APEK80803KET

A80803 Evaluation Kit User Manual

DESCRIPTION

The A80803 Evaluation Kit 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 Evaluation Board is available in four configurations to support low/high-beam and fixed LED string applications. The Evaluation Board 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 Evaluation Board to identify in which mode the Evaluation Board 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.

FEATURES

- Fixed Frequency
- Built-in support for low/high-beam operation
- Remote configuration via SPI

EVALUATION KIT CONTENTS

- A80803 Evaluation Board
- FTDI USB to Serial adapter cable C232HM-EDHSL-0

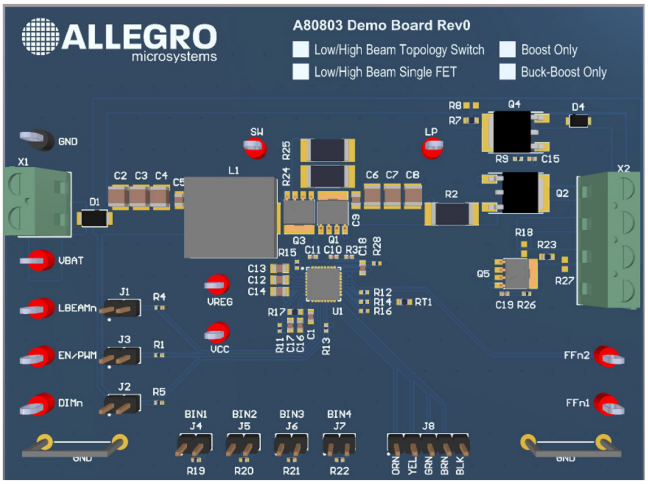

Figure 1: A80803 Evaluation Board

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Table 1: A80803 Evaluation Board 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	–

USING THE EVALUATION BOARD

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

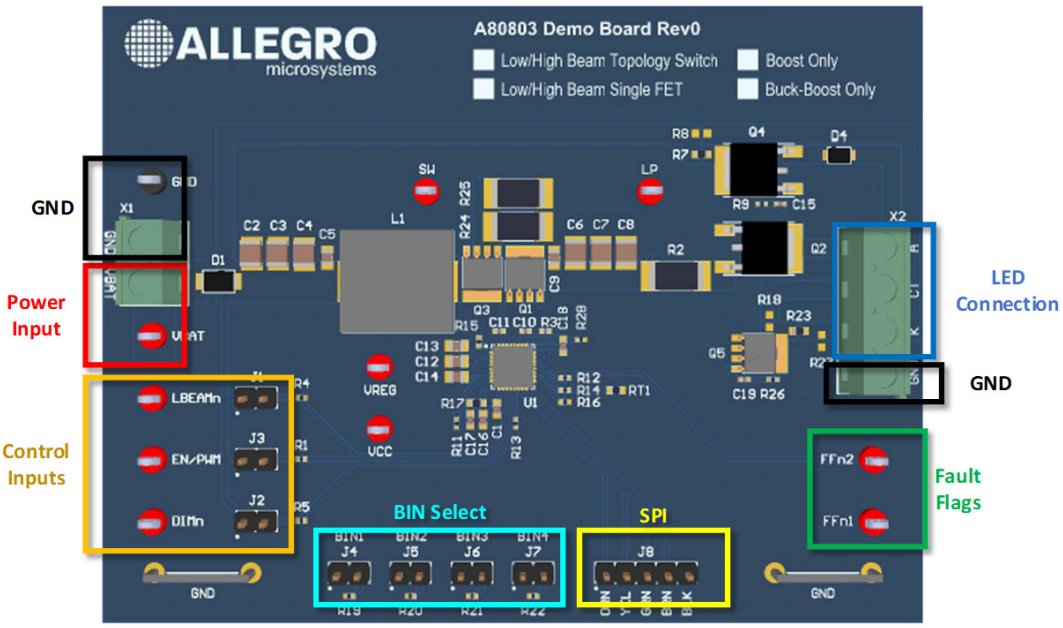

Figure 2: A80803 Evaluation Board I/O Connections

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

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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 4 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 Evaluation Board. The fault flags are pulled up to V_{CC} with a 10 kΩ resistor on the Evaluation Board.

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Sense Resistor

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

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

Each Evaluation Board configuration is designed for a 1 A LED current; with V_{IDL} = 200 mV then R2 = 0.2 Ω.

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 kΩ. Each Evaluation Board configuration is designed for a switching frequency of 400 kHz with R16 = 86.6 kΩ.

NTC LED Current Derating

There is a NTC thermistor on the Evaluation Board, RT1, in a voltage divider leading to the NTC pin. The thermistor, part number NTCS0603E3103FHT, has a base resistance of 10 kΩ. See the Thermal Derating section in the A80803 datasheet for more information about programming the derating values.

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GUI OPERATION

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.

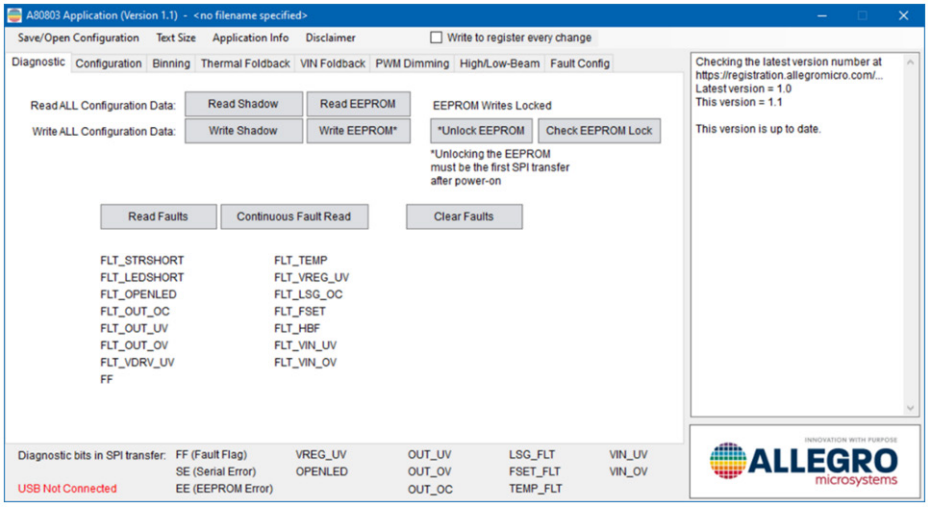

Figure 3: First screen after starting the GUI

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.

