ASEK37610

Using the ASEK-20 with the ACS37610 Daughterboard and ACS37610 Samples Programmer

Introduction

This section of the ASEK37610 user guide documents the use of the ACS37610 daughterboard and the ASEK-20 (Part #85-0540-004) with the Allegro ACS37610 samples programmer. The ASEK-20 chassis can be seen in Figure 1, and the top and bottom layers of the ASEK-20 ACS37610 daughterboard can be seen in Figure 2. The schematic for the ASEK37610 can be found in the appendix section below.

Figure 1: ASEK-20 Chassis

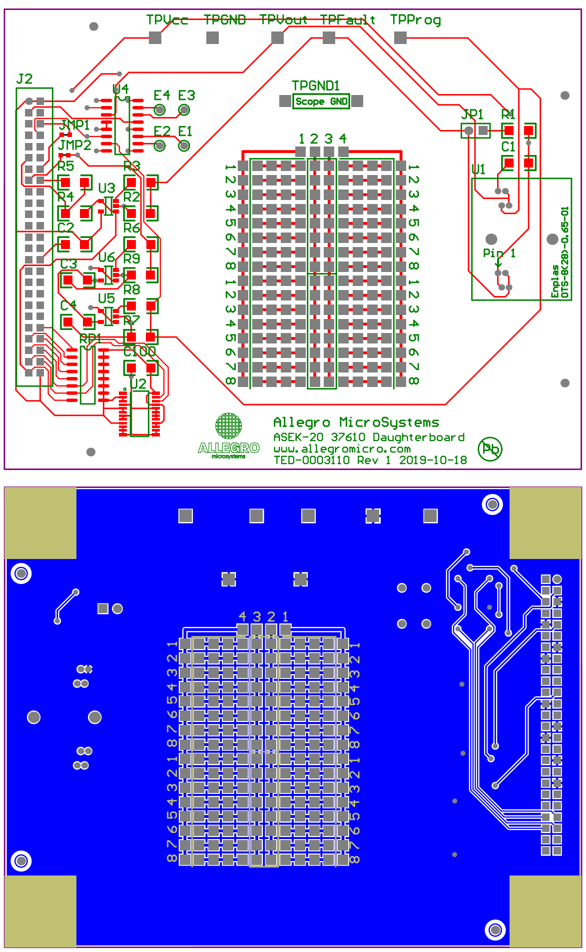

Figure 2: Top and Bottom Layers for ASEK-20 ACS37610 Daughterboard

Downloading the Programmer

1. Register for software on the Allegro Software Portal.
2. Ensure that the ASEK-20 being used has the most recent firmware downloaded. Refer to the ASEK-20 firmware webpage and the ASEK-20 quick guide under "Support Files" on the ASEK-20 firmware webpage.
3. After registering and logging in to the software portal, the user will be greeted with the dashboard page. Choose the "Find a Part" button highlighted in Figure 3.
4. Clicking "Find a Part" will bring the user to the "Available Parts & Software" page.
5. Search for "ACS37610" in the "Select by Part Number" search bar shown in Figure 4.
6. Searching for "ACS37610" will result in one search result. Click "View" next to the result as shown highlighted in Figure 5.
7. Click "Download" next to the ACS37610 Samples Programmer 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#".
10. Open the "Allegro ACS37610 Samples Programmer" application file (.exe file extension) to open the samples programmer.

Note that located on the ACS37610 software portal is the Allegro ACS37610 Busbar Calculator and the ACS37610 PCB Design Tool, helpful tools related to busbar geometry and design and PCB design.

