

A80803 Evaluation Board and Programming GUI

INTRODUCTION

The A80803 Evaluation Board (EVB) is designed to aid system designers with the evaluation of the operation and performance of the A80803, a multi-topology, fixed frequency, switch-mode DC/DC controller for LED lighting applications with built-in support for low/high-beam operation and remote configuration via SPI.

The A80803 EVB is available in four configurations to support low/high-beam and fixed LED string applications. The EVB arrives configured to operate in one of four modes and has a mark on one of the silkscreen boxes in the top right of the EVB to identify in which mode the EVB is configured.

The Allegro A80803 configuration GUI is a tool provided to simplify interaction with the device using the SPI interface. The tool can read and write all configuration registers as well as report and clear the fault status and diagnostic bits. The tool provides a tabbed interface to group similar options together to help the user quickly find configuration options. The GUI is not required for operation but simplifies configuration register modifications.

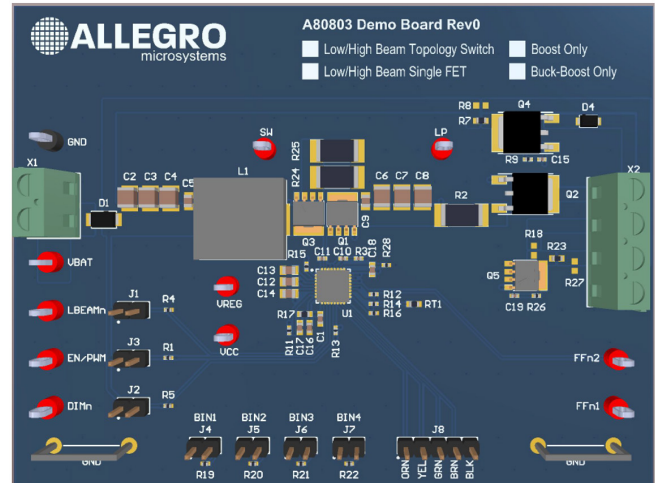


Figure 1: A80803 EVB

Table 1: A80803 EVB Available Configurations

| Configuration Name | Part Number | Low/High-Beam Support | Low-Beam Topology | High-Beam Topology |
|-------------------------------|-----------------|-----------------------|-------------------|--------------------|
| Low/High Beam Topology Switch | APEK80803KET-TS | Yes | Buck-Boost | Boost |
| Low/High Beam Single FET | APEK80803KET-SF | Yes | Boost | Boost |
| Boost Only | APEK80803KET-BO | No | Boost | – |
| Buck-Boost Only | APEK80803KET-BB | No | Buck-Boost | – |

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GENERAL SETUP

This section provides an overview of the connections that are generally applicable to all EVB configurations. Each group of connections is highlighted in Figure 2.

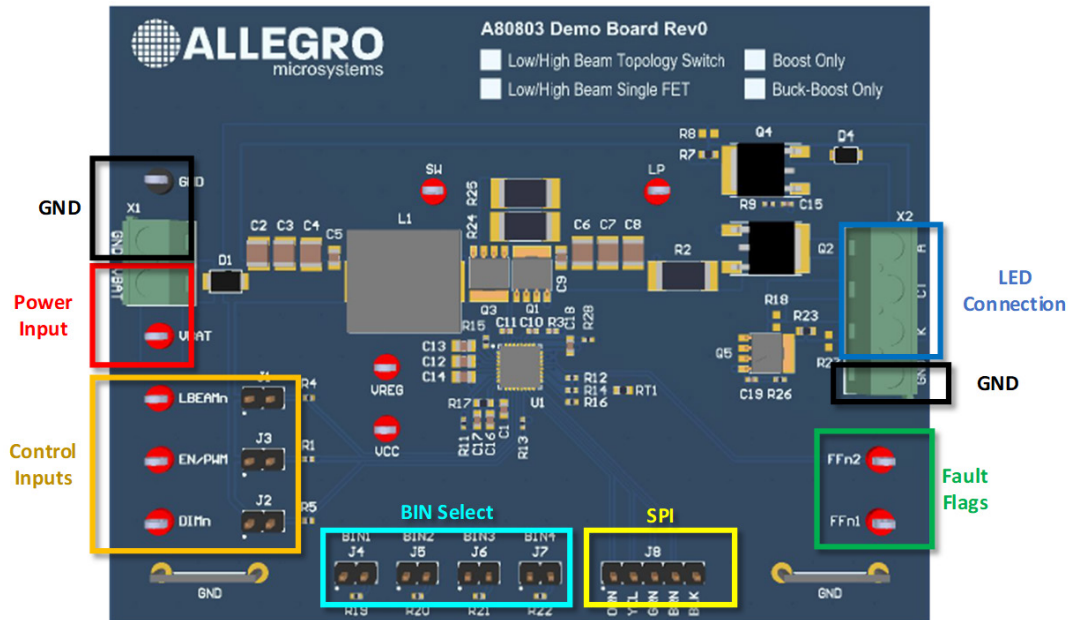


Figure 2: A80803 EVB I/O Connections

Power Input

Connect a power supply using the either X1 terminal block or the VBAT and GND test points.

LED Connection

Connect the anode of the LED string to the X2 connector terminal A (anode) and the cathode of the LED string to the X2 connector terminal K (cathode). For low/high-beam applications, tie the CT terminal to the LED string to mark the bottom of the low-beam string. The APEK80803KET-BB and APEK80803KET-BO options have R18 and R23 installed to tie CT to the K terminal.

Control Pins

The LBEAMn, EN/PWM, and DIMn pins of the A80803 can be tied to VIN with jumpers or left open and controlled with external signals. These test points could be tied to VIN externally or driven from a logic level source such as a microcontroller.

The jumpers J1, J2, and J3 can be installed or opened to set the operating state as shown in Table 2 and Table 3. To operate in external dimming mode, install J2 or tie DIMn to a logic high signal and EN/PWM to an external PWM source for controlled dimming or logic high for 100% dimming. To use internal dimming, open J2 and connect EN/PWM to logic high or install J3 and use the A80803 GUI tool to set the LED brightness.

Table 2: Low/High-Beam Jumper

| J1 (LBEAMn) | State |
|-------------|-----------|
| Open | Low-Beam |
| Installed | High-Beam |

Table 3: Internal/External Dimming Jumpers

| J2 (DIMn) | J3 (EN/PWM) | Dimming Mode |
|-----------|-------------|-----------------|
| Installed | Installed | External - 100% |
| Installed | Open | External - PWM |
| Open | Installed | Internal |

Bin Select

Jumpers J4 to J7 select the bin for analog dimming.

Note: Only one bin select jumper should be installed at a time. See Table 4 for bin selection.

Table 4: BIN Selection Jumpers

| Jumper Installed | BIN |
|------------------|---------------|
| J4 | BIN1 selected |
| J5 | BIN2 selected |
| J6 | BIN3 selected |
| J7 | BIN4 selected |

Gain can be modified for each bin using the A80803 GUI tool; see the Binning Tab section of this document. The jumpers J4 to J7 select a resistor for the bottom of a voltage divider. If all four jumpers are open, the BINSEL pin will be pulled up to VCC and BIN1 will be selected.

SPI Communication

The A80803 supports SPI for serial communication to control the configuration registers. The silkscreen labels are intended for use with the FTDI USB to Serial adapter cable, part number C232HM-EDHSL-0, to be used with the A80803 GUI tool. See Table 5 to compare the silkscreen labels to the SPI pin names. The jumpers J1, J2, and J3 can be installed or opened to set the operating state as shown in Table 2 and Table 3. To operate in external dimming mode, install J2 or tie DIMn to a logic high signal and EN/PWM to an external PWM source for controlled dimming or logic high for 100% dimming. To use internal dimming, open J2 and connect EN/PWM to logic high or install J3 and use the A80803 GUI tool to set the LED brightness.

Table 5: J8 Header SPI Labels

| Silkscreen Label | USB-Serial Breakout Wire | SPI Pin |
|------------------|--------------------------|---------|
| ORN | Orange | SCK |
| YEL | Yellow | MOSI |
| GRN | Green | MISO |
| BRN | Brown | CSn |
| BLK | Black | GND |

Fault Flags

There are two active low fault flag pins on the A80803, FFn1 and FFn2. Both are available as test points on the EVB. The fault flags are pulled up to V_{CC} with a 10 kΩ resistor on the EVB.

Sense Resistor

The LED current is set by the sense resistor R2 and the equation:

$$I_{LED} = V_{IDL} / R2$$

Each EVB configuration is designed for a 1 A LED current; with $V_{IDL} = 200$ mV then $R2 = 0.2 \Omega$.

Switching Frequency

The switching frequency for the power converter stage is set by R16 and the equation:

$$f_{SW} = 35000 / R16$$

where f_{SW} is in kHz and R16 is in k Ω . Each EVB configuration is designed for a switching frequency of 400 kHz with $R16 = 86.6$ k Ω .

NTC LED Current Derating

There is a NTC thermistor on the EVB, RT1, in a voltage divider leading to the NTC pin. The thermistor, part number NTCS0603E-3103FHT, has a base resistance of 10 k Ω . See the Thermal Derating section in the A80803 datasheet for more information about programming the derating values.

GETTING STARTED WITH THE GUI

Download the A80803 GUI tool from <https://registration.allegromicro.com>. The GUI tool is an executable that can be run directly without any additional installation steps once downloaded and extracted. The tool depends on the FTDI D2xx driver for USB to Serial communication.

Note: Text highlighted in **blue monospaced font** refers to a button in the GUI.

The tool opens to the Diagnostic tab but does not attempt to communicate with the part until the user requests a read or write operation. The initial state of the GUI is shown below in Figure 3.

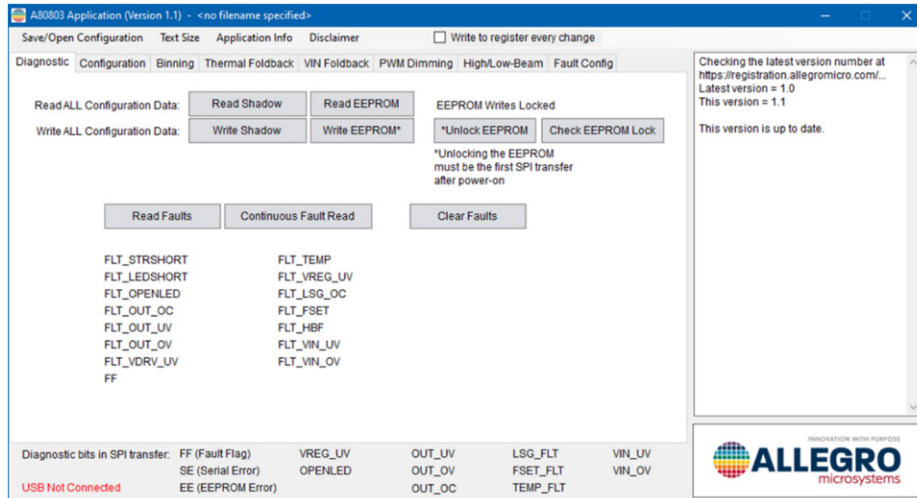


Figure 3: First screen after starting the GUI

Press the **Read Faults** button to start a read and initialize the USB connection. Upon successful connection, the USB status will change to **USB Connected** in green text in the bottom left corner of the window.

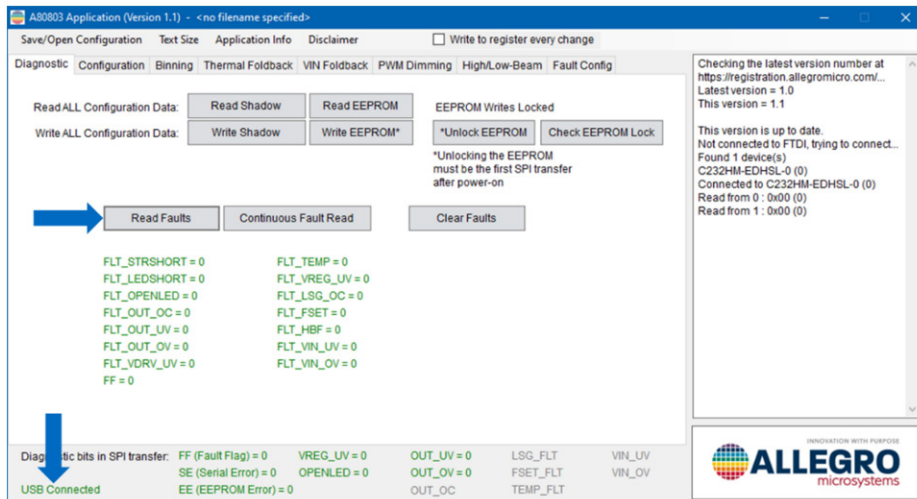


Figure 4: USB Serial Connection Established

At the top of the diagnostics tab there are buttons to read all configuration data from shadow or EEPROM into the state of GUI controls, and to write the full state of the GUI controls to the configuration registers or EEPROM. A good practice is read the shadow registers, once the connection to the A80803 has been established, by clicking the **Read Shadow** button shown in Figure 5, to align the GUI controls with the state of the device. Reading the full contents of the EEPROM can be used to understand what is programmed into EEPROM and is loaded into shadow at each power-on, but the shadow registers are what the A80803 uses during operation.