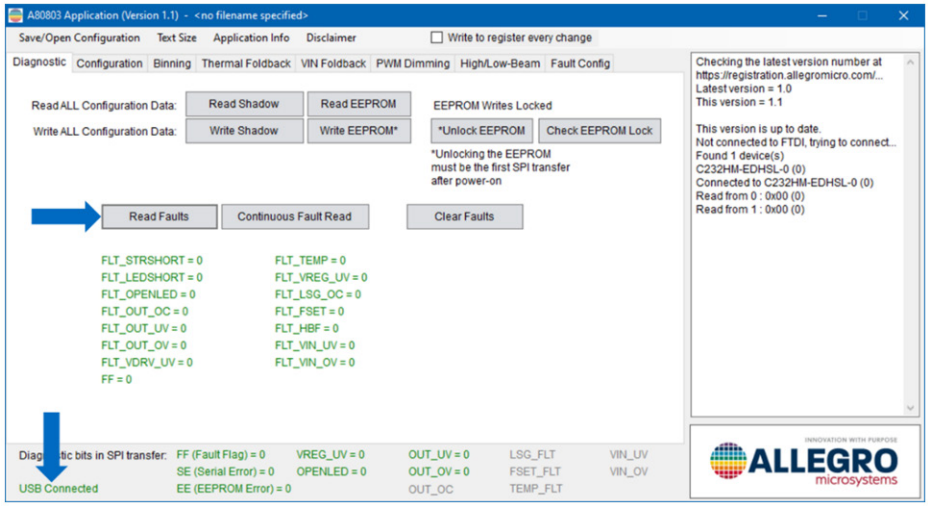

Figure 4: USB Serial Connection Established

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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.

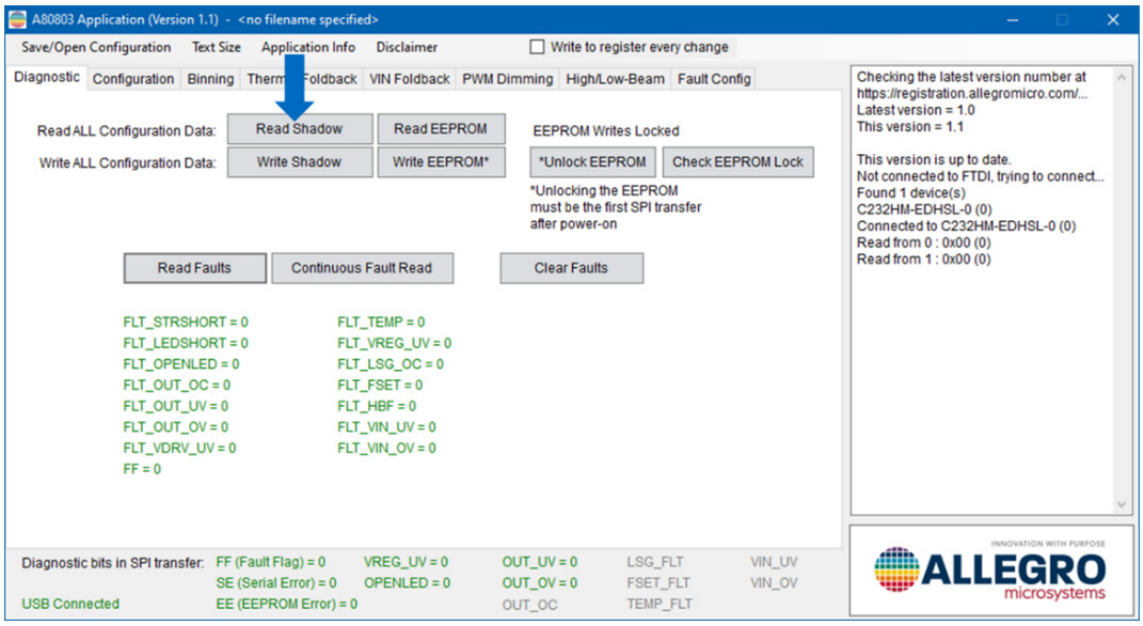

Figure 5: Read All of Shadow to Align GUI Controls with the Device

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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.

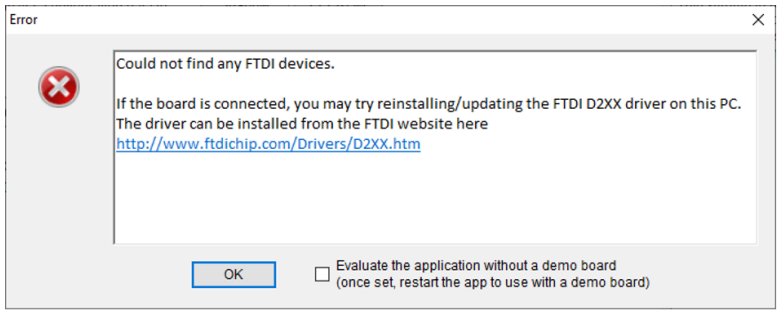

Figure 7: Error when FTDI device cannot be found

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.

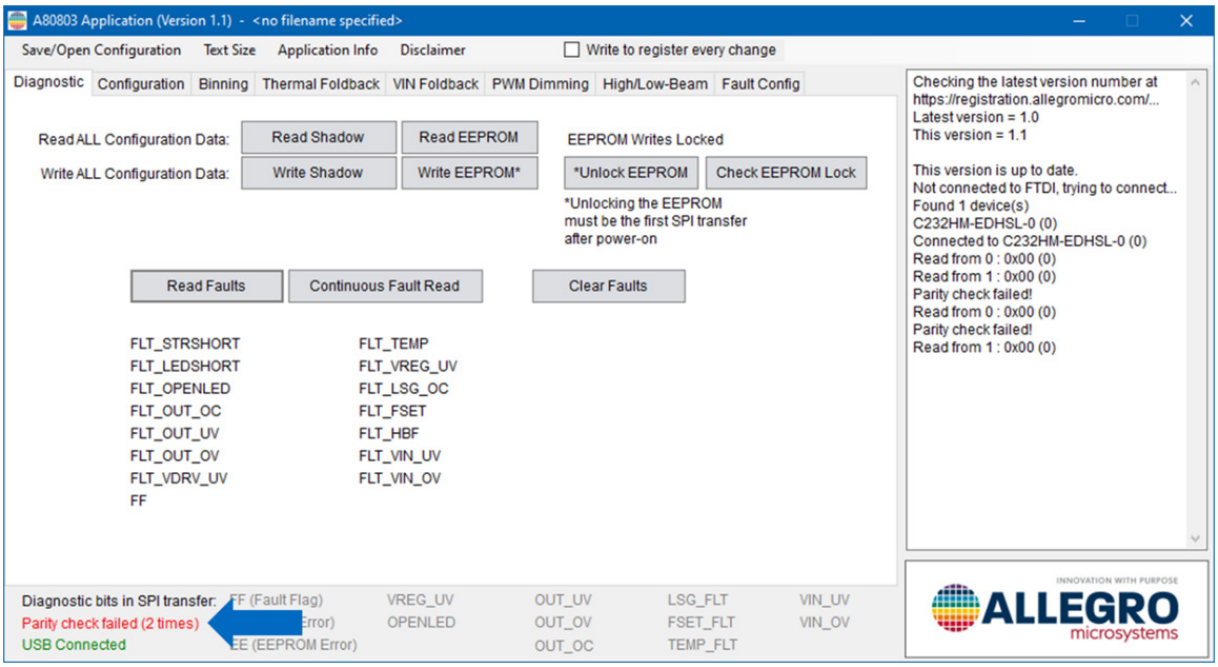

Figure 6: GUI is connected to USB-Serial but cannot find A80803

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.

