MEMORY MAP

R/W = Read and Write; R = Read Only

Register Name	Address	Parameter Name	Description	Access	Size	MSB	LSB
EEPROM: (EE_CUST0) Shadow register [1]: (SH_CUST0)	EEPROM: (0x09) Shadow register [1]: (0x19)	WRITE_LOCK	Lock the device	R/W	1	25	25
		COM_LOCK	Disable communication on VOUT/disable OVD	R/W	1	24	24
		SPARE	–	R/W	1	23	23
		OTF_DIS	Disable overtemperature fault	R/W	1	22	22
		POL	Change output polarity	R/W	1	21	21
		CLAMP_EN	Enable output clamps	R/W	1	20	20
		FAULT_DIS	Disable fault	R/W	1	19	19
		FAULTPUP_DIS	Disconnect fault internal pull-up resistor	R/W	1	18	18
		QVO	Offset adjustment	R/W	9	17	9
		SNS_FINE	Sensitivity fine adjustment	R/W	9	8	0
EEPROM: (EE_CUST1) Shadow register [1]: (SH_CUST1)	EEPROM: (0x0A) Shadow register [1]: (0x1a)	OCF_HYST	Overcurrent fault hysteresis	R/W	2	25	24
		FAULT_LATCH	Enable fault latch	R/W	1	23	23
		OCF_P_DIS	Disable positive overcurrent fault	R/W	1	22	22
		OCF_N_DIS	Disable negative overcurrent fault	R/W	1	21	21
		OCF_QUALIFIER	Overcurrent fault qualifier/short pulse filter	R/W	3	20	18
		OTF_THRESH	Overtemperature fault threshold	R/W	4	17	14
		OCF_N_THRES	Negative overcurrent fault threshold	R/W	7	13	7
		OCF_P_THRES	Positive overcurrent fault threshold	R/W	7	6	0
EEPROM: (EE_CUST2)	EEPROM: (0x0B)	C_SPARE	Customer scratch pad Does not affect device functionality	R/W	26	25	0
Volatile register: (FAULT_STATUS)	Volatile register: (0x20)	TEMP_OUT	Temperature output	R	12	27	16
		UV_STAT	Undervoltage status	R	1	12	12
		OV_STAT	Overvoltage status	R	1	11	11
		OC_STAT	Overcurrent status	R	1	10	10
		OT_STAT	Overtemperature status	R	1	9	9
		FP_STAT	FAULT pin status	R	1	8	8
		UV_EV	Undervoltage event	R	1	4	4
		OV_EV	Overvoltage event	R	1	3	3
		OC_EV	Overcurrent event	R	1	2	2
		OT_EV	Overtemperature event	R	1	1	1
		FP_EV	FAULT pin event	R	1	0	0

[1] Shadow registers are volatile memory. Upon startup, the device loads EEPROM memory into shadow registers. Shadow registers can be used to test different programming options without erasing EEPROM (e.g., to determine the sensitivity and QVO codes before writing the codes to EEPROM).

Allegro MicroSystems
955 Perimeter Road
Manchester, NH 03103-3353 U.S.A.
www.allegromicro.com

Busbar Design Recommendations GUI

For busbar design recommendations, refer to the Allegro application note Guidelines for Designing a Busbar with Notch for Allegro's Coreless AS37612 Differential Current Sensor (https://www.allegromicro.com/-/media/files/application-notes/an296188-acs37612-guidelines-for-designing-a-busbar-web.pdf) in conjunction with the Allegro 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). For an illustration of the busbar design GUI, see Figure 21. 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 in the 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). For reference, see Figure 22.

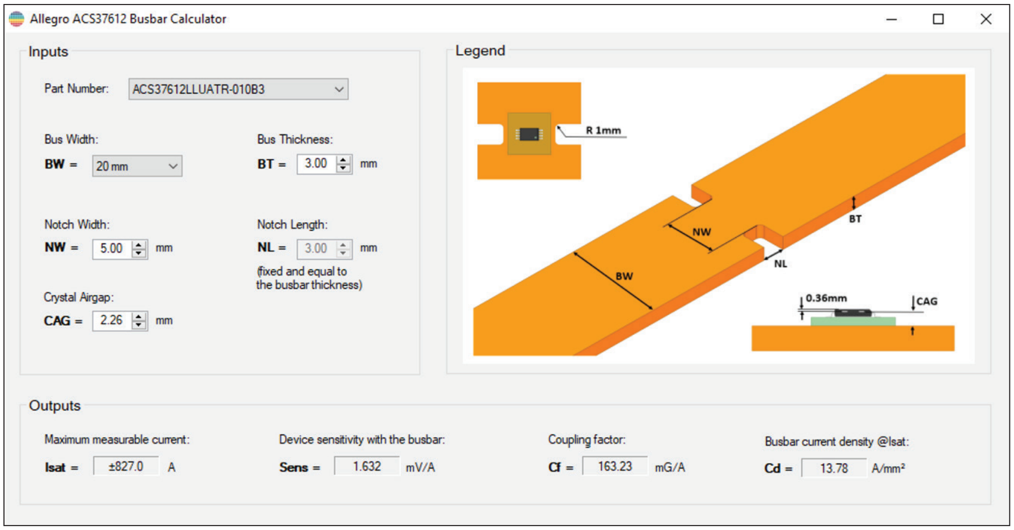


Figure 22: ACS37610 Busbar Calculator GUI

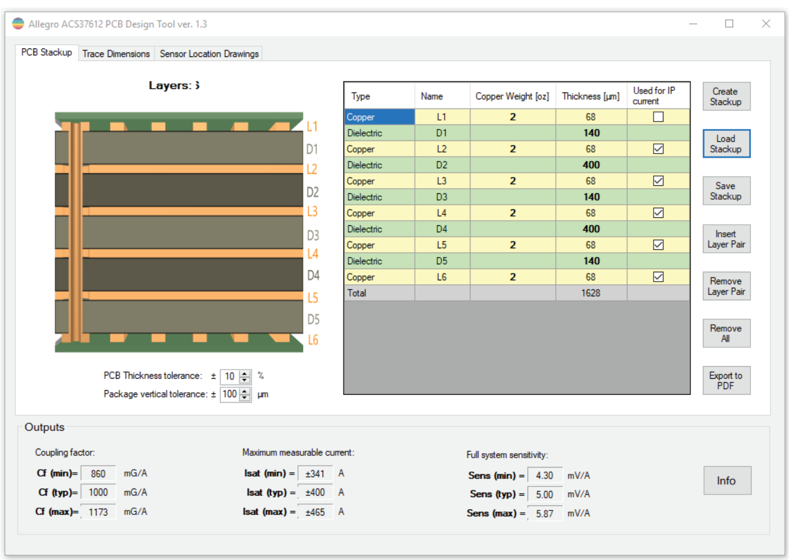


Figure 23: Relationship Between Air Gap and Coupling Factor

Allegro MicroSystems
955 Perimeter Road
Manchester, NH 03103-3353 U.S.A.
www.allegromicro.com

Revision History

Number	Date	Description
–	July 8, 2025	Initial release

Allegro MicroSystems
955 Perimeter Road
Manchester, NH 03103-3353 U.S.A.
www.allegromicro.com