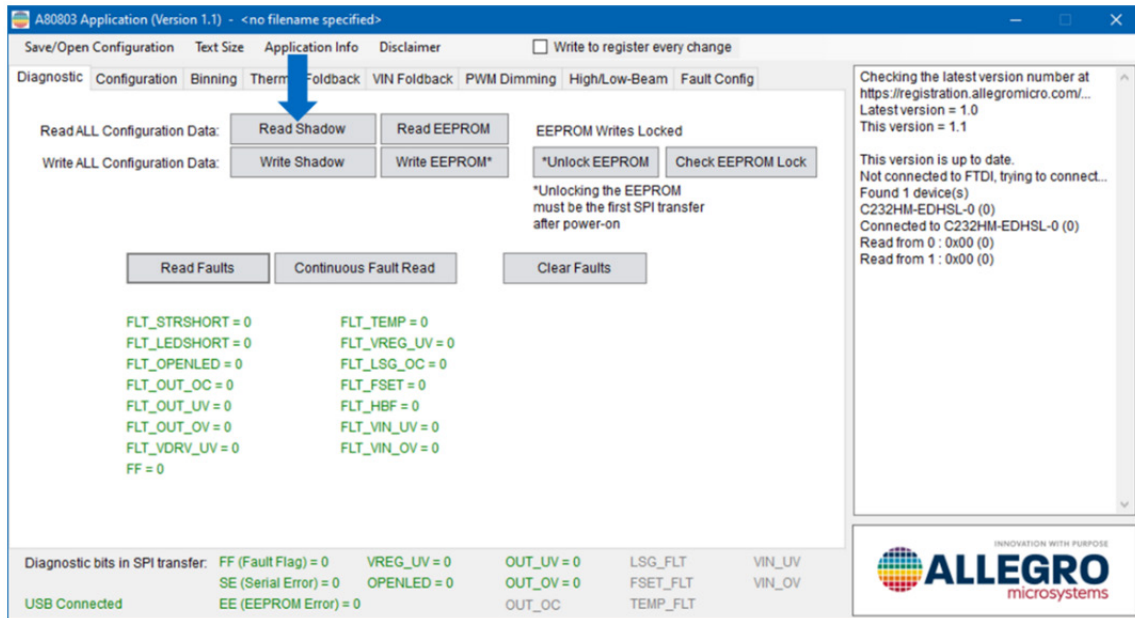


Figure 5: Read All of Shadow to Align GUI Controls with the Device

GUI Troubleshooting

After the first read or write request, the tool will attempt to communicate using the FTDI D2xx driver. If the driver is not installed, or the FTDI USB-Serial device cannot be found, an error message will be displayed as shown in Figure 6.

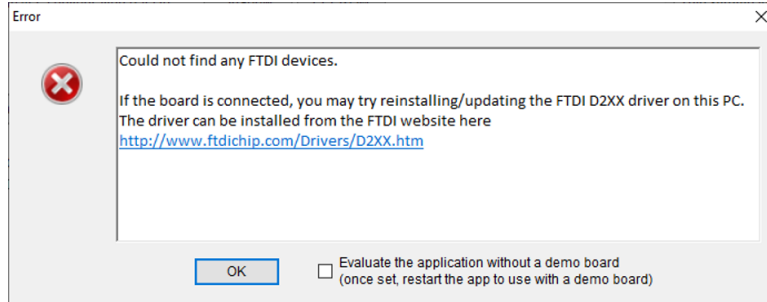


Figure 6: Error when FTDI device cannot be found

If this error appears and the D2xx drivers are believed to be installed, then ensure the USB cable is fully connected to the PC. If the USB cable was recently plugged-in, then ensure the PC has had enough time to recognize the USB device.

If the GUI shows **USB Connected** and **Parity check failed** as shown in Figure 7, this means the USB-to-serial converter is connected but cannot communicate to the A80803. Ensure the A80803 SPI pins are properly connected in the correct order (refer to the SPI Communication section of this document), and the device is powered. A parity error while reading the fault registers will reset the fault indicators to black text to indicate the state is unknown.

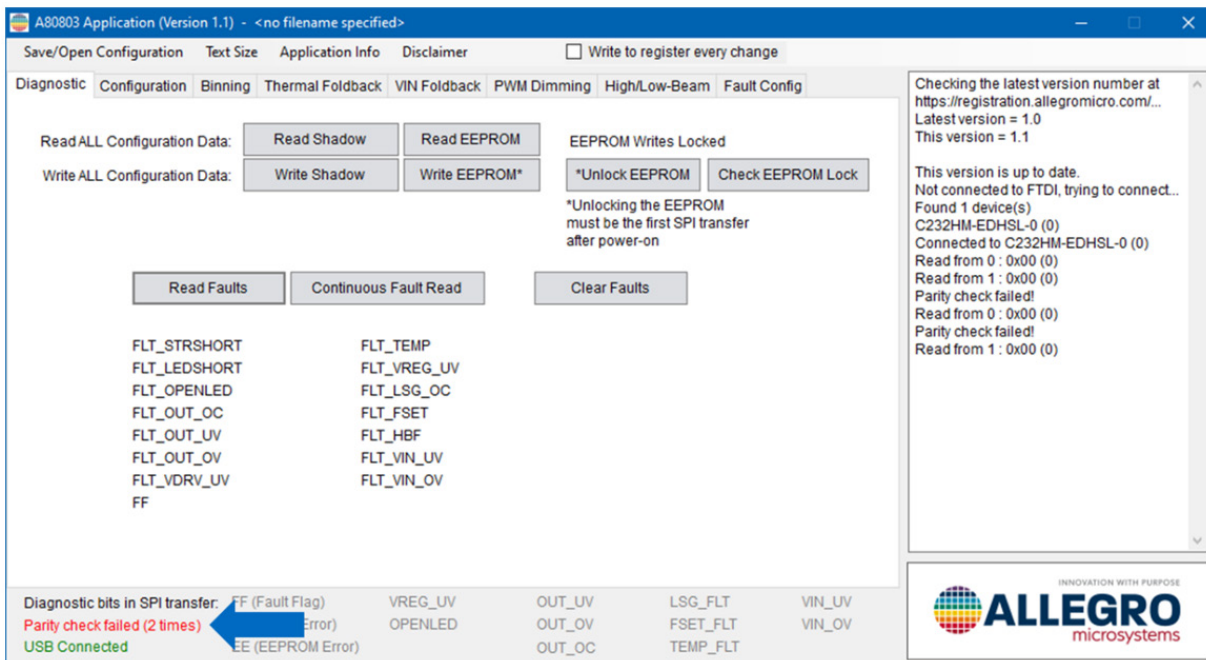


Figure 7: GUI is connected to USB-Serial but cannot find A80803

The window on the right side of the GUI window shows the details of each SPI transaction as they are processed. The bottom of the window shows the diagnostic information from on the MISO pin after each SPI read or write. See the Serial Communication section in the datasheet for more details about the SPI interface.

Device Configuration

Each of the other tabs after the Diagnostics tab has two buttons in the top right corner, one to read just the registers represented on that tab, **Read config**, and one to write the state of the GUI controls in that tab to those registers, **Write config**. The numbers in the button label indicate the Config registers affected. There is also a checkbox near the top of the window for **Write to register every change** which will update configuration registers every time a change is made without having to make the change and click the **Write** button.

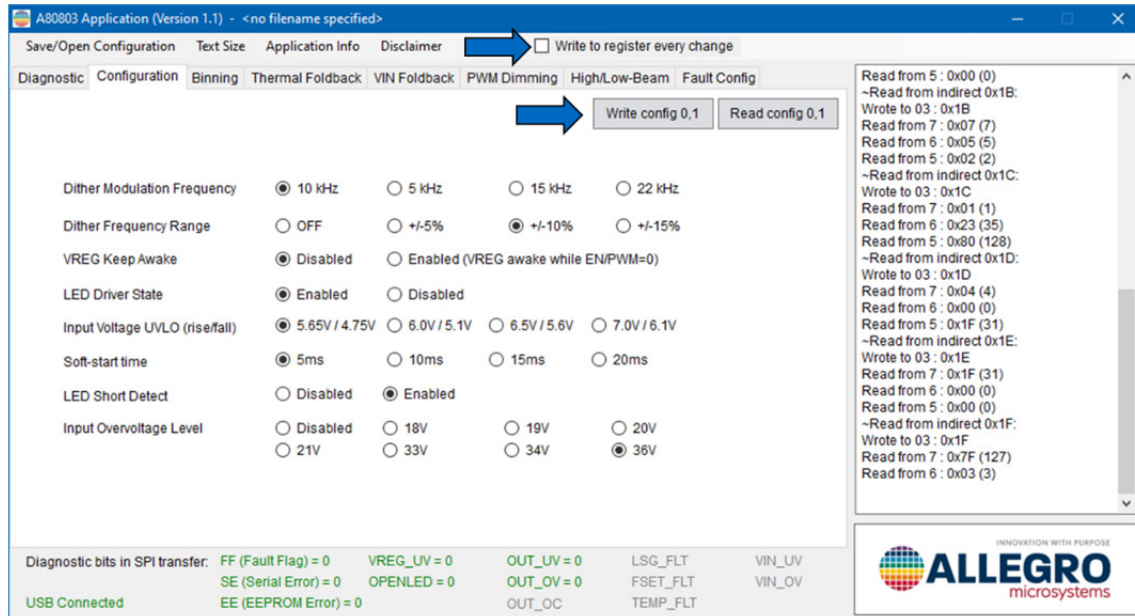


Figure 8: Read, Write, and Write Every Change

Configuration Files and Default EEPROM

The GUI tool has an option to save its state to a file to be recalled later. Click on the [Save/Open Configuration](#) menu item, then click [Save this configuration to a file...](#), and select a location and name the file, shown in Figure 9. Recall this configuration by clicking the [Save/Open Configuration](#) button, select [Open device configuration file...](#), and select the file to load. After loading a configuration file, the GUI will update to match the state when it was saved.

At any time, the factory default EEPROM state can be loaded into the GUI controls by selecting [Load default configuration to application](#) option from the Save/Open menu.

Note: Loading a configuration (including the default) does not automatically send the configuration to the device, giving an opportunity to modify a loaded configuration before writing to the device.

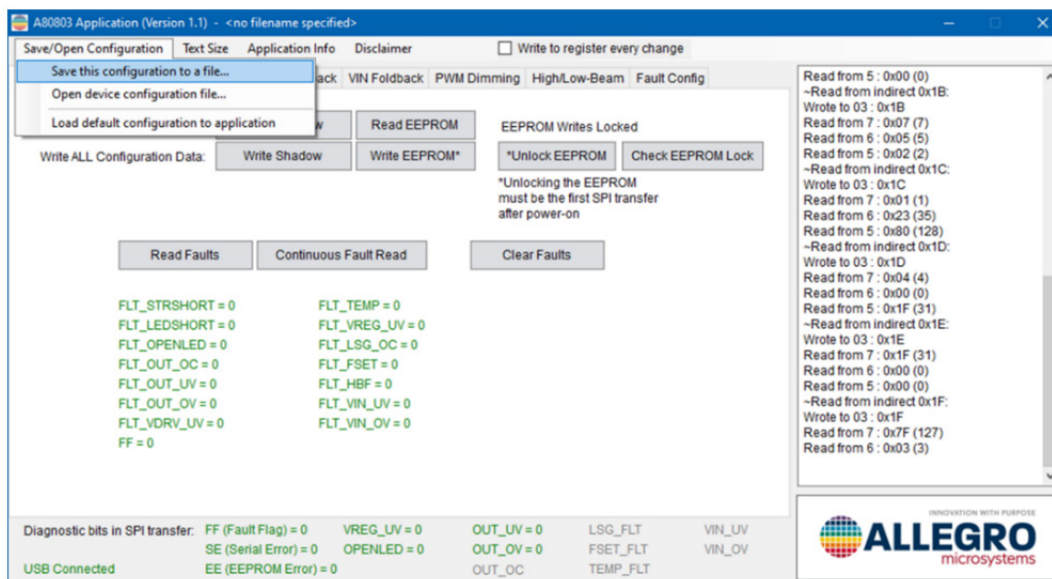


Figure 9: Save and Load Configuration Files

Diagnostic Tab

In addition to the buttons to read or write the full register set, the Diagnostic tab also shows the status of the faults captured in the DIAG0 and DIAG1 registers. The fault status indicators will update with each click of the **Read Faults** button or continuously if the **Continuous Fault Read** button is pressed. The fault status indicators will be **green** and show a value of 0 when no fault is present and **red** with a value of 1 when a fault is present. Some faults are latched and must be cleared with the **Clear Faults** button. See DIAG0 and DIAG1 register descriptions in the datasheet for more information.

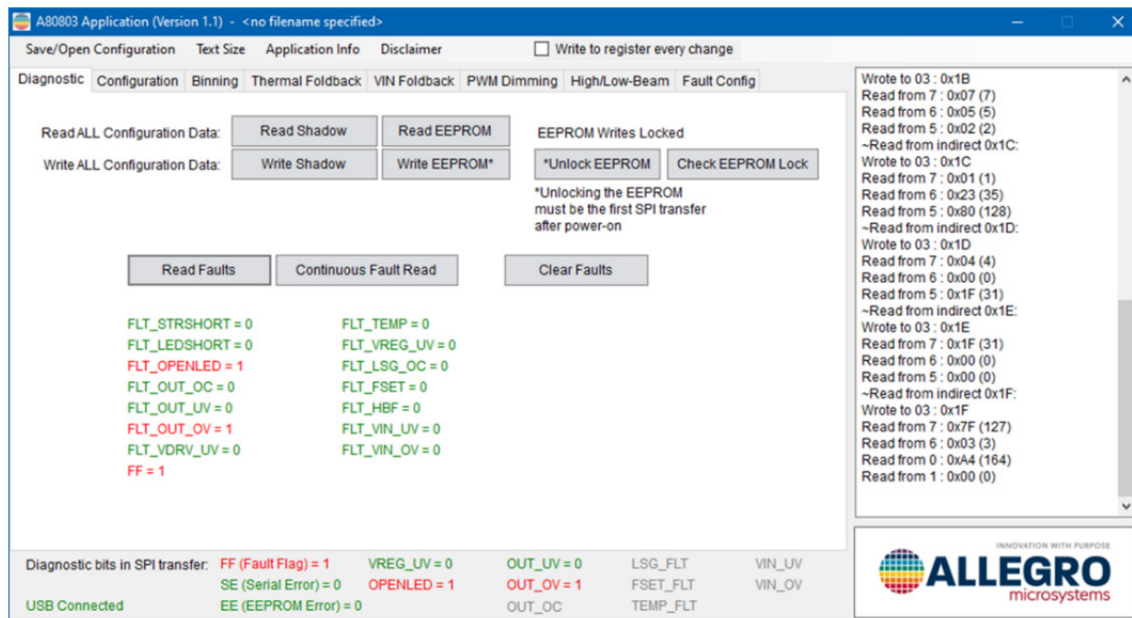


Figure 10: Fault Indicators

The bottom of the GUI window shows the faults that are on the MISO line during every SPI transaction. The faults in gray in Figure 10 are only available on the MISO line during a write. See the SPI Data Frames section of the datasheet for more information.