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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.

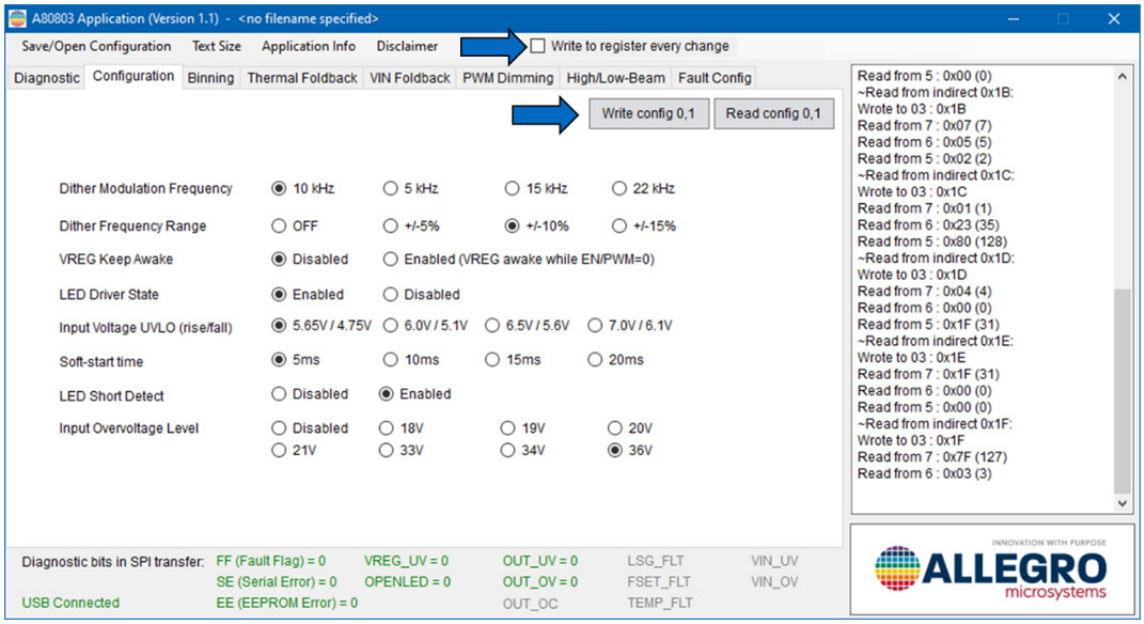

Figure 8: Read, Write, and Write Every Change

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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.

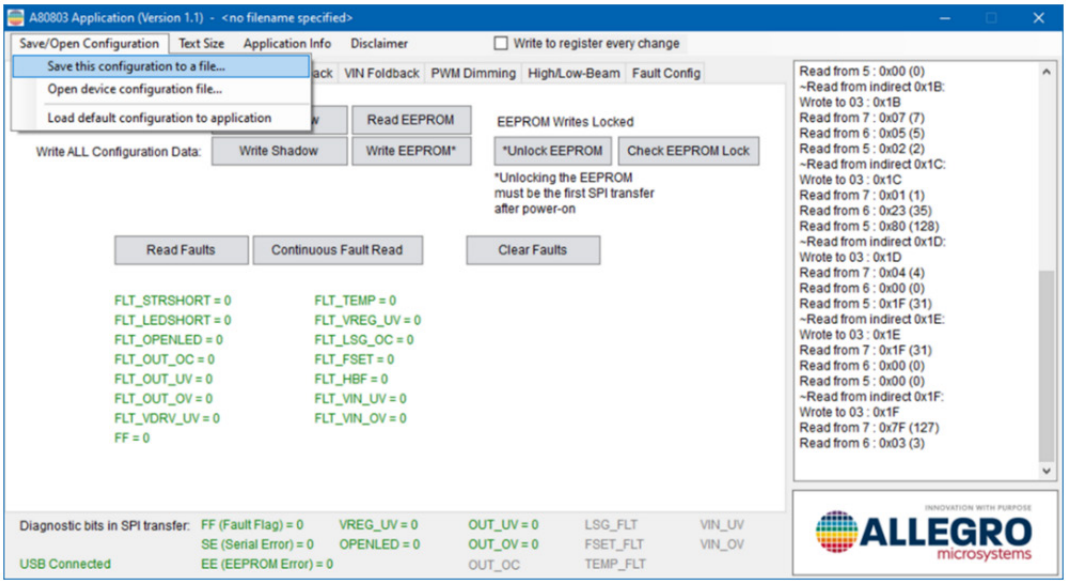

Figure 9: Save and Load Configuration Files

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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.

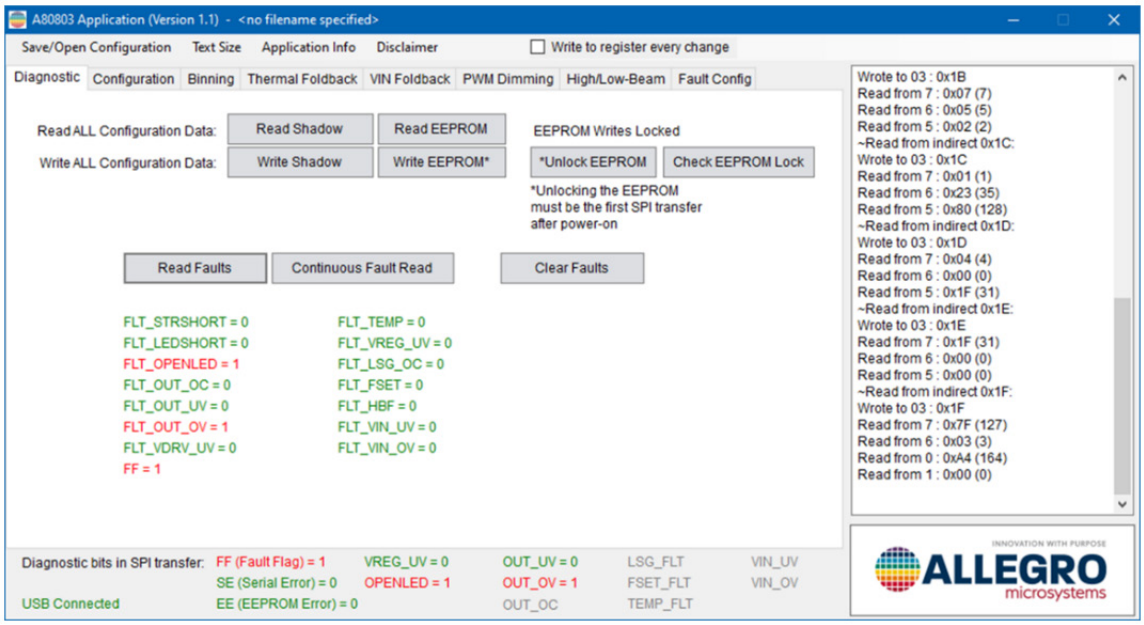

Figure 10: Fault Indicators

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.