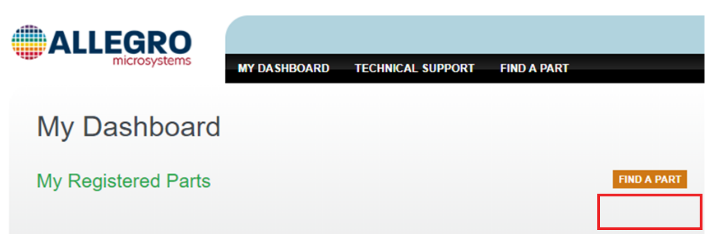

Figure 3: "Find a Part" button allowing the user to register specific devices

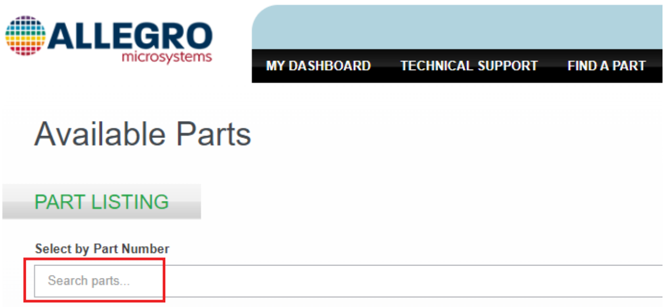

Figure 4: "Select by Part Number" on the Available Parts & Software page

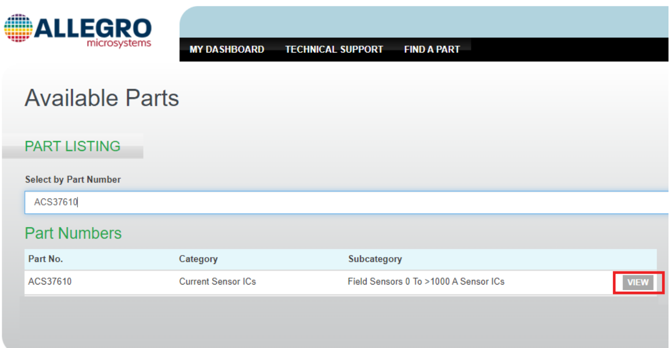

Figure 5: Select "View" next to "ACS37610" search result

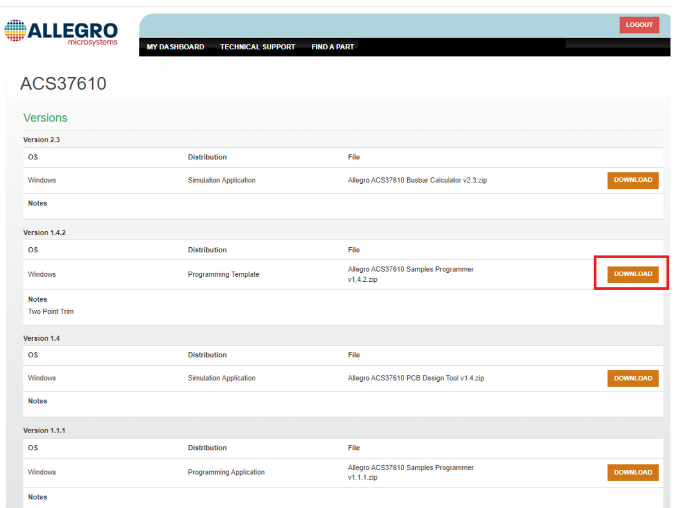

Figure 6: Select "Download" to open the Programming Application

Connecting the ASEK-20 to the PC and to the ACS37610 Daughterboard

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 of the ASEK-20 chassis.
3. Connect a ribbon cable to the "J2" connector on the left-hand side of the ACS37610 daughterboard.
4. Connect the other end of the ribbon cable to the "Device Connection" port on the front of the ASEK-20 chassis as shown in Figure 7.

Figure 7: Connection between ASEK-20 and ACS37610 Daughterboard

5. Connect the DC Power Supply/Cable to the "5V" port on the ASEK-20 chassis.
6. Plug in the DC Power Supply to a 110/220AC 60/50 Hz outlet with the appropriate power adapter.