Configuration Tab

The Configuration tab provides several general purpose options to configure the A80803, as shown in Figure 11.

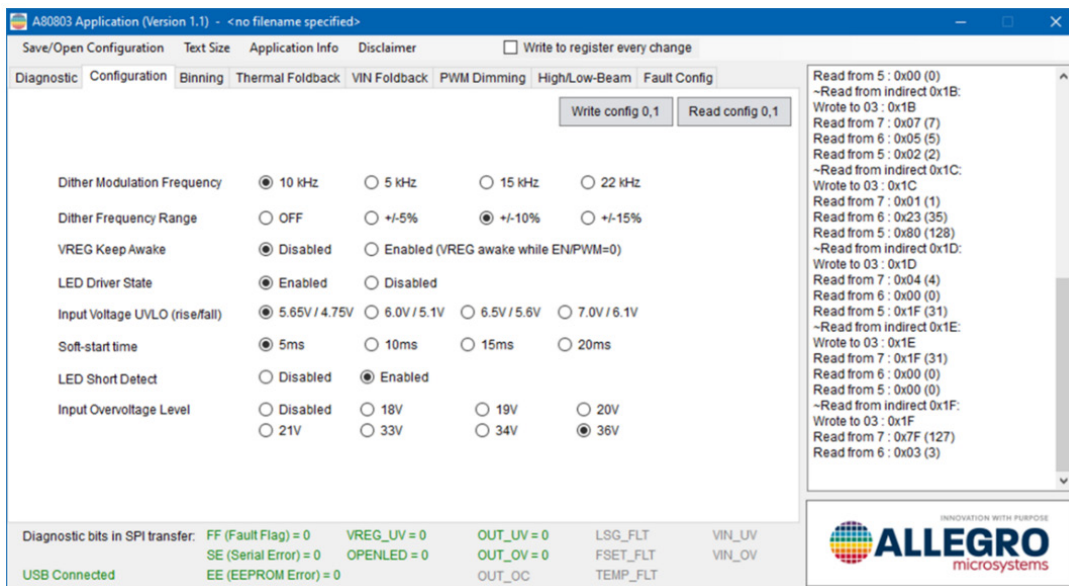


Figure 11: General Configuration

Binning Tab

The Binning tab has four sliders to control the bin gain for each of the four bins. The binning level acts as a derating for the maximum LED current. The BINSSEL pin (a resistor divider from VCC selectable by jumpers on the evaluation board) selects which bin is active; see the Bin Select section of this document and the LED Analog Dimming section of the datasheet for more information about binning with the A80803.

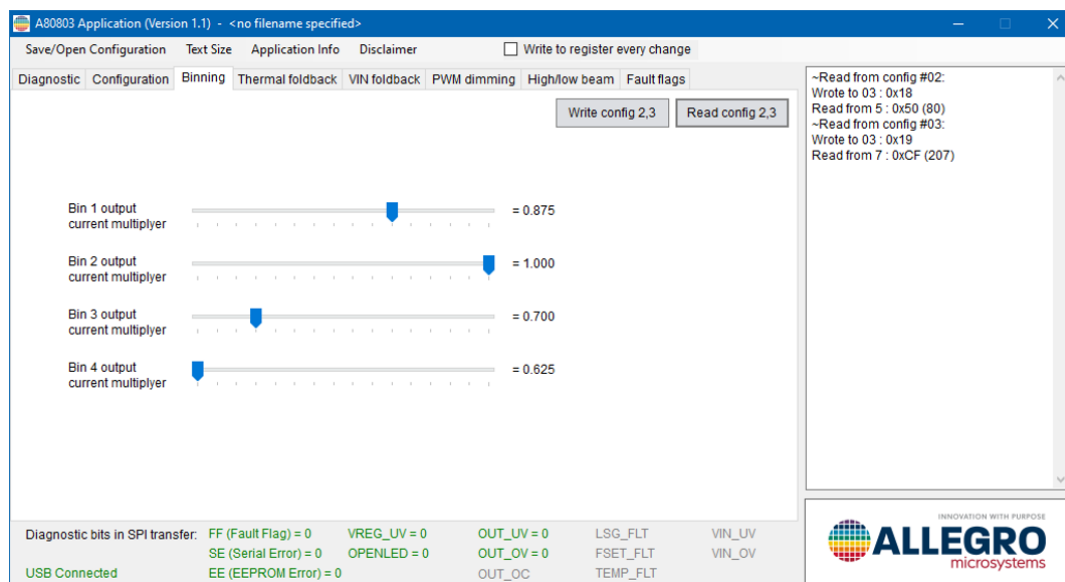


Figure 12: Binning Configuration

Thermal Foldback Tab

The Thermal Foldback tab has sliders for the NTC analog dimming options. See the Thermal Derating section and the Thermal Derating Example in the datasheet for more information about calculating these values.

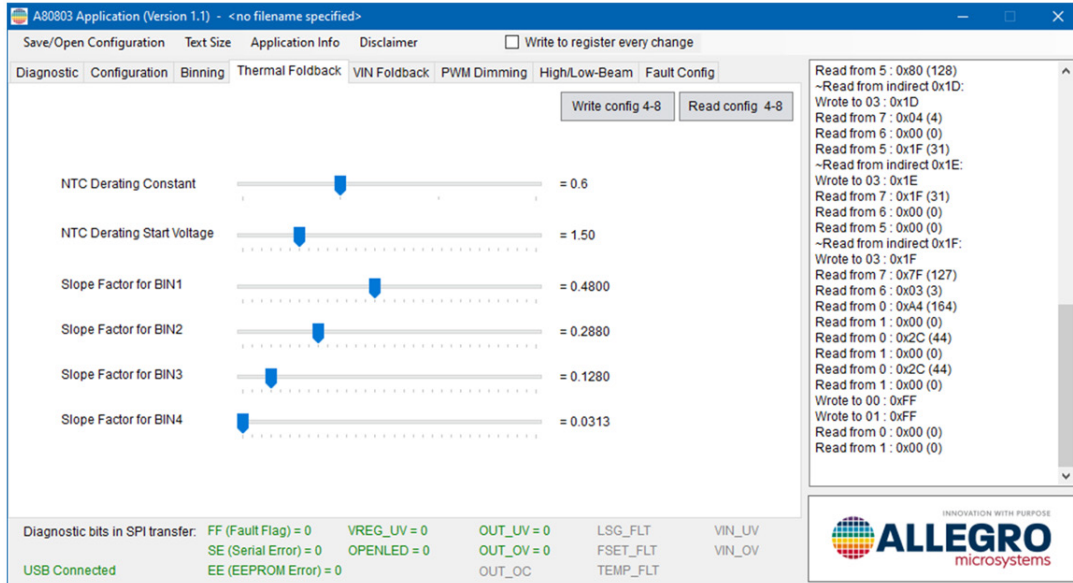


Figure 13: Thermal Foldback Configuration

VIN Foldback Tab

The VIN Foldback tab has sliders for the VIN derating analog dimming options. See the Input Voltage Derating section and the Input Voltage Derating Example in the datasheet for more information about calculating these values.

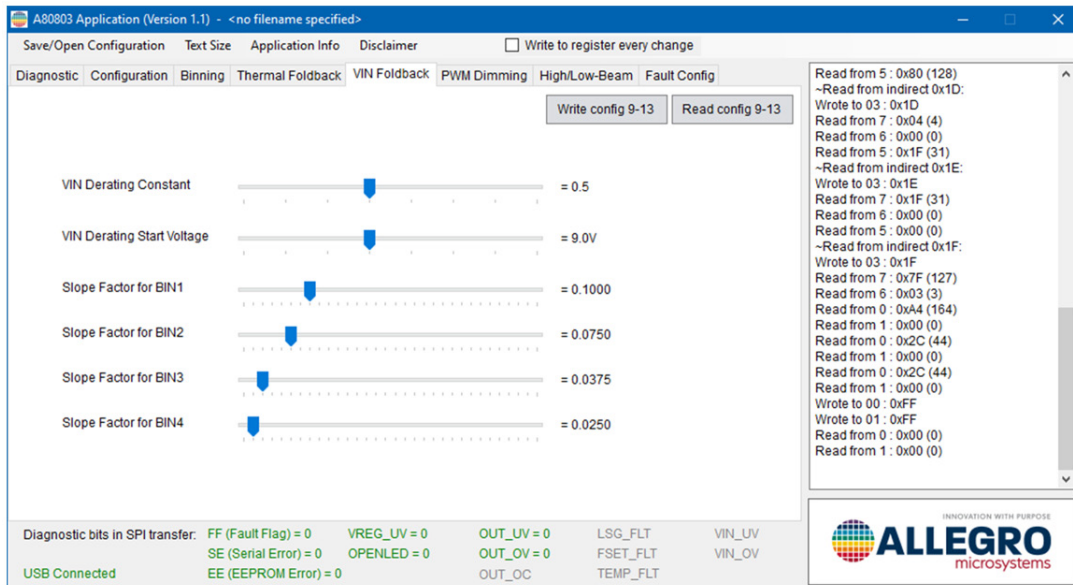


Figure 14: Input Voltage Foldback Configuration

PWM Dimming Tab

This tab has options related to PWM dimming and includes the following options for internal PWM dimming: a toggle selection for [Internal PWM Dimming Override](#), four options for [Internal PWM Dimming Frequency](#), and a slider for [Internal PWM Dimming Duty Cycle](#). The [Internal/External PMOSFET Gate Current](#) option applies to the PWMOUT gate driver for both internal and external PWM dimming. See the LED PWM Dimming section of the datasheet for more information about PWM dimming with the A80803.

Note: If the DIMn pin is low, the [Internal PWM Dimming Duty Cycle](#) slider will set the PWM dimming duty cycle even if [Internal PWM Dimming Override](#) is set to Disabled because the device will honor the DIMn selection for internal PWM.

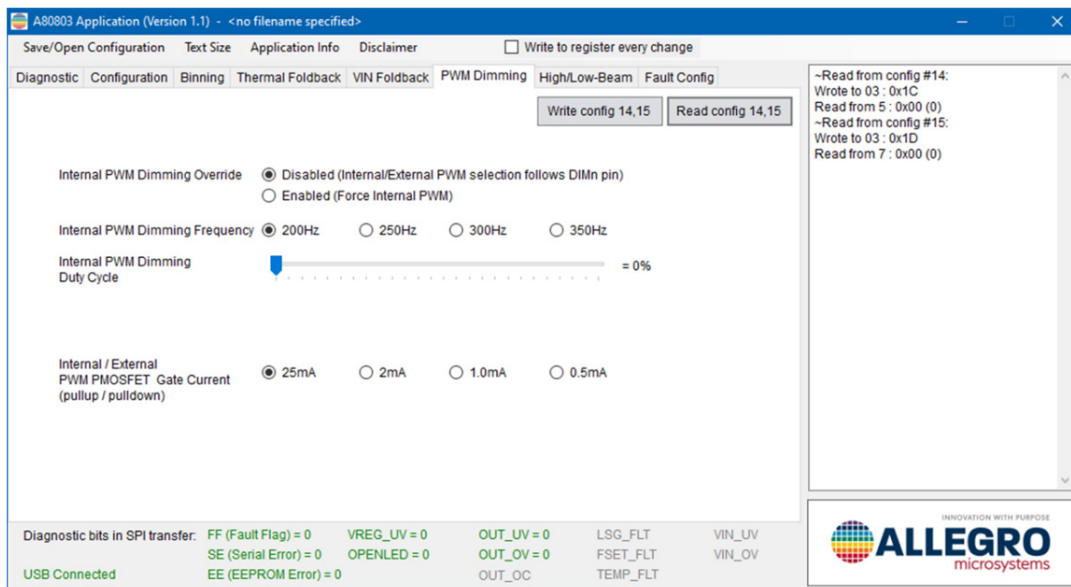


Figure 15: PWM Dimming Configuration

High/Low-Beam Tab

The High/Low-Beam tab has options to set the overvoltage and undervoltage thresholds for both low-beam and high-beam, the overvoltage behavior, the additional dead time setting, and high-beam gate controls. The high-beam gate can be forced on with the [High-beam Gate On/Off](#) option, and the [HBG Control](#) option can be set to invert how HBG reacts to the LBEAMn pin (this option should only be used with the application circuit for low/high-beam transitions that short out the high-beam LEDs; see APE-K80803KET-SF for an evaluation board of this application. Also see Low and High Beam Control section of the datasheet for more information.

Note: Allegro recommends setting low-beam and high-beam overvoltage limits approximately 5 V above the expected output voltage.