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Configuration Tab

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

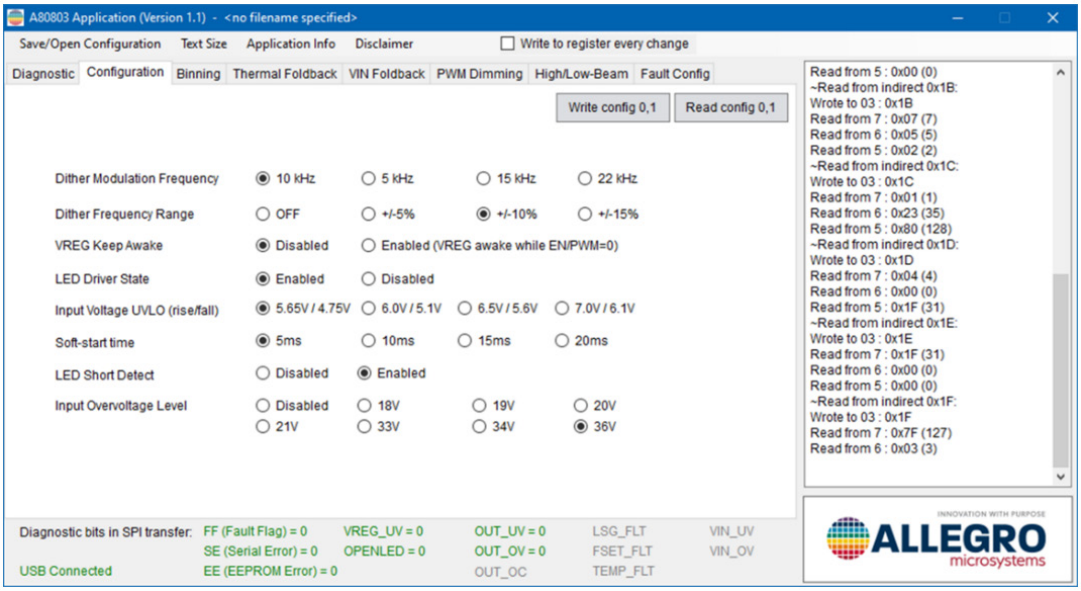

Figure 11: General Configuration

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 BINSEL 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.

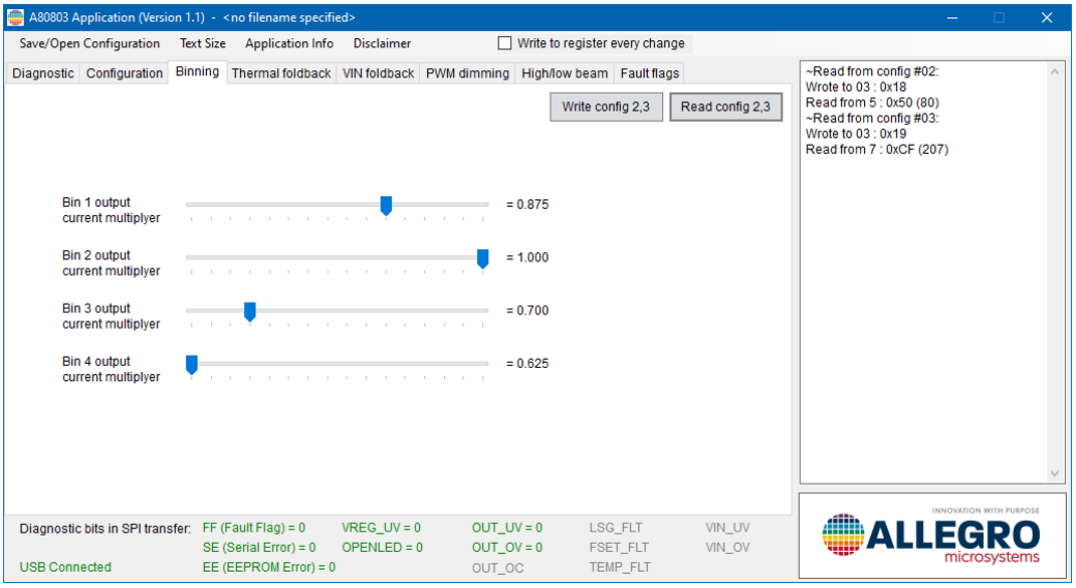

Figure 12: Binning Configuration

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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.

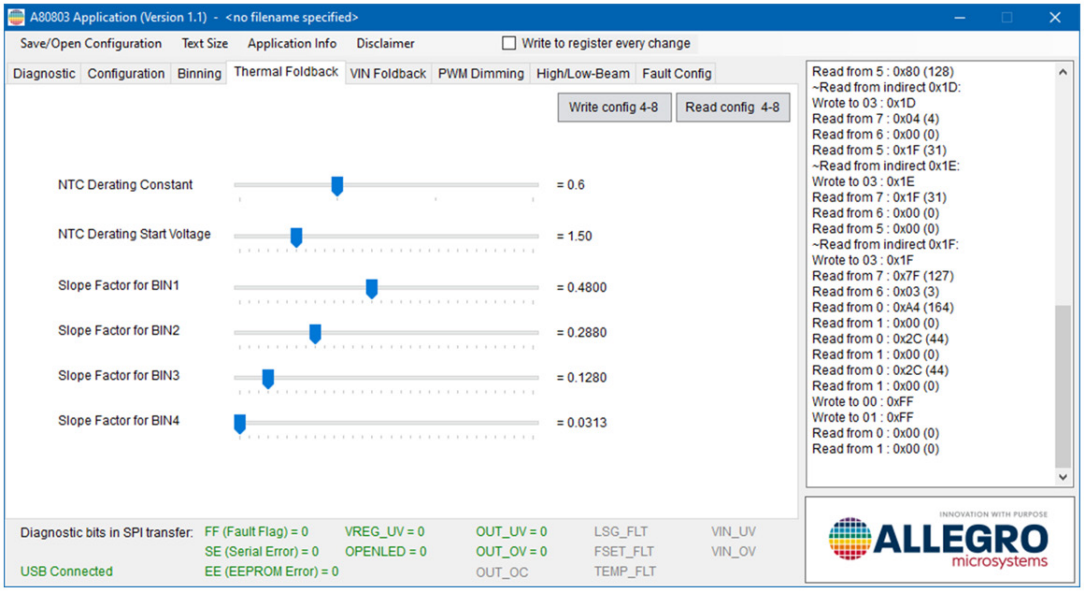

Figure 13: Thermal Foldback Configuration

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.