Inserting the ACS37610 into the ACS37610 Daughterboard

If using an ASEK37610 evaluation board with an ACS37610 populated, proceed to the Connecting the ASEK37610 Evaluation Board to the ASEK-20 ACS37610 Daughterboard section below. If using a standalone ACS37610 IC, see paragraph below.

The ACS37610 current sensor is provided in a small, low-profile, 8-pin surface mount TSSOP package, making the ACS37610 an ideal sensor for space constrained applications, while still allowing simple assembly. The package is shown in Figure 8 below. For more information, refer to the ACS37610 device datasheet.

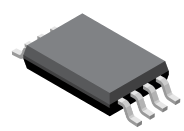

Figure 8: 8-Pin TSSOP package (suffix LU)

To insert the ACS37610 into the ACS37610 daughterboard, do the following:

1. Place the ACS37610 in the socket labeled "J1".
2. Secure the part in place.

Proceed to the Using the Programmer section below.

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Connecting the ASEK37610 Evaluation Board to the ASEK-20 ACS37610 Daughterboard

To connect the ASEK37610 evaluation board to the ACS37610 daughterboard, do the following:

1. Connect the VCC pin on the ASEK37610 evaluation board to the TPVCC pin on the ACS37610 daughterboard.
2. Connect the OUT pin on the ASEK37610 evaluation board to the TPGND pin on the ACS37610 daughterboard.
3. Connect the GND pin on the ASEK3761 evaluation board to the TPGND pin on the ACS37610 daughterboard.
4. See Figure 9 and Figure 10 below showing the connection setup between the VCC, OUT, and GND pins of the ASEK-20 ACS37610 daughterboard and the ASEK37610 evaluation board.

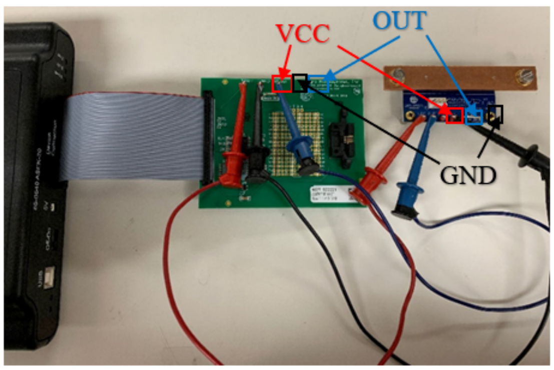

Figure 9: Connection between ACS37610 evaluation board and ASEK20 ACS37610 daughterboard

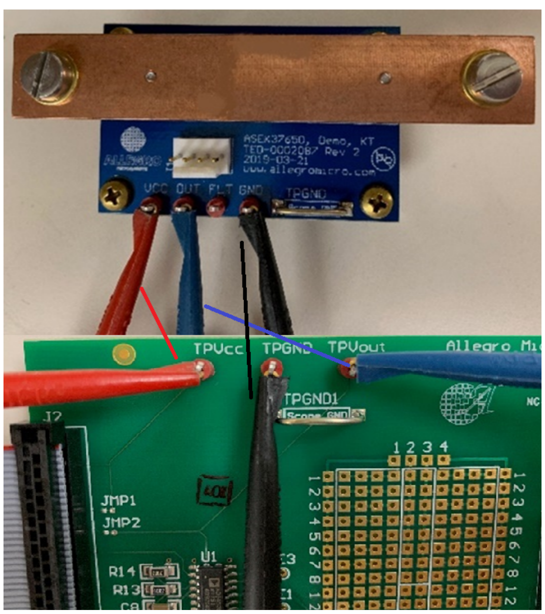

Figure 10: Closeup of VCC, OUT, and GND pin connections on the ACS37610 busbar evaluation board (top) to the ACS37610 daughterboard (bottom)

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

Using the Programmer

CONNECTING TO THE ASEK-20

Opening the programmer will result in a window identical to Figure 11.