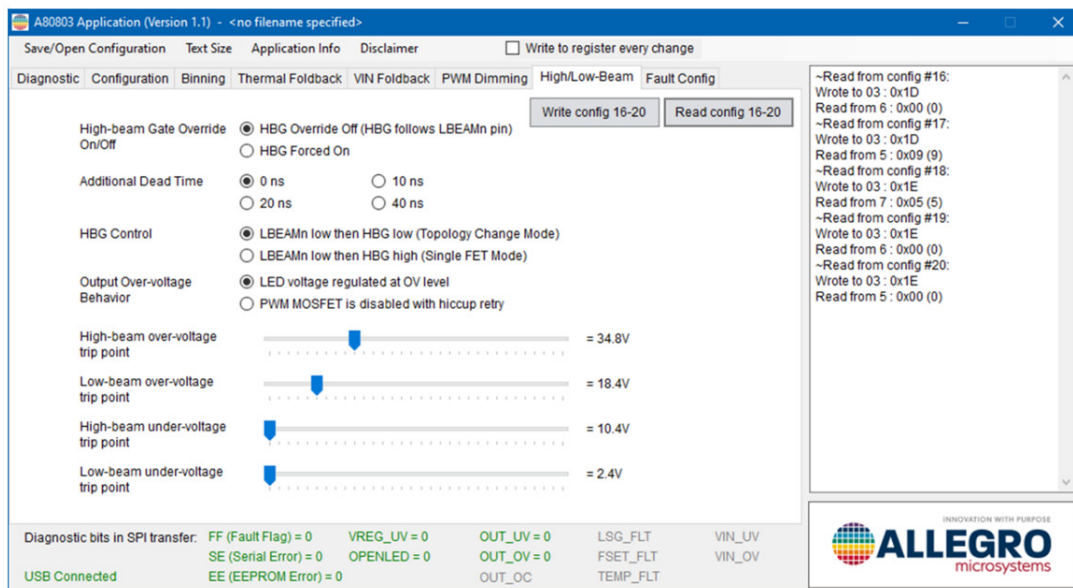


Figure 16: PWM Dimming Configuration

Fault Flags Tab

The Fault Flags tab has options to set which faults are reported on FFn2, the FFn2 delay, the overcurrent detection filter, and the one-out-all-out behavior.

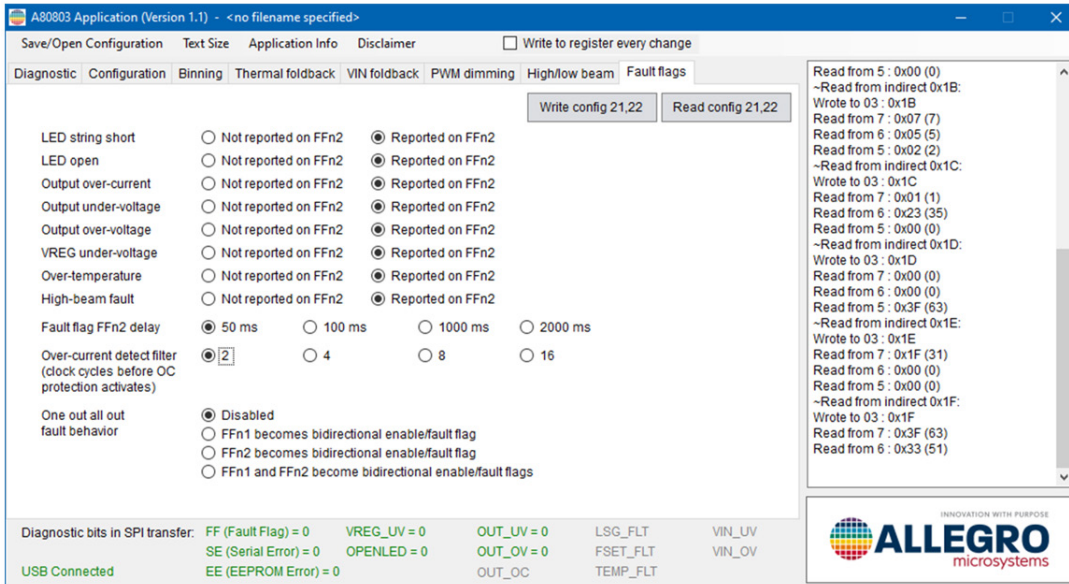


Figure 17: Fault Flag Configuration

Writing to EEPROM

The EEPROM must be unlocked before it can be written. Unlocking the EEPROM must be the first SPI transaction after the device is powered. To unlock and write EEPROM with the GUI, follow this procedure:

1. Power on the device and read the faults to verify communication.
2. Power cycle the A80803 while keeping the GUI open.
3. Click the **Unlock EEPROM** button (this must be first button after A80803 is powered).
4. If the unlock was successful, the text above the unlock button will read EEPROM Writes **Unlocked** in green text.
5. Click the **Read Shadow** button to read the full shadow register contents into the GUI.

Note: If this step is skipped, the full state of the GUI will still be written into the full EEPROM in Step 7. Reading shadow before making changes to the GUI is the best practice to ensure only the desired settings are modified in EEPROM.

6. Update the controls on any tab to the desired state to be written into EEPROM.
7. Return to the **Diagnostic** tab and click the **Write EEPROM** button to write all configuration data to EEPROM.
8. Optionally, power-cycle and use the **Read Shadow** button to verify the shadow registers are updated with the new values on power-up.

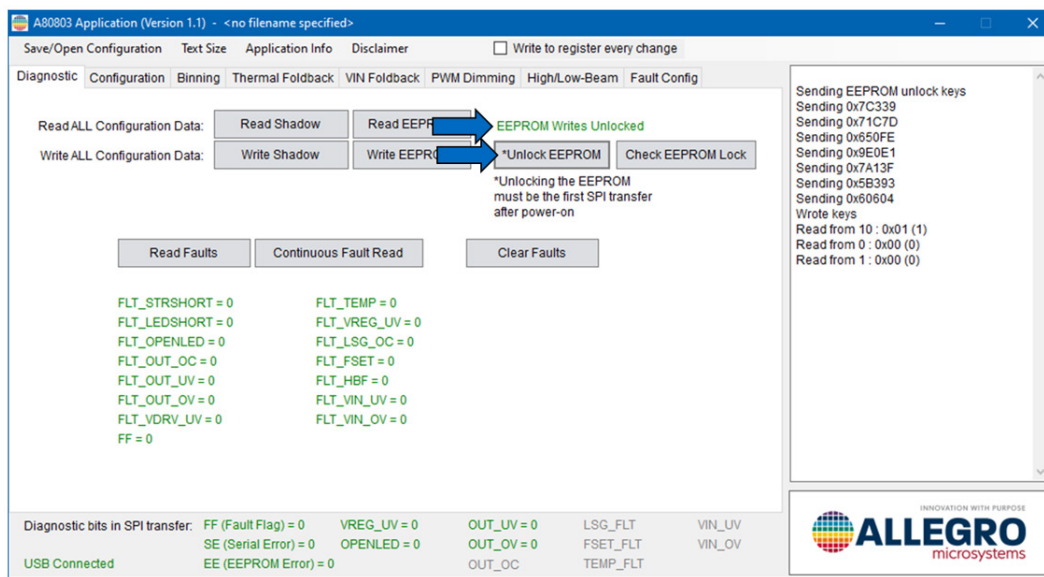


Figure 18: EEPROM Writes Unlocked

Note: If needed, to restore the EEPROM to the factory settings, load the default configuration into the GUI (see Configuration Files) and write it to EEPROM.

LOW/HIGH-BEAM TOPOLOGY SWITCH EVB

The low/high-beam topology switch configuration operates in buck-boost mode while in low-beam and in boost mode while in high-beam. This allows for shorter low-beam strings that may have an output voltage less than the input voltage. Connect the LED string to terminal block X2 as shown in Figure 19, where terminal A to CT is the low-beam string, and terminal A to K is the high-beam string. Connect a power supply as described in the Power Input section of this document and set the jumpers to achieve the desired dimming option as described in the Control Pins section. Connect the FTDI USB breakout cable to J8 for optional software configuration and fault readback.

When LBEAMn is low, Q4 is on and Q5 is off, directing the LED current from the LED anode through the CT terminal and through Q4 back to VIN. When LBEAMn is high, Q4 is off and Q5 is on, directing the LED current through the full LED string and through Q5 to ground.