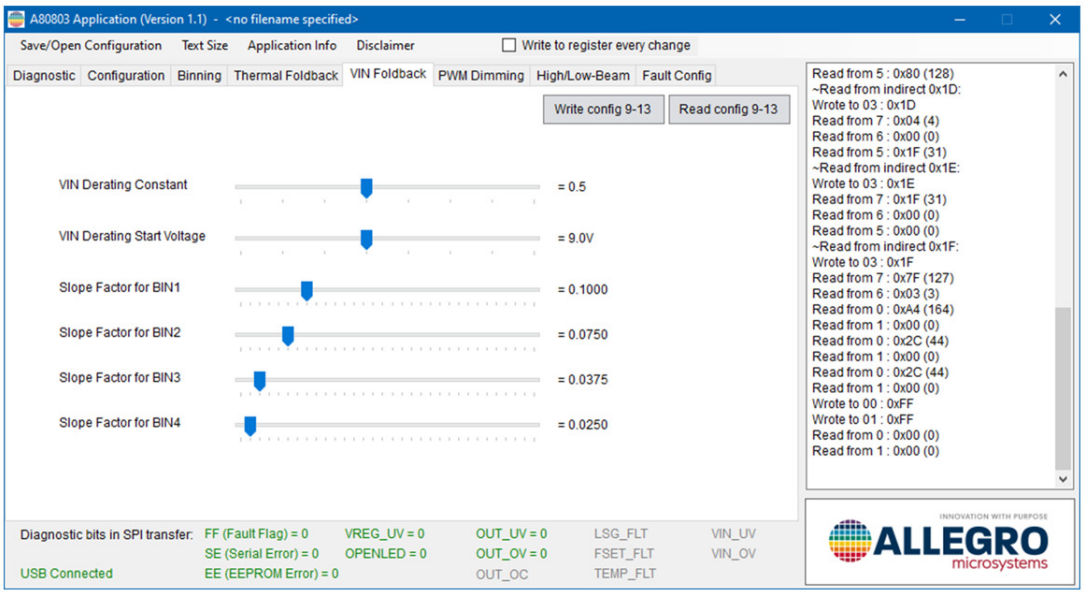

Figure 14: Input Voltage Foldback Configuration

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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.

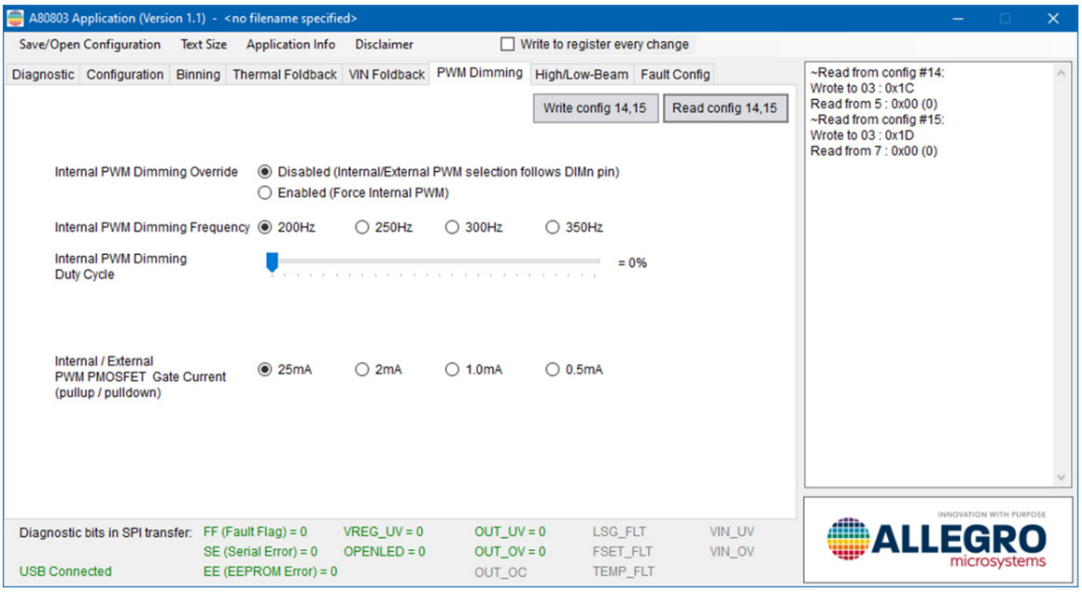

Figure 15: PWM Dimming Configuration

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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.

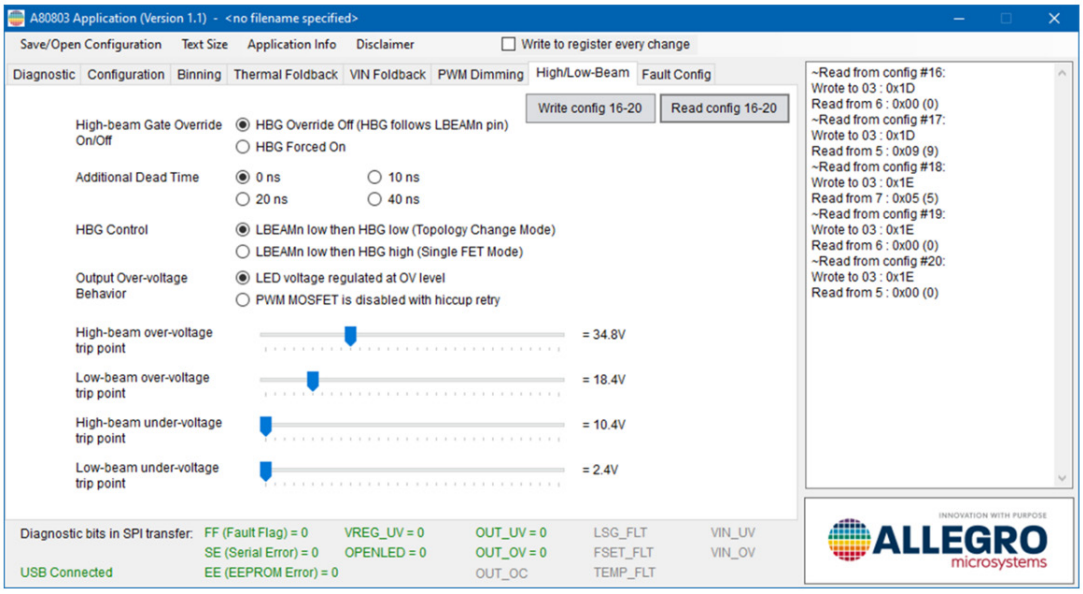

Figure 16: PWM Dimming Configuration

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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.