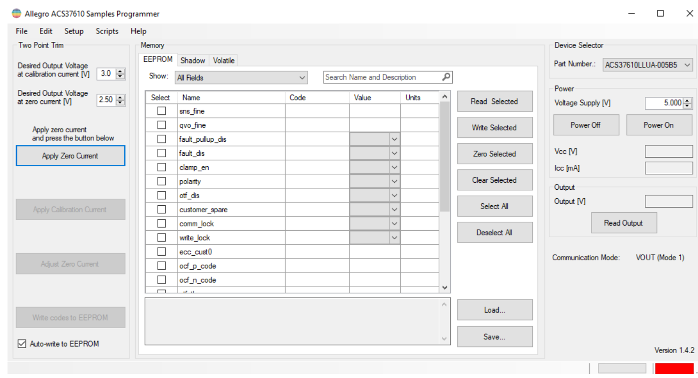

Figure 11: ACS37610 Programmer Application

To connect the ASEK-20, click “Setup”, then “Communication Setup”. The dialog box in Figure 12 will appear. Click the correct COM# in the pull-down menu next to COM Port. If the COM port is unknown, do the following:

1. Unplug the USB cable to the ASEK-20.
2. Click “Refresh” in the “Communication Setup” dialog window as highlighted in blue in Figure 12.
3. Click on the “COM Port” pull down menu.
4. Note which ports are in the menu.
5. Plug the USB cable back into the ASEK-20.
6. Click “Refresh”.
7. Click the “COM Port” popup menu again.
8. Note the COM port not previously listed in the menu; this is the port connected to the ASEK-20.
9. Select this COM port to use.

Once the correct COM port is selected and the ASEK-20 is connected to the PC, verify next to “Communication” the status of the ASEK-20.

If the status is “Active”, the ASEK-20 is powered and responding. If the status is “Inactive”, the ASEK-20 is not responding or is not powered on. If this is the case, click “Refresh” and ensure the ASEK-20 chassis is plugged into the PC and the chassis is powered on.

Click “OK” to exit the dialog box.

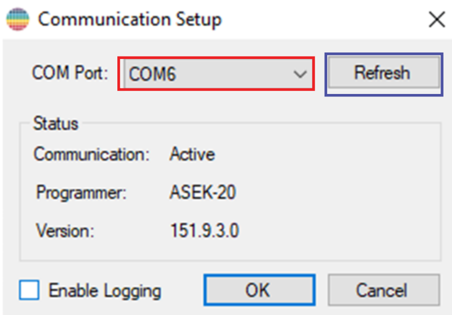

Figure 12: Communication Setup dialog box

Status Bar

The green or red colored rectangle on the bottom right of the programmer window, highlighted in red in Figure 13 below, indicates the status of the communication with the ASEK. If the status bar is red, the communication is not active and if green, the application is communicating with the ASEK. The COM port that is currently set is overlaid on the colored rectangle. Clicking on the rectangle will open the Communication setup dialog window.

Figure 13: Status bar on the bottom right side of GUI

Turning the Part ON and OFF

To power on the part using the ASEK-20, click “Power On” on the right-hand side of the programmer as show in red in Figure 14.

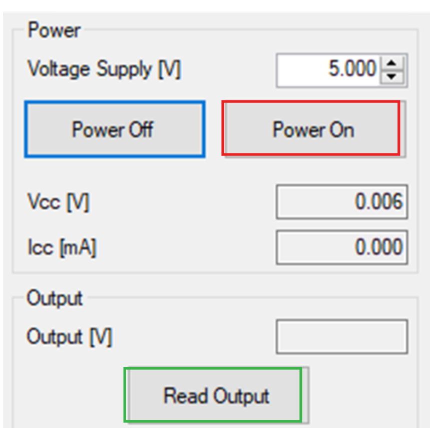

Figure 14: "Power On", “Power Off”, and “Read Output”

Once the part is powered on, values for “VCC [V]” and “ICC [mA]” will populate with the measured values. Verify that the voltage is what is desired and that the device is consuming approximately 10 to 17 mA.