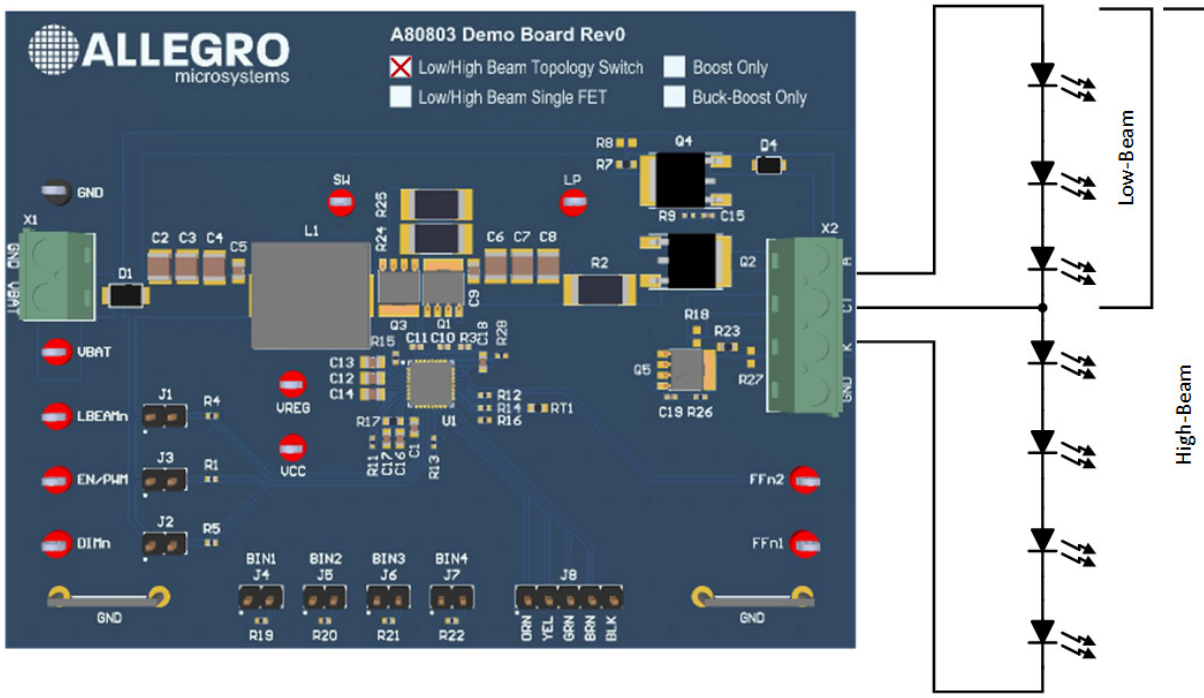


Figure 19: APEK80803KET-TS PCB with LED Connection

APEK80803KET-TS SCHEMATIC

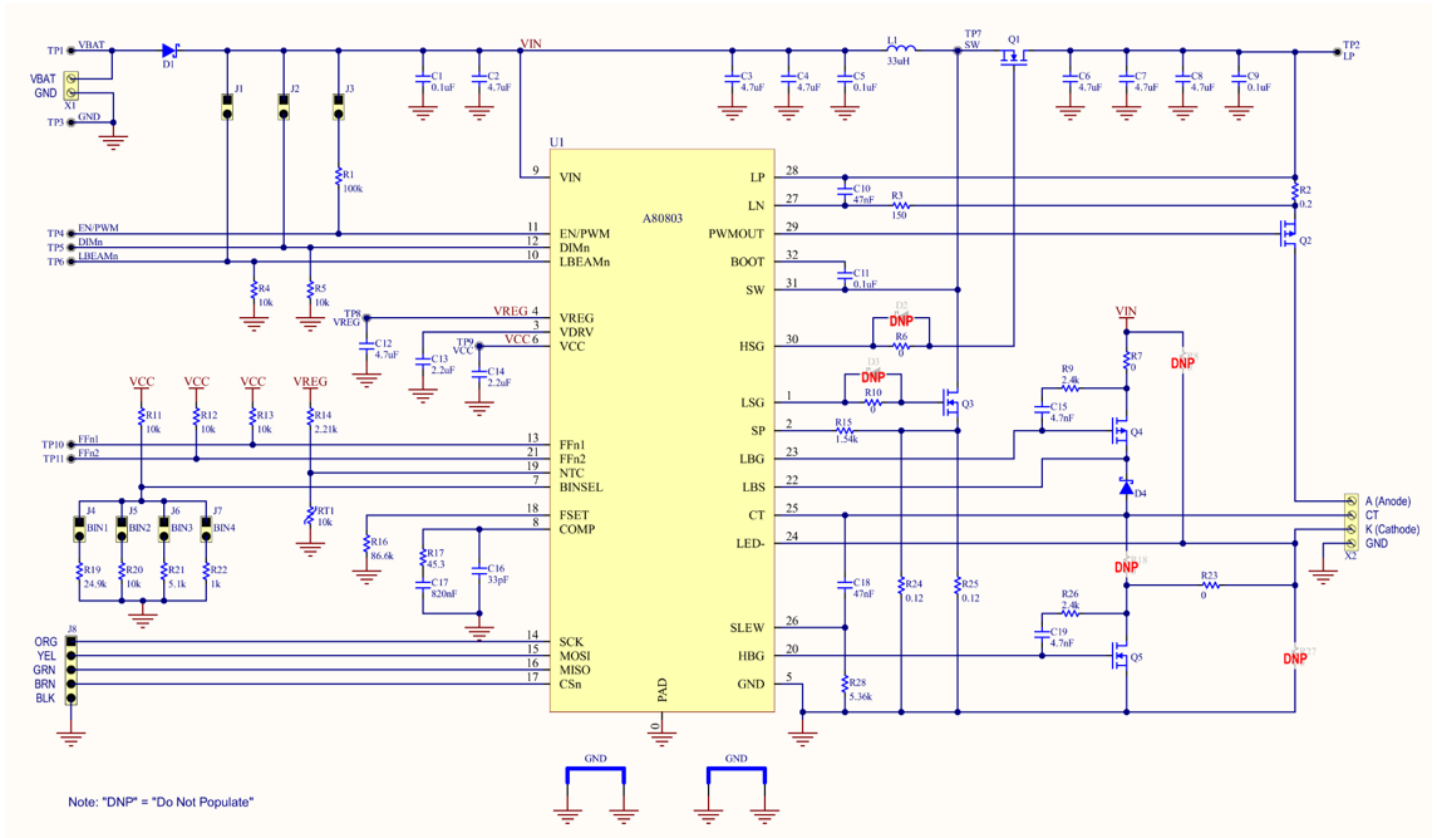


Figure 20: APEK80803KET-TS Schematic

APEK80803KET-TS Bill of Materials

| Designator | Description | Quantity | Manufacturer | Manufacturer P/N |
|--|---|----------|----------------------|----------------------|
| U1 | A80803 in the QFN-32 | 1 | Allegro MicroSystems | |
| C1 | Capacitor, Ceramic, 0.1 μ F, 50 V, X7R, 0603 | 1 | | |
| C2, C3, C4 | Capacitor, Ceramic, 4.7 μ F, 50 V, X7R, 1210 | 3 | Murata | GCM32ER71H475KA55K |
| C5, C9 | Capacitor, Ceramic, 0.1 μ F, 50 V, X7R, 0805 | 2 | | |
| C6, C7, C8 | Capacitor, Ceramic, 4.7 μ F, 100 V, X7R, 1210 | 3 | TDK | CNA6P1X7R2A475K250AE |
| C10 | Capacitor, Ceramic, 47 nF, 25 V, X7R, 0402 | 1 | | |
| C11 | Capacitor, Ceramic, 0.1 μ F, 16 V, X7R, 0402 | 1 | | |
| C12 | Capacitor, Ceramic, 4.7 μ F, 16 V, X7R, 0805 | 1 | | |
| C13, C14 | Capacitor, Ceramic, 2.2 μ F, 16 V, X7R, 0805 | 2 | | |
| C15, C19 | Capacitor, Ceramic, 4.7 nF, 50 V, X7R, 0402 | 2 | | |
| C16 | Capacitor, Ceramic, 33 pF, 50 V, C0G, 0603 | 1 | | |
| C17 | Capacitor, Ceramic, 820 nF, 25 V, X7R, 0603 | 1 | | |
| C18 | Capacitor, Ceramic, 47 nF, 50 V, X7R, 0603 | 1 | | |
| D1 | Diode, Schottky, 60 V, 5 A, SOD-128 | 1 | Nexperia | PMEG60T50ELPX |
| D4 | Diode, Schottky, 100 V, 2 A, SOD123W | 1 | | |
| GND1, GND2 | Ground Bar, 18 AWG Bus Bar, 15 mm Body | 2 | | |
| J1, J2, J3, J4, J5, J6, J7 | Connector, Header, 2 Position, 0.1" | 7 | Würth | 61300211121 |
| J8 | Connector, Header, 5 Position, 0.1" | 1 | Würth | 61300511121 |
| L1 | Inductor, 33 μ H, \pm 20%, 8 A sat, 85.5 m Ω Max | 1 | Eaton | HCMA1305-330-R |
| Q1, Q3 | MOSFET, N-Channel, 30 A, 100 V, LFPAK56 | 2 | Nexperia | PSMN038-100YL |
| Q2, Q4 | MOSFET, P-Channel, 100 V, 15 A, TO252-3 | 2 | Infineon | SPD15P10PLGBTMA1 |
| Q5 | MOSFET, N-Channel, 14.8 A, 100 V, LFPAK56 | 1 | Nexperia | BUK9Y104-100B |
| R1 | Resistor, 100 k Ω , 1/16W, 1%, 0402 | 1 | | |
| R2 | Resistor, 0.2 Ω , 1 W, 1%, 2512 | 1 | | |
| R3 | Resistor, 150 Ω , 1/16 W, 1%, 0402 | 1 | | |
| R4, R5, R11, R12, R13, R20 | Resistor, 10 k Ω , 1/16 W, 1%, 0402 | 6 | | |
| R6, R10 | Resistor, 0 Ω , 1/16 W, 1%, 0402 | 2 | | |
| R7, R23 | Resistor, 0 Ω , 1/10 W, 0603 | 2 | | |
| R9, R26 | Resistor, 2.4 k Ω , 1/16 W, 1%, 0402 | 2 | | |
| R14 | Resistor, 2.21 k Ω , 1/16 W, 1%, 0402 | 1 | | |
| R15 | Resistor, 1.54 k Ω , 1/16 W, 1%, 0402 | 1 | | |
| R16 | Resistor, 86.6 k Ω , 1/16 W, 1%, 0402 | 1 | | |
| R17 | Resistor, 45.3 Ω , 1/10 W, 1%, 0603 | 1 | | |
| R19 | Resistor, 24.9 k Ω , 1/16 W, 1%, 0402 | 1 | | |
| R21 | Resistor, 5.1 k Ω , 1/16 W, 1%, 0402 | 1 | | |
| R22 | Resistor, 1 k Ω , 1/16 W, 1%, 0402 | 1 | | |
| R24, R25 | Resistor, 0.12 Ω , 1 W, 1%, 2512 | 2 | | |
| R28 | Resistor, 5.36 k Ω , 1/16 W, 1%, 0402 | 1 | | |
| RT1 | Thermistor, NTC, 10 k Ω , 0603 | 1 | Vishay | NTCS0603E3103FHT |
| TP1, TP2, TP4, TP5, TP6, TP7, TP8, TP9, TP10, TP11 | Test Point, Red, 0.063" Diameter | 10 | Keystone | 5010 |
| TP3 | Test Point, Black, 0.063" Diameter | 1 | Keystone | 5011 |
| X1 | Terminal Block, 5.08 mm, Vertical, 2 position | 1 | TE Connectivity | 282837-2 |
| X2 | Terminal Block, 5.08 mm, Vertical, 4 position | 1 | TE Connectivity | 282837-4 |

LOW/HIGH-BEAM SINGLE FET EVB

The low/high-beam single FET configuration operates in boost mode for both low-beam and high-beam and shorts out the high-beam part of the LED string while in low-beam. The LED string must have enough LEDs for the boost output voltage to be higher than the input voltage for both low-beam and high-beam. Connect the LED string to terminal block X2 as shown in Figure 21, where A to CT is low-beam, and A to K is high-beam. Connect a power supply as described in the Power Input section of this document and set the jumpers to achieve the desired dimming option as described in the Control Pins section. Connect the FTDI USB breakout cable to J8 for optional software configuration and fault readback.

When LBEAMn is low, the high-beam LEDs are shorted to ground by Q5, and when LBEAMn is high, Q5 is open and the LED current flows through the high-beam LEDs and returns through the cathode terminal to ground.

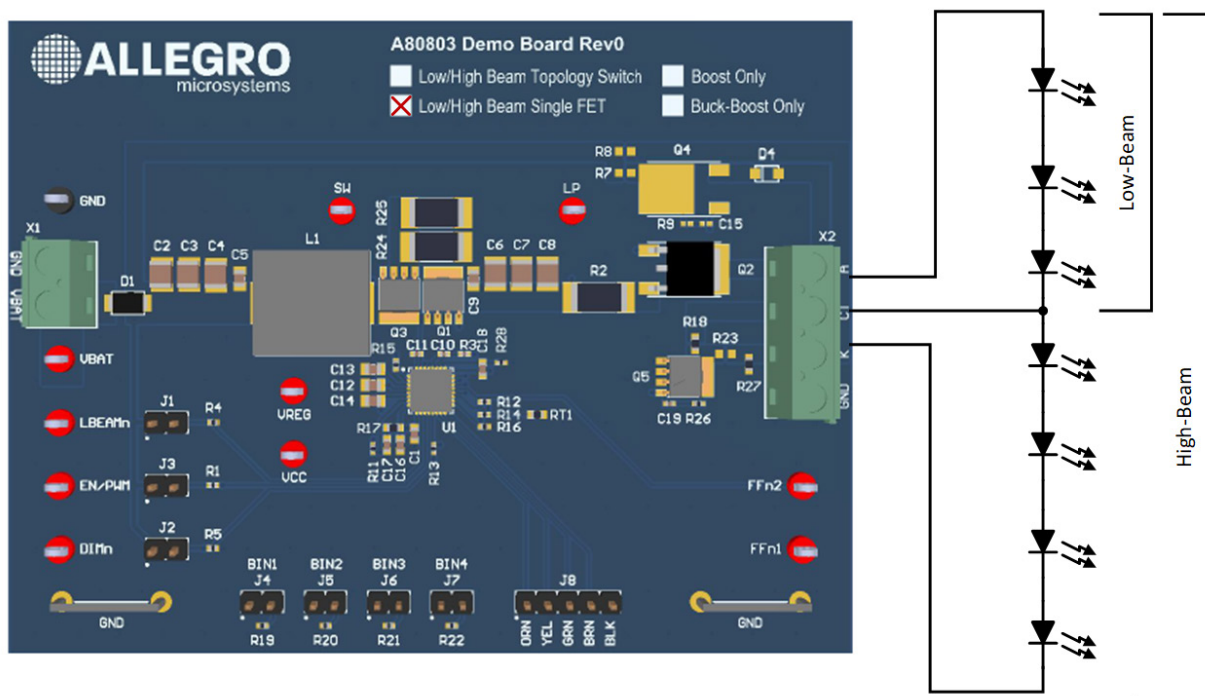


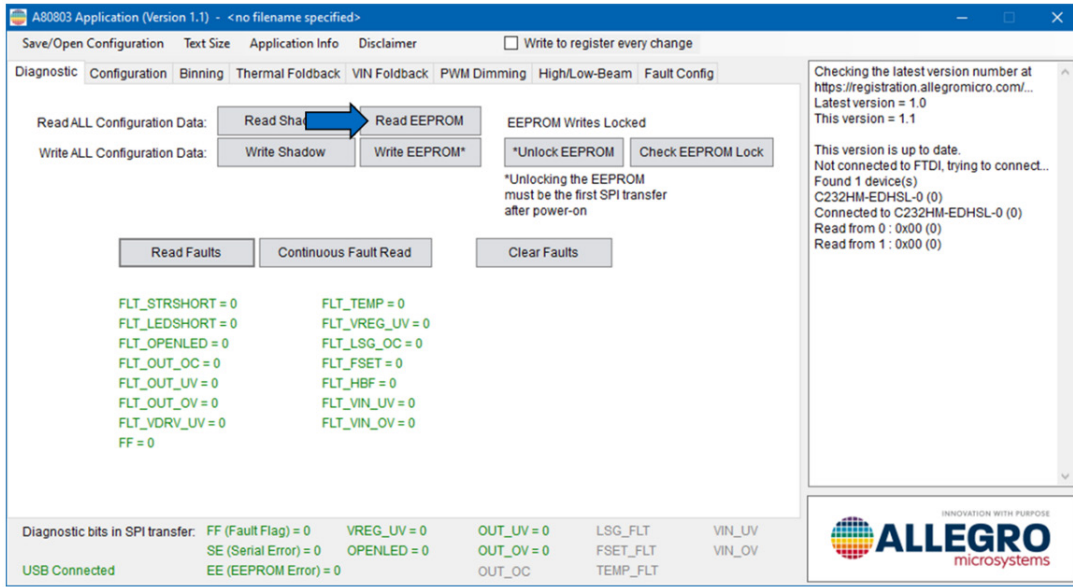
Figure 21: APEK80803KET-SF PCB with LED Connection

Note: This EVB requires EEPROM bit HBGCTRL = 1, which is different from the other EVBs and the default EEPROM which sets HBGCTRL = 0. See the Confirm HBGCTRL Bit section before powering up LEDs.

Confirm HBGCTRL Bit

To confirm the HBGCTRL bit is set appropriately for the shorting FET configuration, power-on the device into internal dimming mode (J3 installed, J2 open), then read back EEPROM and check the HBGCTRL bit. If HBGCTRL = 0, the EEPROM must be updated before the device can be used for driving LEDs. This process is illustrated in the figures below using the A80803 GUI tool.

Power on the device and read EEPROM.



Check the HBG Control section of the [High/Low-Beam](#) tab.

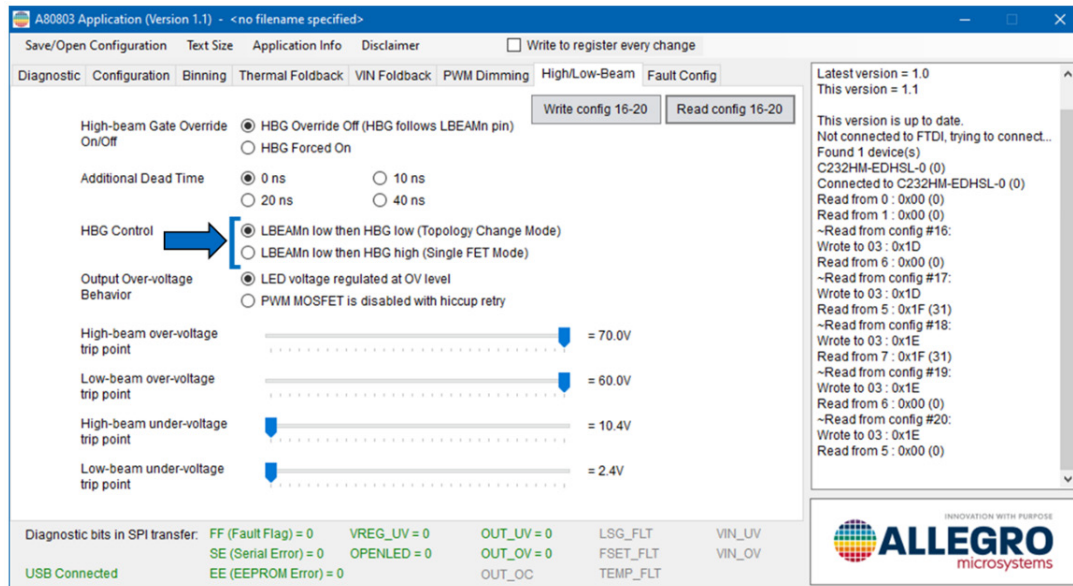


Figure 22: HBGCTRL Bit in A80803 GUI

If HBG Control is set for **Topology Change Mode**, then refer to the Writing to EEPROM section and follow the steps below to configure the device properly for this application.