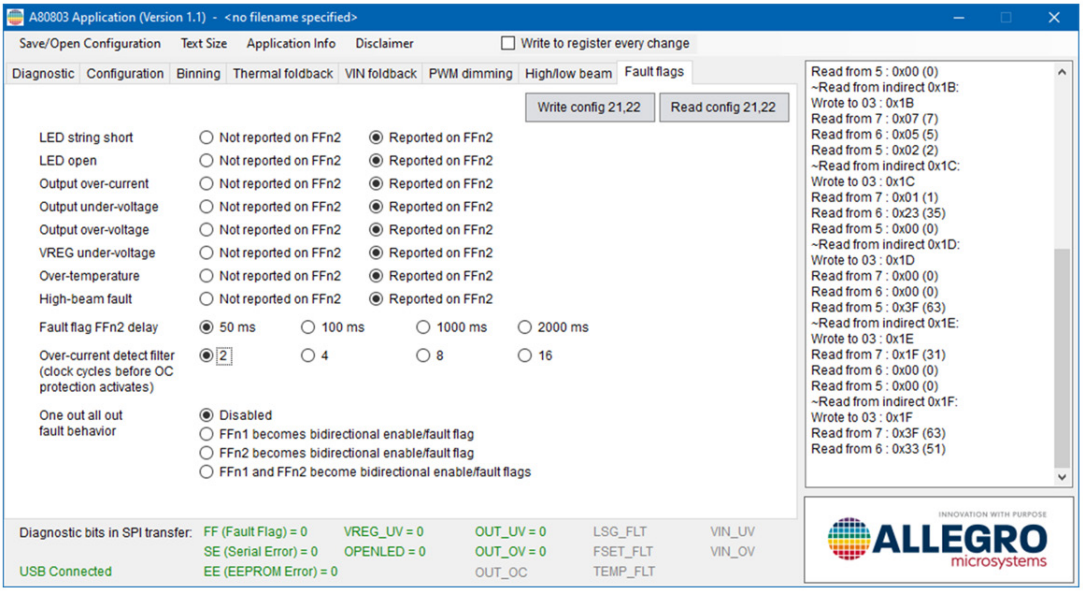

Figure 17: Fault Flag Configuration

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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.

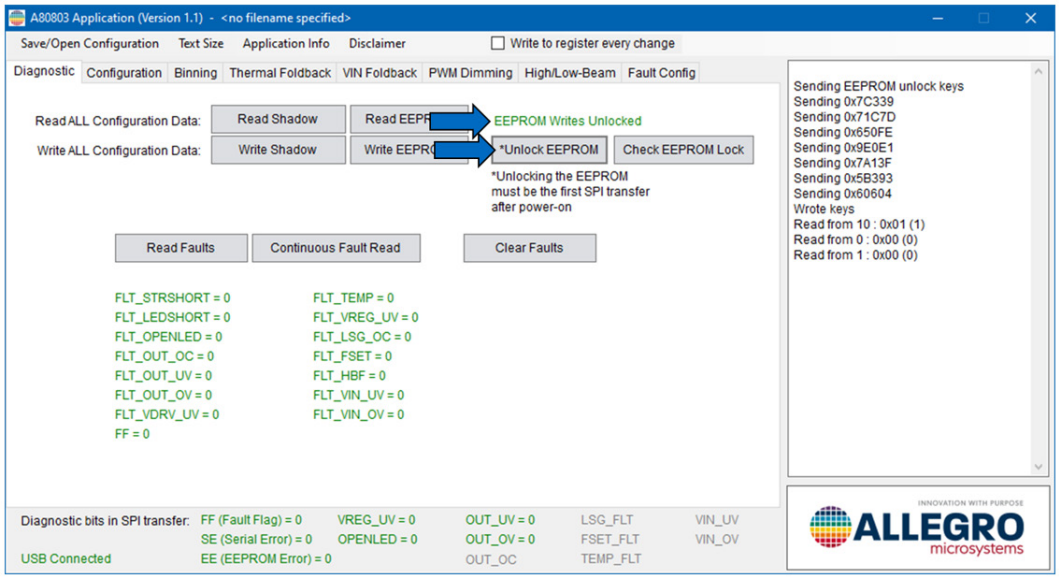

Figure 18: EEPROM Writes Unlocked

> ***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.

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LOW/HIGH-BEAM TOPOLOGY SWITCH EVALUATION BOARD

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.