To read the output of the ACS37610, select “Read Output” highlighted in green in Figure 14 above. Verify the Output [V] is a reasonable number, around 2.5 V with zero external field applied if testing a bidirectional part with 5 V typical V_{CC}.

To turn the part off, select “Power Off” to the left of “Power On”, highlighted in blue in Figure 14 above. Clicking “Power Off” will cause I_{CC} to fall to approximately 0 mA.

Read and Writing to the Part

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

It is strongly recommended that the user save the memory to a tabular file before experimenting with programming, allowing the user to return the device to its original factory programmed state, if necessary. See the Saving and Loading Memory Files section below.

To read a field, select the desired field by checking the box under “Select” to the left of the register name and click the “Read Selected” button highlighted in red in Figure 17.

To write to a field, select the desired field by checking the box under “Select” to the left of the name. Change the value under “Code” to the desired value and press Enter. Click “Write Selected” button highlighted in blue in Figure 17.

To verify that field was written to the device, do the following: click “Clear Selected” causing the values in the “Code” and “Value” cells to disappear. Then click “Read Selected”. The values that were written will reappear in the “Code” and “Value” cells verifying the user correctly wrote to the part.

Referencing DLLs

If using Visual Studio to build the application, the first step is to add references to the DLLs. All of the DLLs will require a reference to ASEKBase.dll. Right click on the project icon in the Solution Explorer; select “Add Reference…” from the menu. In the Add reference dialog, use the Browse tab to navigate to the ASEKBase.dll and selected it then click on the OK button. Perform the same actions to add ASEK20.dll and ASEK20_ACS37610.dll.

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

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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 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, there is no acknowledging from the device. 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 15)

Voltage is raised on V_{CC} (V_{OVDE}) for at least t_{OVDE} followed by access code on VOUT to enable bidirectional programming on VOUT. If COM_LOCK bit is set (=1), bidirectional programming on VOUT is disabled. If COM_LOCK bit is not set (=0), there is no timeout limit to send the access code as long as V_{CC} stays above 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 reset of Manchester state machine. If an incorrect access code is sent, VOUT remains in the normal analog mode (responds to magnetic stimulus) and the device remains locked for communication on VOUT until a power reset occurs.

When writing into non-volatile 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>

Locking VOUT into communication mode such that VCC can returned to normal supply voltage (5 V / 3.3 V):

1. Set V_{CC} to V_{OVDE} (OVD).
2. Send Access code + COMM_EN.
3. Set V_{CC} back to normal level (5 V / 3.3 V).
4. Send EEPROM write commands.
5. Power-cycle the device to re-enable Analog output on VOUT.

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

Reducing V_{CC} back to normal supply voltage (5 V / 3.3 V) after sending the EEPROM write sequence:

1. Set V_{CC} to V_{OVDE} (OVD).
2. Send Access code.
3. Send EEPROM write commands.
4. Set V_{CC} to normal level (5 V / 3.3 V).
5. Wait 20 ms for EEPROM write.

With method 2, PROG pin must not be connected to GND (can be left floating or connect to VCC).

See access code section and Manchester protocol figures for more details. When not used, it is recommended to tie PROG pin to VCC (for Broken GND feature).