1. Power-cycle the device.
2. Unlock the EEPROM for writes.
3. Click **Read EEPROM** to align the GUI controls with the EEPROM on the device.
4. Return to the **High/Low-Beam** tab and set the **HBG Control** field for **Single FET Mode**.
5. Return to the **Diagnostic** tab and click **Write EEPROM**.

APEK80803KET-SF SCHEMATIC

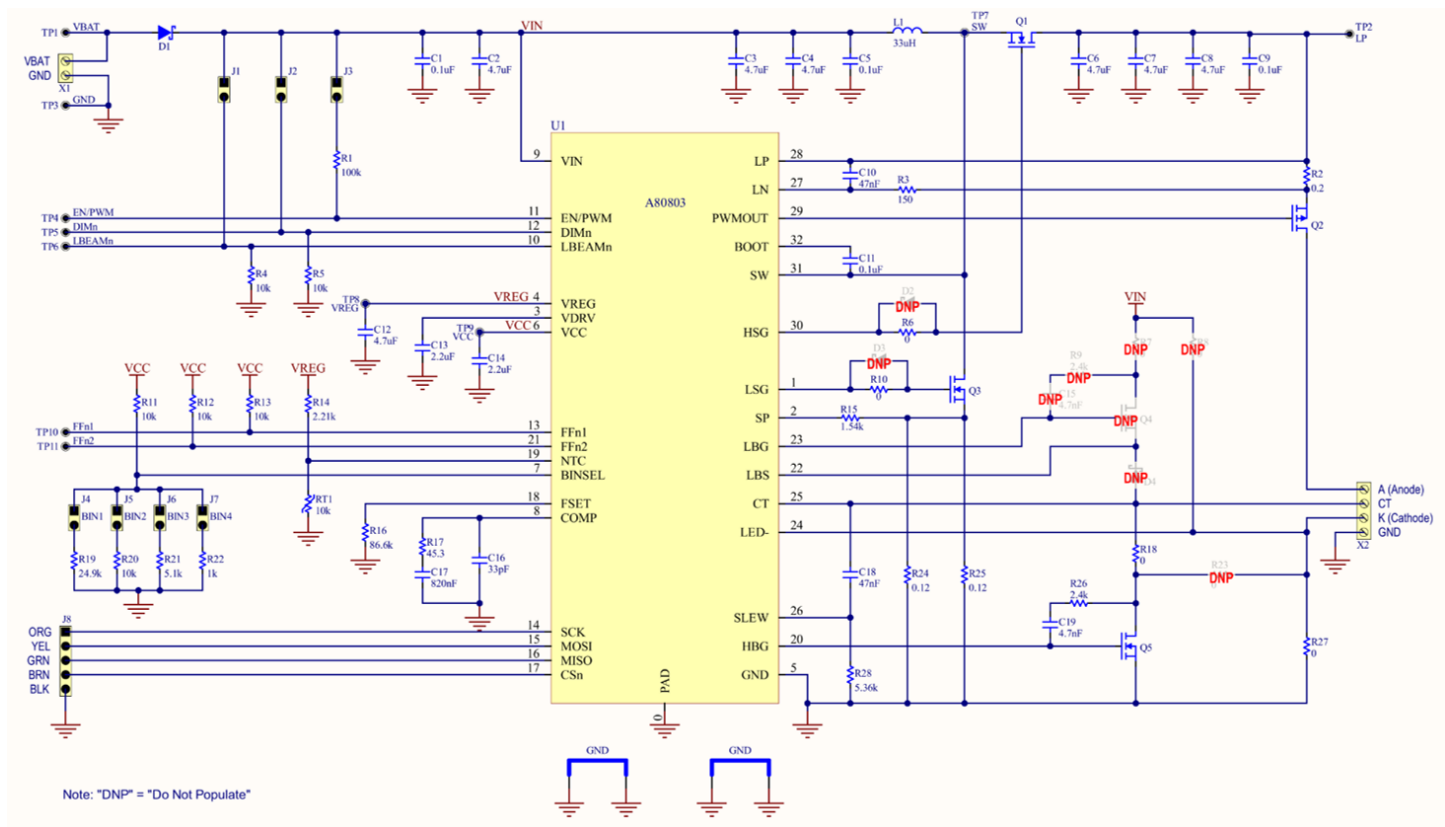


Figure 23: APEK80803KET-SF Schematic

APEK80803KET-SF Bill of Materials

| Designator | Description | Quantity | Manufacturer | Manufacturer P/N |
|--|---|----------|----------------------|----------------------|
| U1 | A80803 in the QFN-32 | 1 | Allegro MicroSystems | A80803KETASR |
| C1 | Capacitor, Ceramic, 0.1 μ F, 50 V, X7R, 0603 | 1 | | |
| C2, C3, C4 | Capacitor, Ceramic, 4.7 μ F, 50 V, X7R, 1210 | 3 | Murata | GCM32ER71H475KA55K |
| C5, C9 | Capacitor, Ceramic, 0.1 μ F, 50 V, X7R, 0805 | 2 | | |
| C6, C7, C8 | Capacitor, Ceramic, 4.7 μ F, 100 V, X7R, 1210 | 3 | TDK | CNA6P1X7R2A475K250AE |
| C10 | Capacitor, Ceramic, 47 nF, 25 V, X7R, 0402 | 1 | | |
| C11 | Capacitor, Ceramic, 0.1 μ F, 16 V, X7R, 0402 | 1 | | |
| C12 | Capacitor, Ceramic, 4.7 μ F, 16 V, X7R, 0805 | 1 | | |
| C13, C14 | Capacitor, Ceramic, 2.2 μ F, 16 V, X7R, 0805 | 2 | | |
| C16 | Capacitor, Ceramic, 33 pF, 50 V, C0G, 0603 | 1 | | |
| C17 | Capacitor, Ceramic, 820 nF, 25 V, X7R, 0603 | 1 | | |
| C18 | Capacitor, Ceramic, 47 nF, 50 V, X7R, 0603 | 1 | | |
| C19 | Capacitor, Ceramic, 4.7 nF, 50 V, X7R, 0402 | 1 | | |
| D1 | Diode, Schottky, 60 V, 5 A, SOD-128 | 1 | Nexperia | PMEG60T50ELPX |
| GND1, GND2 | Ground Bar, 18 AWG Bus Bar, 15 mm Body | 2 | | |
| J1, J2, J3, J4, J5, J6, J7 | Connector, Header, 2 Position, 0.1" | 7 | Würth | 61300211121 |
| J8 | Connector, Header, 5 Position, 0.1" | 1 | Würth | 61300511121 |
| L1 | Inductor, 33 μ H, \pm 20%, 8 A sat, 85.5 m Ω Max | 1 | Eaton | HCMA1305-330-R |
| Q1, Q3 | MOSFET, N-Channel, 30 A, 100 V, LFPAK56 | 2 | Nexperia | PSMN038-100YL |
| Q2 | MOSFET, P-Channel, 100 V, 15 A, TO252-3 | 1 | Infineon | SPD15P10PLGBTMA1 |
| Q5 | MOSFET, N-Channel, 14.8 A, 100 V, LFPAK56 | 1 | Nexperia | BUK9Y104-100B |
| R1 | Resistor, 100 k Ω , 1/16 W, 1%, 0402 | 1 | | |
| R2 | Resistor, 0.2 Ω , 1%, 2512 | 1 | | |
| R3 | Resistor, 150 Ω , 1/16 W, 1%, 0402 | 1 | | |
| R4, R5, R11, R12, R13, R20 | Resistor, 10 k Ω , 1/16 W, 1%, 0402 | 6 | | |
| R6, R10 | Resistor, 0 Ω , 1/16 W, 1%, 0402 | 2 | | |
| R14 | Resistor, 2.21 k Ω , 1/16 W, 1%, 0402 | 1 | | |
| R15 | Resistor, 1.54 k Ω , 1/16 W, 1%, 0402 | 1 | | |
| R16 | Resistor, 86.6 k Ω , 1/16 W, 1%, 0402 | 1 | | |
| R17 | Resistor, 45.3 Ω , 1/10 W, 1%, 0603 | 1 | | |
| R18, R27 | Resistor, 0 Ω , 1/10 W, 0603 | 2 | | |
| R19 | Resistor, 24.9 k Ω , 1/16 W, 1%, 0402 | 1 | | |
| R21 | Resistor, 5.1 k Ω , 1/16 W, 1%, 0402 | 1 | | |
| R22 | Resistor, 1 k Ω , 1/16 W, 1%, 0402 | 1 | | |
| R24, R25 | Resistor, 0.12 Ω , 1 W, 1%, 2512 | 2 | | |
| R26 | Resistor, 2.4 k Ω , 1/16 W, 1%, 0402 | 1 | | |
| R28 | Resistor, 5.36 k Ω , 1/16 W, 1%, 0402 | 1 | | |
| RT1 | Thermistor, NTC, 10 k Ω , 0603 | 1 | Vishay | NTCS0603E3103FHT |
| TP1, TP2, TP4, TP5, TP6, TP7, TP8, TP9, TP10, TP11 | Test Point, Red, 0.063" Diameter | 10 | Keystone | 5010 |
| TP3 | Test Point, Black, 0.063" Diameter | 1 | Keystone | 5011 |
| X1 | Terminal Block, 5.08 mm, Vertical, 2 position | 1 | TE Connectivity | 282837-2 |
| X2 | Terminal Block, 5.08 mm, Vertical, 4 position | 1 | TE Connectivity | 282837-4 |

BOOST ONLY EVB

The boost only configuration operates in boost mode without an option for low-beam or high-beam. The EVB should only operate low-beam mode in this configuration for the fault detection to work properly. Connect the LED string to terminal block X2 as shown in Figure 24, where the LEDs connect between the anode terminal A and the cathode terminal K. The CT pin should connect to ground, which is done on the EVB through R18, R23, and R27. Connect a power supply as described in the Power Input section and set the jumpers to achieve the desired dimming option. Connect the FTDI USB breakout cable to J8 for optional software configuration and fault readback.

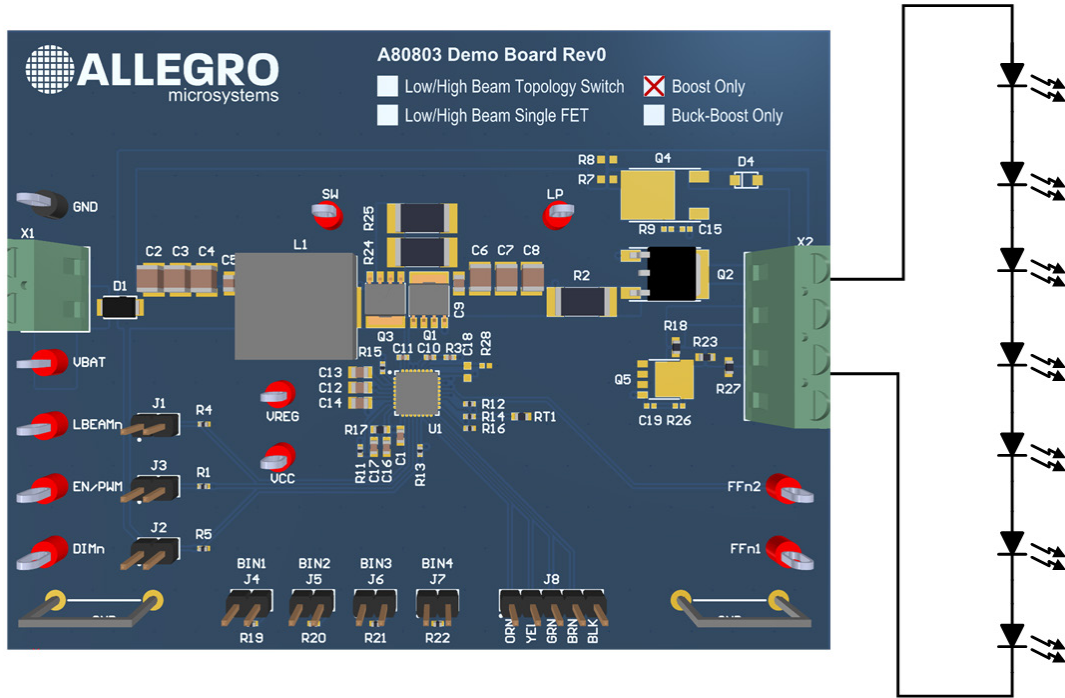


Figure 24: APEK80803KET-BO PCB with LED Connection

Note: Keep the jumper J1 open to keep the LBEAMn pin pulled to ground in this configuration.