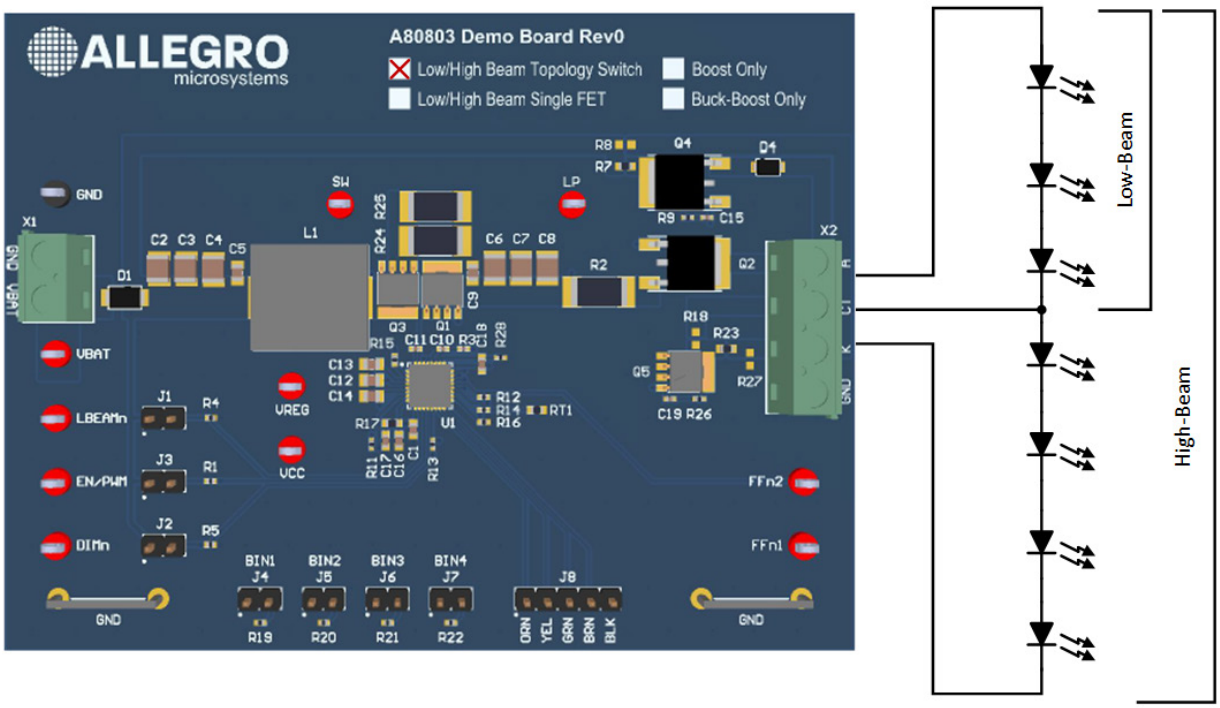

Figure 19: APEK80803KET-TS PCB with LED Connection

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APEK80803KET-TS SCHEMATIC

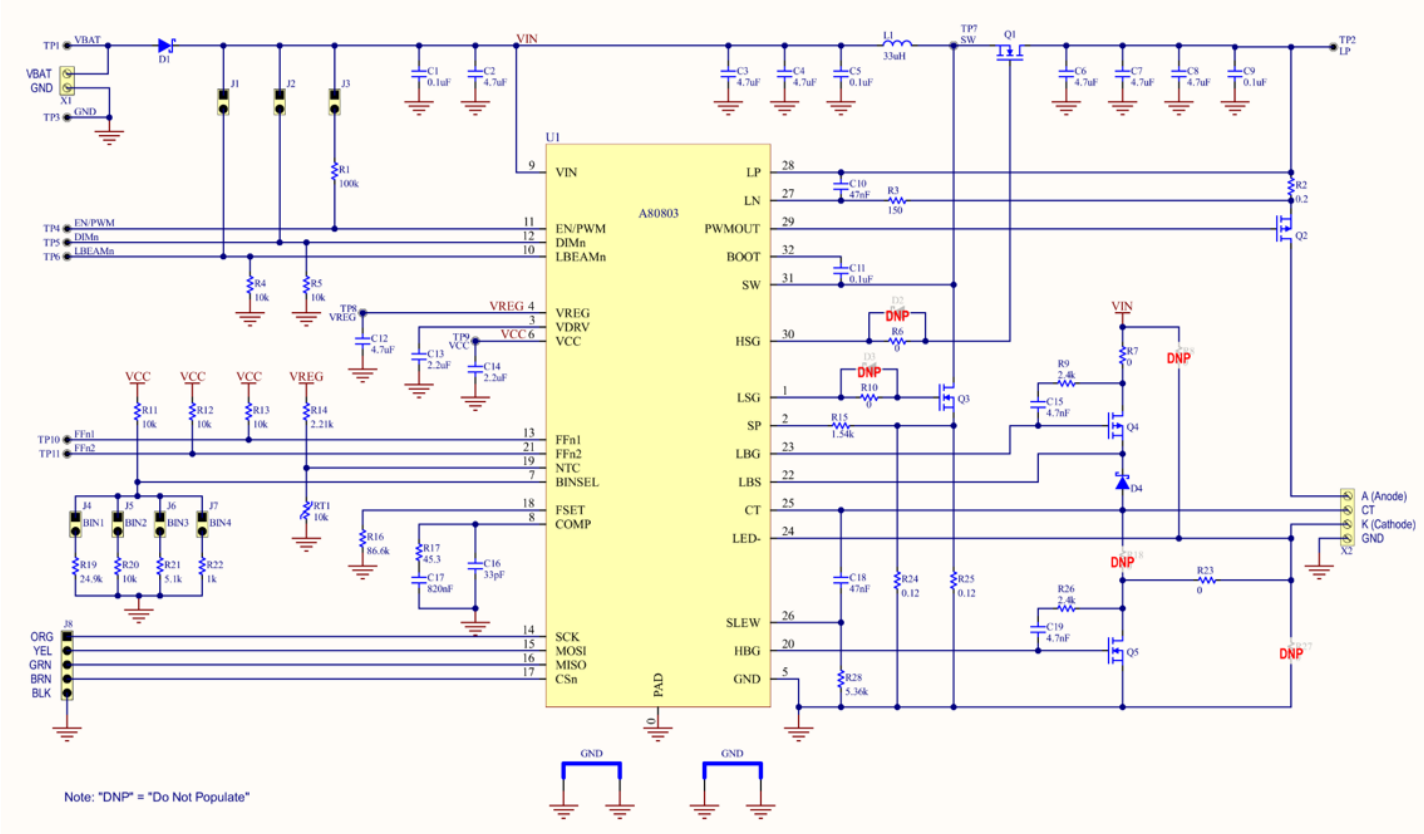

Figure 20: APEK80803KET-TS Schematic

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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 µF, 50 V, X7R, 0603	1		
C2, C3, C4	Capacitor, Ceramic, 4.7 µF, 50 V, X7R, 1210	3	Murata	GCM32ER71H475KA55K
C5, C9	Capacitor, Ceramic, 0.1 µF, 50 V, X7R, 0805	2		
C6, C7, C8	Capacitor, Ceramic, 4.7 µF, 100 V, X7R, 1210	3	TDK	CNA6P1X7R2A475K250AE
C10	Capacitor, Ceramic, 47 nF, 25 V, X7R, 0402	1		
C11	Capacitor, Ceramic, 0.1 µF, 16 V, X7R, 0402	1		
C12	Capacitor, Ceramic, 4.7 µF, 16 V, X7R, 0805	1		
C13, C14	Capacitor, Ceramic, 2.2 µF, 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	Wurth	61300211121
J8	Connector, Header, 5 Position, 0.1"	1	Wurth	61300511121
L1	Inductor, 33 µH, ±20%, 8 A sat, 85.5 mΩ 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 kΩ, 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 kΩ, 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 kΩ, 1/16 W, 1%, 0402	2		
R14	Resistor, 2.21 kΩ, 1/16 W, 1%, 0402	1		
R15	Resistor, 1.54 kΩ, 1/16 W, 1%, 0402	1		
R16	Resistor, 86.6 kΩ, 1/16 W, 1%, 0402	1		
R17	Resistor, 45.3 Ω, 1/10 W, 1%, 0603	1		
R19	Resistor, 24.9 kΩ, 1/16 W, 1%, 0402	1		
R21	Resistor, 5.1 kΩ, 1/16 W, 1%, 0402	1		
R22	Resistor, 1 kΩ, 1/16 W, 1%, 0402	1		
R24, R25	Resistor, 0.12 Ω, 1 W, 1%, 2512	2		
R28	Resistor, 5.36 kΩ, 1/16 W, 1%, 0402	1		
RT1	Thermistor, NTC, 10 kΩ, 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

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LOW/HIGH-BEAM SINGLE FET EVALUATION BOARD

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.