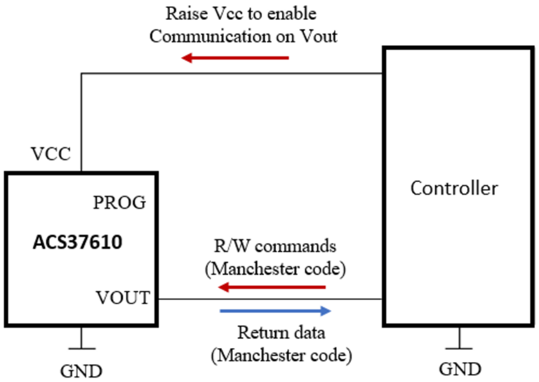

Figure 15: Programming Connection – Mode 1

Mode 2, Programming on PROG pin (see Figure 16)

V_{CC} remains 5 V (below V_{OVDE}), and bidirectional programming is achieved on PROG pin by sending an Access code (independently of COM_LOCK value). No pull-up is required on PROG pin.

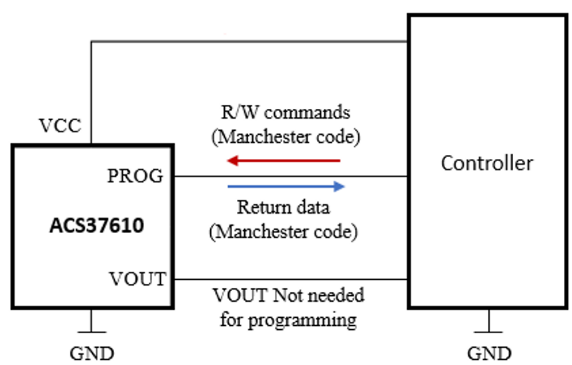

Figure 16: Programming Connections – Mode 2

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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 will be ignored, and the PROG pin will always be selected.
2. Lock bit after EEPROM has been programmed by the user. The WRITE_LOCK bit can be set to 1 and VCC power-cycles to permanently disable the ability to write to any EEPROM register. Volatile register can still be written to.

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 MSB first. Four commands are recognized by the device: Write Access Code, Write to Volatile Memory, Write to Non-Volatile Memory (EEPROM) and Read. One frame type, Read Acknowledge, is sent by the device in response to a Read command.

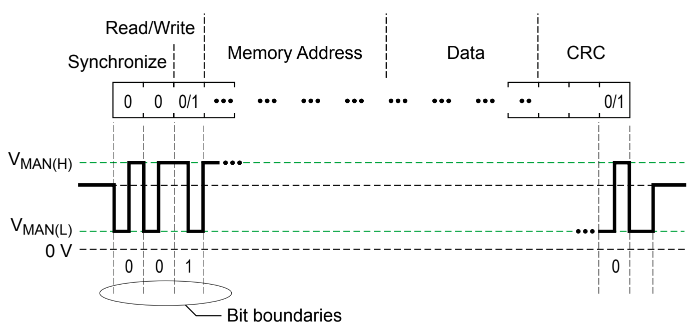

Figure 17: General Format for Serial Interface Commands

Read (Controller to Device)

The fields for the Read command are:

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

Figure 18 shows the sequence for a Read command.

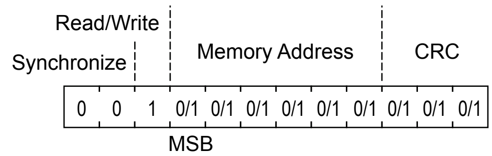

Figure 18: Read Sequence

Read Acknowledge (Device to Controller)

The fields for the data return frame are:

- Sync (2 zero bits)
- Data (32 bits):
  - □ [31:28] Don't Care
  - □ [27:26] ECC Pass/Fail
  - □ [25:0] Data
- CRC (3 bits)

Figure 19 shows the sequence for a Read Acknowledge. Refer to the Detecting ECC Error section for instructions on how to detect Read/Write Synchronize Memory Address Data (32 bits) and ECC failure.

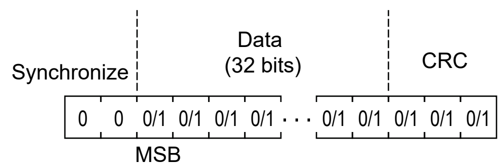

Figure 19: Read Acknowledge Sequence

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] Don't Care
  - □ [25:0] Data
- CRC (3 bits)

Figure 20 shows the sequence for a Write command. Bits [31:26] are Don't Care because the device automatically generates 6 ECC bits based on the content of bits [25:0]. These ECC bits will be stored in EEPROM at locations [31:26].