APEK80803KET-BO SCHEMATIC

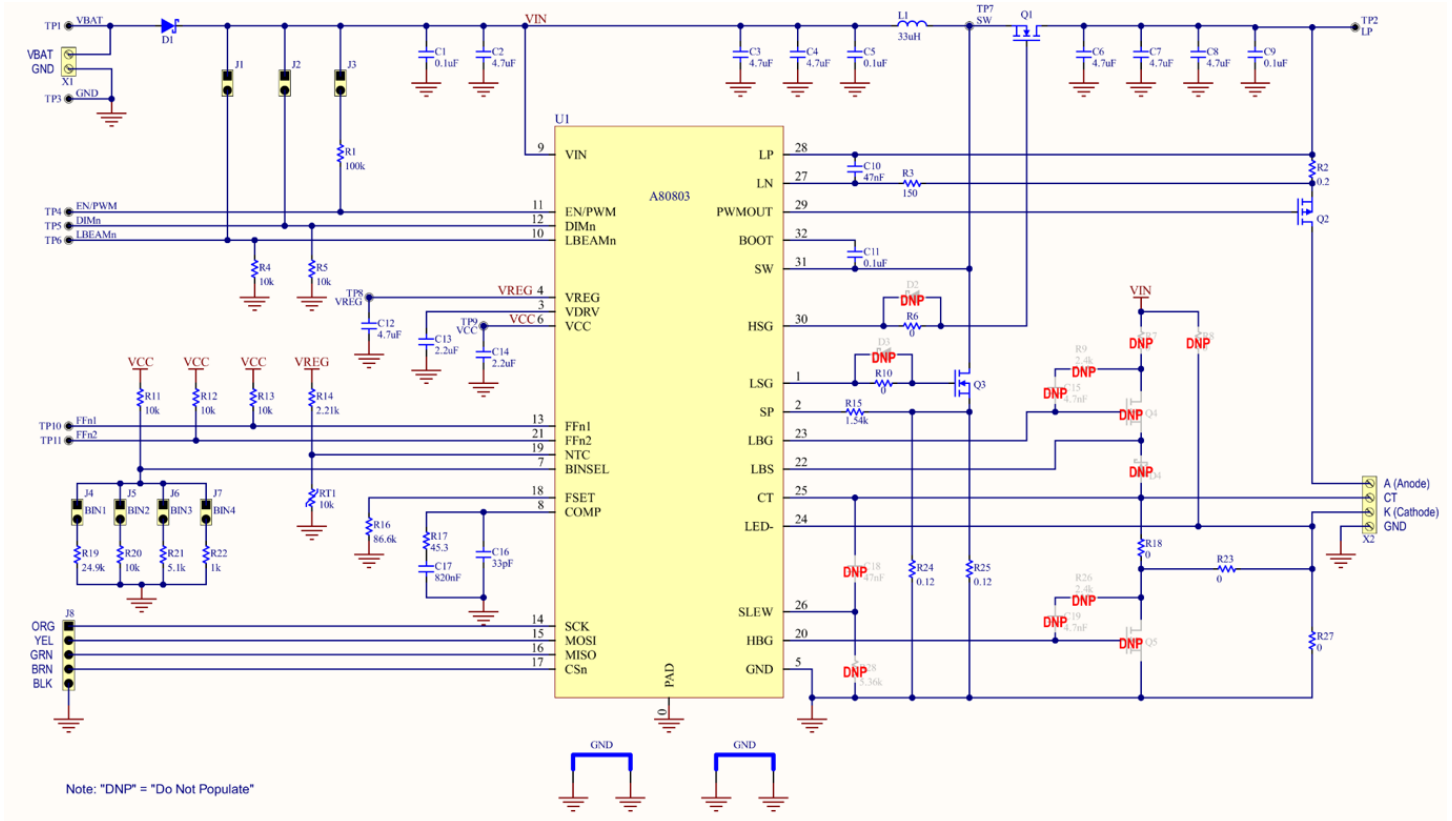


Figure 25: APEK80803KET-BO Schematic

APEK80803KET-BO Bill of Materials

| Designator | Description | Quantity | Manufacturer | Manufacturer P/N |
|--|---|----------|----------------------|----------------------|
| U1 | A80803 in the QFN-32 | 1 | Allegro MicroSystems | A80803KETASR |
| C1 | Capacitor, Ceramic, 0.1 μ F, 50 V, X7R, 0603 | 1 | | |
| C2, C3, C4 | Capacitor, Ceramic, 4.7 μ F, 50 V, X7R, 1210 | 3 | Murata | GCM32ER71H475KA55K |
| C5, C9 | Capacitor, Ceramic, 0.1 μ F, 50 V, X7R, 0805 | 2 | | |
| C6, C7, C8 | Capacitor, Ceramic, 4.7 μ F, 100 V, X7R, 1210 | 3 | TDK | CNA6P1X7R2A475K250AE |
| C10 | Capacitor, Ceramic, 47 nF, 25 V, X7R, 0402 | 1 | | |
| C11 | Capacitor, Ceramic, 0.1 μ F, 16 V, X7R, 0402 | 1 | | |
| C12 | Capacitor, Ceramic, 4.7 μ F, 16 V, X7R, 0805 | 1 | | |
| C13, C14 | Capacitor, Ceramic, 2.2 μ F, 16 V, X7R, 0805 | 2 | | |
| C16 | Capacitor, Ceramic, 33 pF, 50 V, C0G, 0603 | 1 | | |
| C17 | Capacitor, Ceramic, 820 nF, 25 V, X7R, 0603 | 1 | | |
| D1 | Diode, Schottky, 60 V, 5 A, SOD-128 | 1 | Nexperia | PMEG60T50ELPX |
| GND1, GND2 | Ground Bar, 18 AWG Bus Bar, 15 mm Body | 2 | | |
| J1, J2, J3, J4, J5, J6, J7 | Connector, Header, 2 Position, 0.1" | 7 | Würth | 61300211121 |
| J8 | Connector, Header, 5 Position, 0.1" | 1 | Würth | 61300511121 |
| L1 | Inductor, 33 μ H, \pm 20%, 8 A sat, 85.5 m Ω Max | 1 | Eaton | HCMA1305-330-R |
| Q1, Q3 | MOSFET, N-Channel, 30 A, 100 V, LFPAK56 | 2 | Nexperia | PSMN038-100YL |
| Q2 | MOSFET, P-Channel, 100 V, 15 A, TO252-3 | 1 | Infineon | SPD15P10PLGBTMA1 |
| R1 | Resistor, 100 k Ω , 1/16 W, 1%, 0402 | 1 | | |
| R2 | Resistor, 0.2 Ω , 1 W, 1%, 2512 | 1 | | |
| R3 | Resistor, 150 Ω , 1/16 W, 1%, 0402 | 1 | | |
| R4, R5, R11, R12, R13, R20 | Resistor, 10 k Ω , 1/16 W, 1%, 0402 | 6 | | |
| R6, R10 | Resistor, 0 Ω , 1/16 W, 1%, 0402 | 2 | | |
| R14 | Resistor, 2.21 k Ω , 1/16 W, 1%, 0402 | 1 | | |
| R15 | Resistor, 1.54 k Ω , 1/16 W, 1%, 0402 | 1 | | |
| R16 | Resistor, 86.6 k Ω , 1/16 W, 1%, 0402 | 1 | | |
| R17 | Resistor, 45.3 Ω , 1/10 W, 1%, 0603 | 1 | | |
| R18, R23, R27 | Resistor, 0 Ω , 1/10 W, 0603 | 3 | | |
| R19 | Resistor, 24.9 k Ω , 1/16 W, 1%, 0402 | 1 | | |
| R21 | Resistor, 5.1 k Ω , 1/16 W, 1%, 0402 | 1 | | |
| R22 | Resistor, 1 k Ω , 1/16 W, 1%, 0402 | 1 | | |
| R24, R25 | Resistor, 0.12 Ω , 1 W, 1%, 2512 | 2 | | |
| RT1 | Thermistor, NTC, 10 k Ω , 0603 | 1 | Vishay | NTCS0603E3103FHT |
| TP1, TP2, TP4, TP5, TP6, TP7, TP8, TP9, TP10, TP11 | Test Point, Red, 0.063" Diameter | 10 | Keystone | 5010 |
| TP3 | Test Point, Black, 0.063" Diameter | 1 | Keystone | 5011 |
| X1 | Terminal Block, 5.08 mm, Vertical, 2 position | 1 | TE Connectivity | 282837-2 |
| X2 | Terminal Block, 5.08 mm, Vertical, 4 position | 1 | TE Connectivity | 282837-4 |

BUCK-BOOST ONLY EVB

The buck-boost only configuration operates in buck-boost mode without an option for low-beam or high-beam. The EVB should only operate in low-beam mode in this configuration for the fault detection to work properly. Connect the LED string to terminal block X2 as shown in Figure 26, where the LEDs connect between the anode terminal A and the cathode terminal K. The CT pin should connect to the LED string cathode, which is done on the EVB through R18 and R23. Connect a power supply as described in the Power Input section and set the jumpers to achieve the desired dimming option. Connect the FTDI USB breakout cable to J8 for optional software configuration and fault readback. APEK80803KET-BB Rev0 has a zero ohm resistor across Q4.

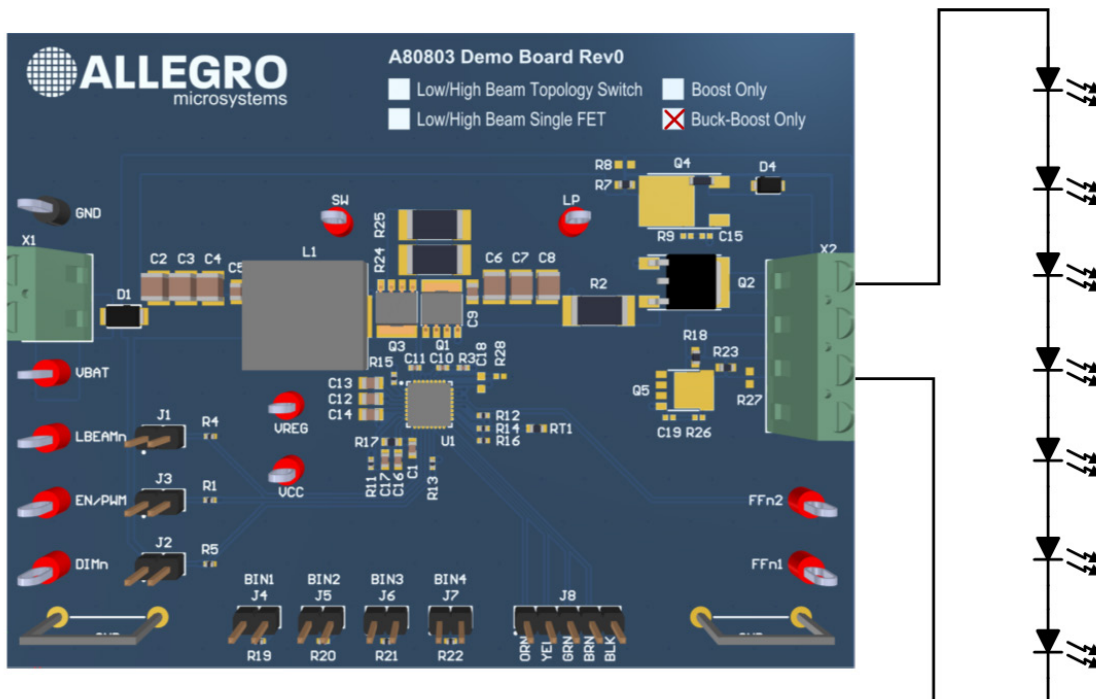


Figure 26: APEK80803KET-BB PCB with LED Connection

Note: Keep the jumper J1 open to keep the LBEAMn pin pulled to ground in this configuration.

APEK80803KET-BB SCHEMATIC

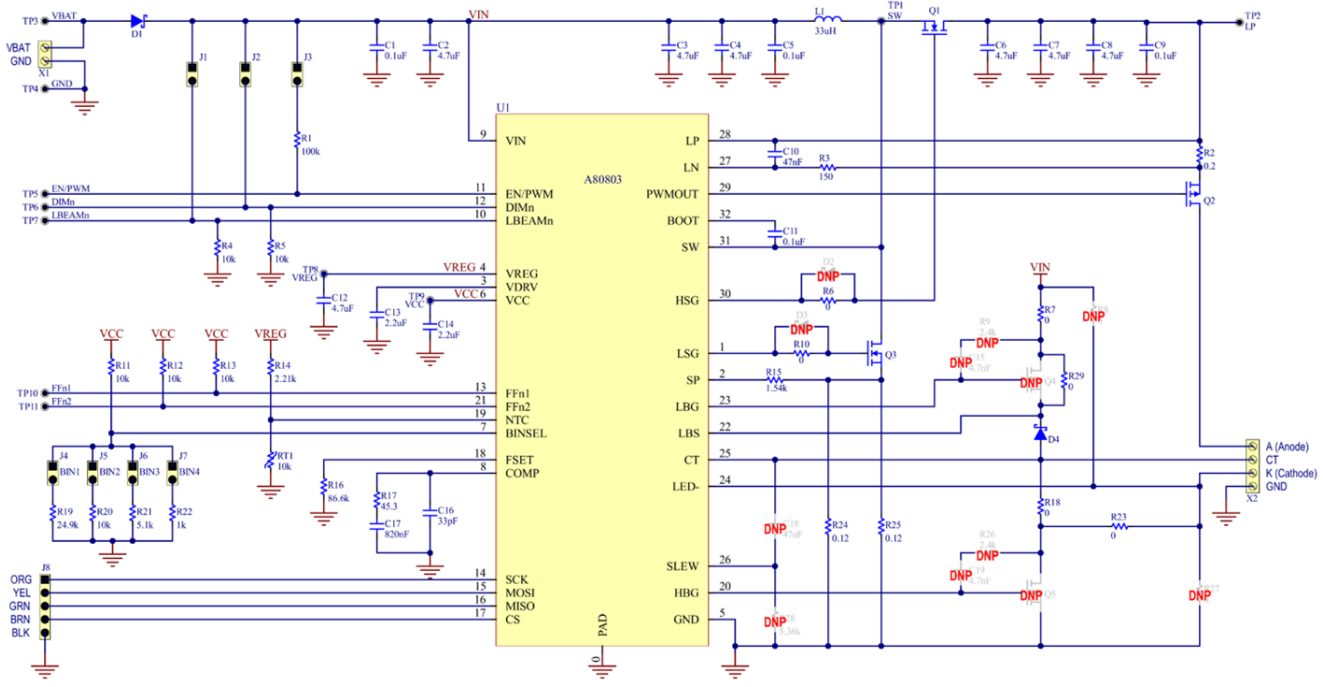


Figure 27: APEK80803KET-BB Schematic

R29 was added post-fabrication to connect the LED cathode to VIN through diode D4.