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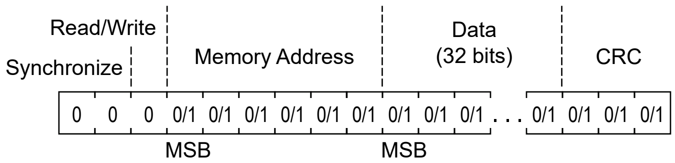

Figure 20: Write Sequence

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)

shows the sequence for an Access Code command.

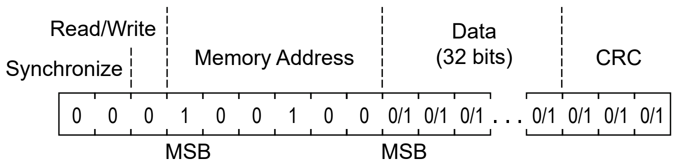

Figure 21: Write Access Code

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ACS37610 Calibration

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

The recommended order of system trims during calibration is sensitivity followed by QVO. It is expected that the factory-trimmed value for V_{REF} is sufficient so an end-of-line V_{REF} trim should not be required. There are coarse and fine trims for each parameter; however, only the fine trims should need to be adjusted during calibration. 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 1 LSB adjustment for each of these trims is shown in Table 2. To allow margin for temperature and supply variation, it is recommended that codes used are restricted to 0 to 223 and 288 to 511. The transfer function for each of the trimmable parameters is shown below (see Figure 22 and Figure 23).

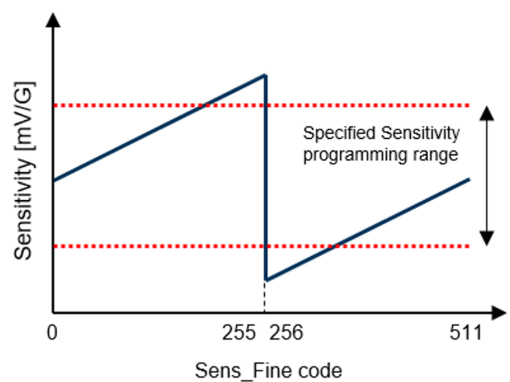

Figure 22: Sensitivity Trim Range

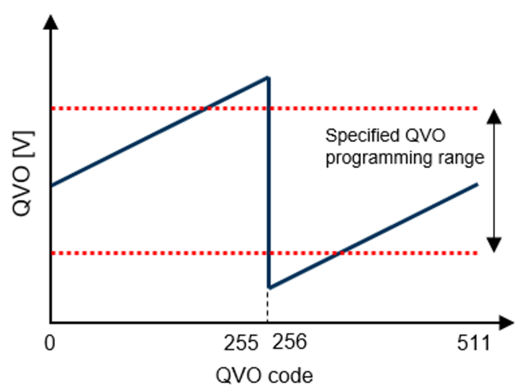

Figure 23: QVO Trim Range

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 maximum magnetic field to the device. The maximum magnetic field is determined by the maximum magnetic field that is expected to be seen 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 will be 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:
   $SENS\_FINE = SENS\_FINE + V_{\Delta SENS}/SENS_{STEP}$ where $SENS_{STEP}$ is the sensitivity trim step size.

5. Repeat steps 2-4 until $V_{\Delta SENS} < 0.5 \times SENS_{STEP}$.

OFFSET VOLTAGE (QVO) TRIM

Assuming the desired value of V_{OUT} when no magnetic field is 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} with no magnetic field applied.

3. Adjust QVO_Fine to set QVO to desired voltage (2.5 V for bidirectional, 0.5 V for unidirection).

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.