APEK80803KET-BB Bill of Materials

| Designator | Description | Quantity | Manufacturer | Manufacturer P/N |
|--|---|----------|----------------------|----------------------|
| U1 | A80803 in the QFN-32 | 1 | Allegro MicroSystems | A80803KETASR |
| C1 | Capacitor, Ceramic, 0.1 μ F, 50 V, X7R, 0603 | 1 | | |
| C2, C3, C4 | Capacitor, Ceramic, 4.7 μ F, 50 V, X7R, 1210 | 3 | Murata | GCM32ER71H475KA55K |
| C5, C9 | Capacitor, Ceramic, 0.1 μ F, 50 V, X7R, 0805 | 2 | | |
| C6, C7, C8 | Capacitor, Ceramic, 4.7 μ F, 100 V, X7R, 1210 | 3 | TDK | CNA6P1X7R2A475K250AE |
| C10 | Capacitor, Ceramic, 47 μ F, 25 V, X7R, 0402 | 1 | | |
| C11 | Capacitor, Ceramic, 0.1 μ F, 16 V, X7R, 0402 | 1 | | |
| C12 | Capacitor, Ceramic, 4.7 μ F, 16 V, X7R, 0805 | 1 | | |
| C13, C14 | Capacitor, Ceramic, 2.2 μ F, 16 V, X7R, 0805 | 2 | | |
| C16 | Capacitor, Ceramic, 33 pF, 50 V, C0G, 0603 | 1 | | |
| C17 | Capacitor, Ceramic, 820 nF, 25 V, X7R, 0603 | 1 | | |
| D1 | Diode, Schottky, 60 V, 5 A, SOD-128 | 1 | Nexperia | PMEG60T50ELPX |
| D4 | Diode, Schottky, 100 V, 2 A, SOD123W | 1 | | |
| GND1, GND2 | Ground Bar, 18 AWG Bus Bar, 15 mm Body | 2 | | |
| J1, J2, J3, J4, J5, J6, J7 | Connector, Header, 2 Position, 0.1" | 7 | Würth | 61300211121 |
| J8 | Connector, Header, 5 Position, 0.1" | 1 | Würth | 61300511121 |
| L1 | Inductor, 33 μ H, \pm 20%, 8 A sat, 85.5 m Ω Max | 1 | Eaton | HCMA1305-330-R |
| Q1, Q3 | MOSFET, N-Channel, 30 A, 100 V, LPAK56 | 2 | Nexperia | PSMN038-100YL |
| Q2 | MOSFET, P-Channel, 100 V, 15 A, TO252-3 | 1 | Infineon | SPD15P10PLGBTMA1 |
| R1 | Resistor, 100 k Ω , 1/16 W, 1%, 0402 | 1 | | |
| R2 | Resistor, 0.2 Ω , 1 W, 1%, 2512 | 1 | | |
| R3 | Resistor, 150 Ω , 1/16 W, 1%, 0402 | 1 | | |
| R4, R5, R11, R12, R13, R20 | Resistor, 10 k Ω , 1/16 W, 1%, 0402 | 6 | | |
| R6, R10 | Resistor, 0 Ω , 1/16 W, 1%, 0402 | 2 | | |
| R7, R18, R23, R29 | Resistor, 0 Ω , 1/10 W, 0603 | 4 | | |
| R14 | Resistor, 2.21 k Ω , 1/16 W, 1%, 0402 | 1 | | |
| R15 | Resistor, 1.54 k Ω , 1/16 W, 1%, 0402 | 1 | | |
| R16 | Resistor, 86.6 k Ω , 1/16 W, 1%, 0402 | 1 | | |
| R17 | Resistor, 45.3 Ω , 1/10 W, 1%, 0603 | 1 | | |
| R19 | Resistor, 24.9 k Ω , 1/16 W, 1%, 0402 | 1 | | |
| R21 | Resistor, 5.1 k Ω , 1/16 W, 1%, 0402 | 1 | | |
| R22 | Resistor, 1 k Ω , 1/16 W, 1%, 0402 | 1 | | |
| R24, R25 | Resistor, 0.12 Ω , 1 W, 1%, 2512 | 2 | | |
| RT1 | Thermistor, NTC, 10 k Ω , 0603 | 1 | Vishay | NTCS0603E3103FHT |
| TP1, TP2, TP4, TP5, TP6, TP7, TP8, TP9, TP10, TP11 | Test Point, Red, 0.063" Diameter | 10 | Keystone | 5010 |
| TP3 | Test Point, Black, 0.063" Diameter | 1 | Keystone | 5011 |
| X1 | Terminal Block, 5.08 mm, Vertical, 2 position | 1 | TE Connectivity | 282837-2 |
| X2 | Terminal Block, 5.08 mm, Vertical, 4 position | 1 | TE Connectivity | 282837-4 |

BOARD LAYOUT

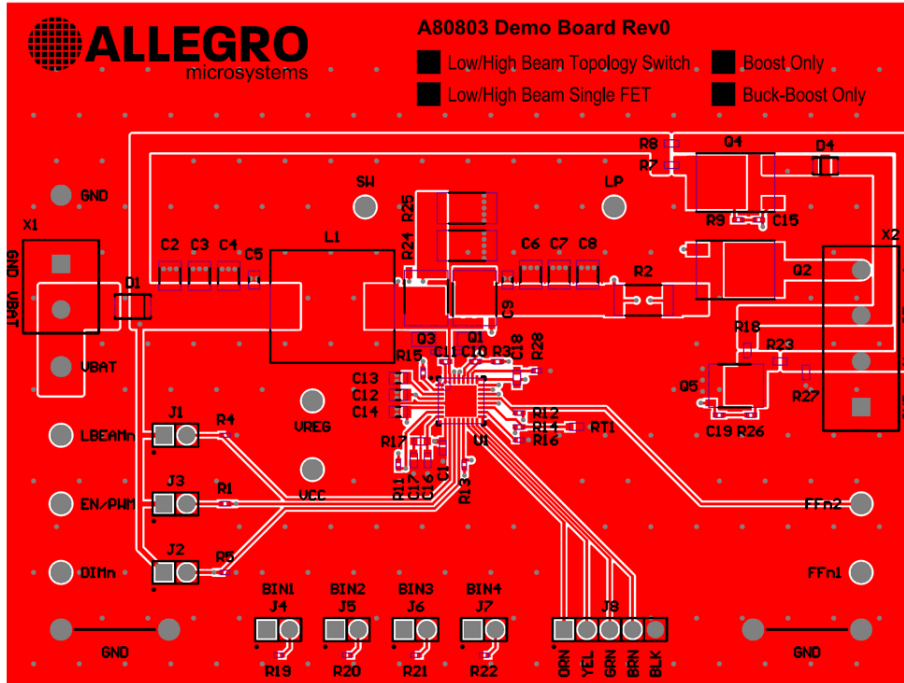


Figure 28: Top Layer

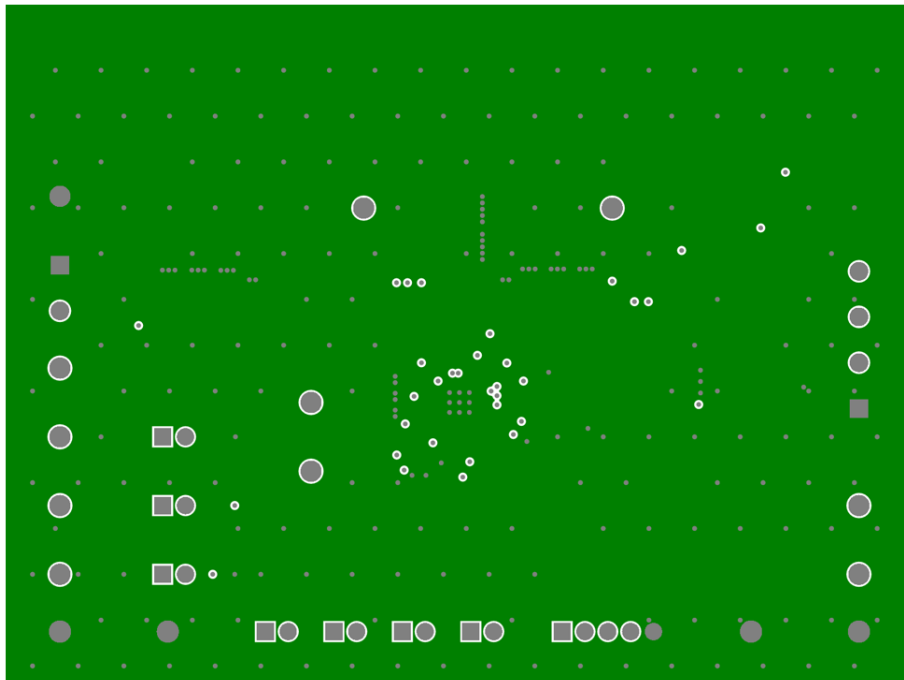


Figure 29: Inner Layer 1 (GND Plane)

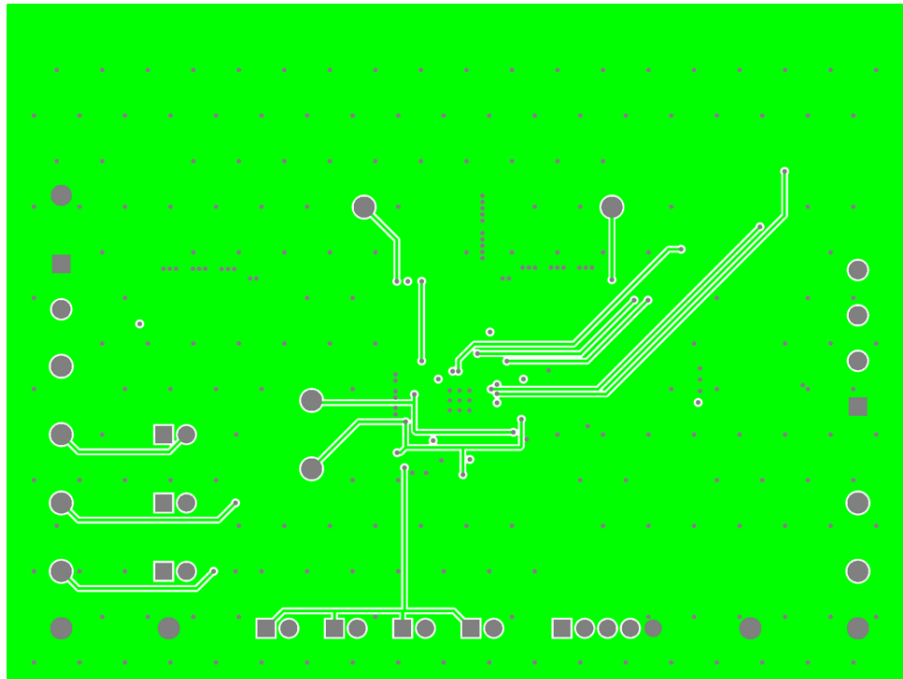


Figure 30: Inner Layer 2

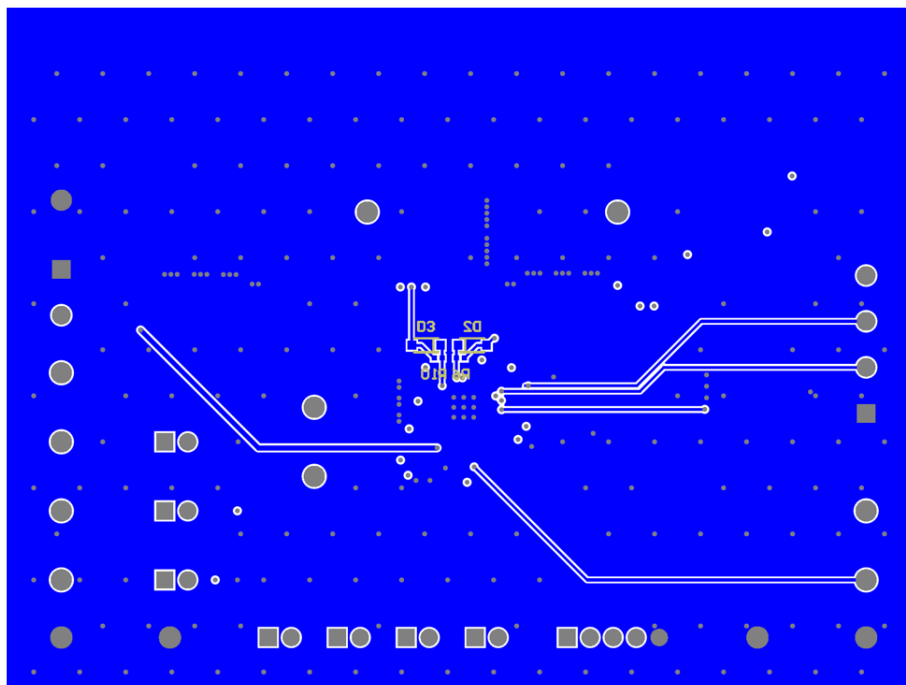


Figure 31: Bottom Layer

Revision History

| Number | Date | Description |
|--------|------------------|----------------------------|
| – | June 25, 2021 | Initial Release |
| 1 | February 4, 2022 | Corrected table 5 (page 3) |

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[0301-000](#) [ROA1286023/1](#)