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MEMORY MAP

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	Disables communication on VOUT / disables OVD	R/W	1	24	24
		SPARE	n/a	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 scratchpad No effect on 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 device loads EEPROM memory into shadow registers. Shadow registers can be used to test different programming options without erasing EEPROM (e.g., finding sensitivity and QVO codes before writing into EEPROM).

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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.

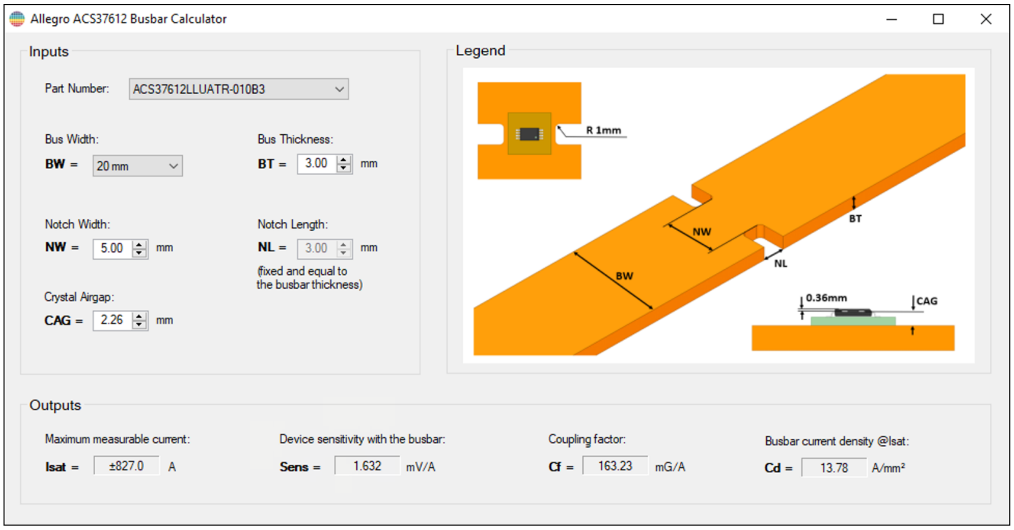

Figure 24: ACS37610 Busbar Calculator GUI

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.

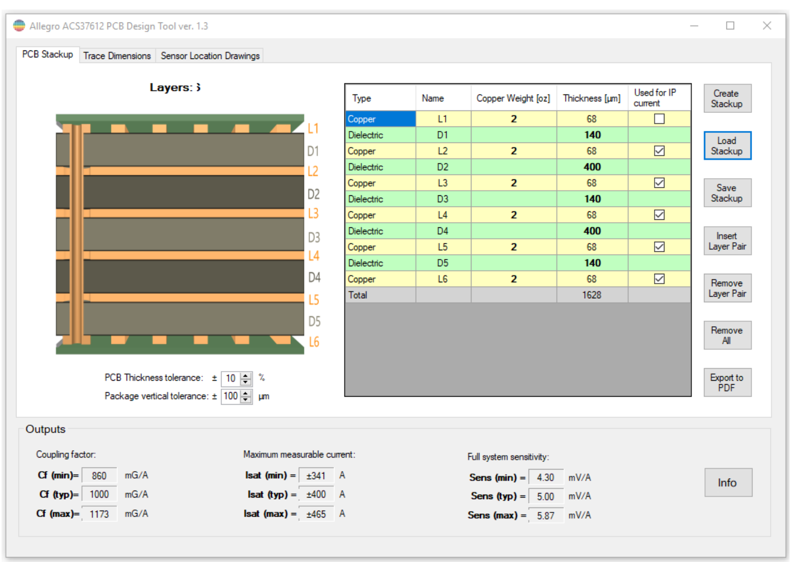

Figure 25: Relationship between Air Gap and Coupling Factor

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Revision History

Number	Date	Description
–	June 10, 2025	Initial release

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