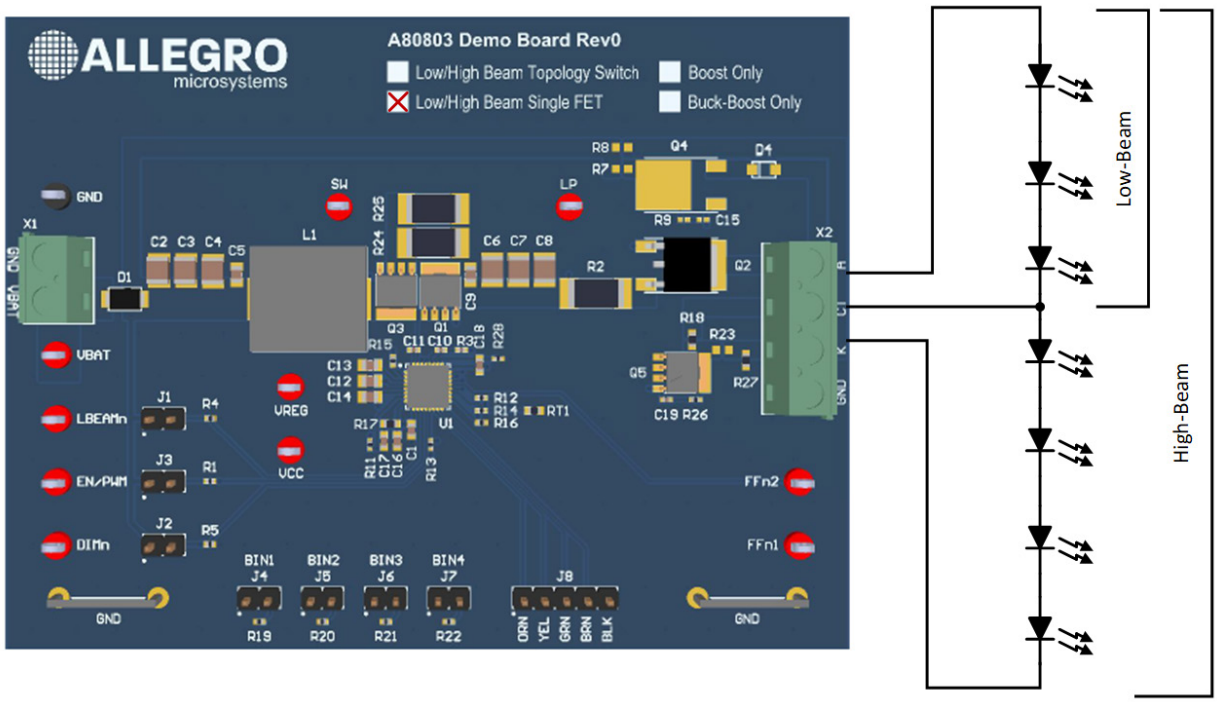

Figure 21: APEK80803KET-SF PCB with LED Connection

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

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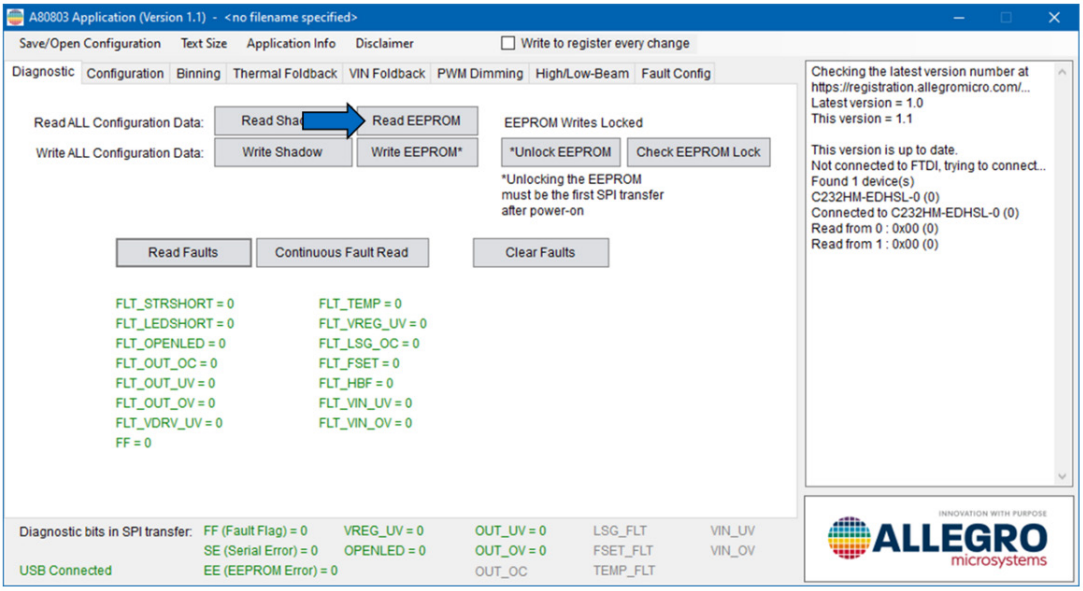
Confirm HBGCTRL Bit

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.

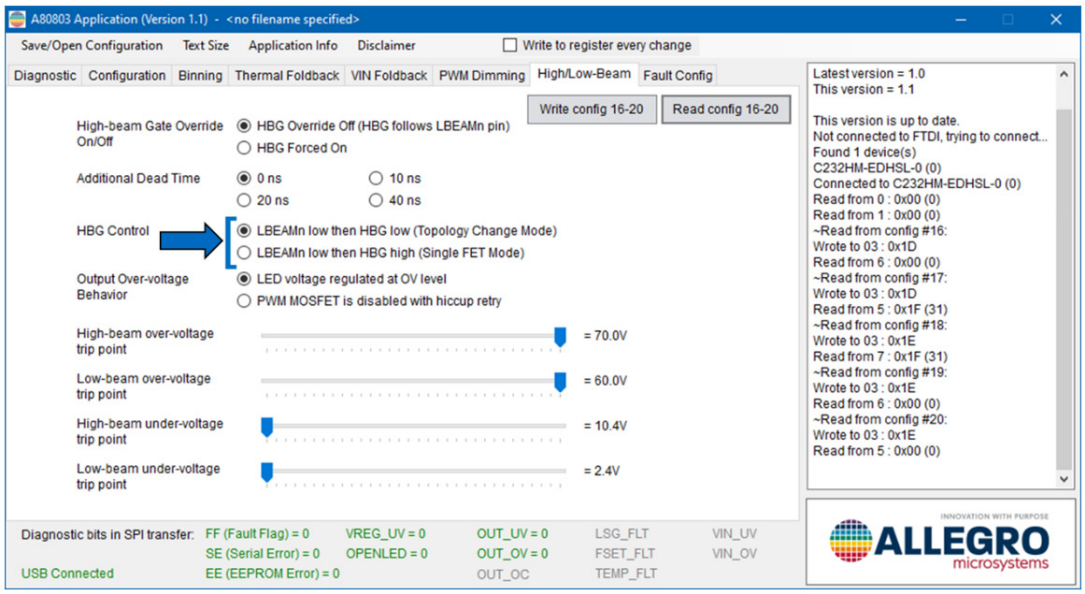


Figure 22: HBGCTRL Bit in A80803 GUI

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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

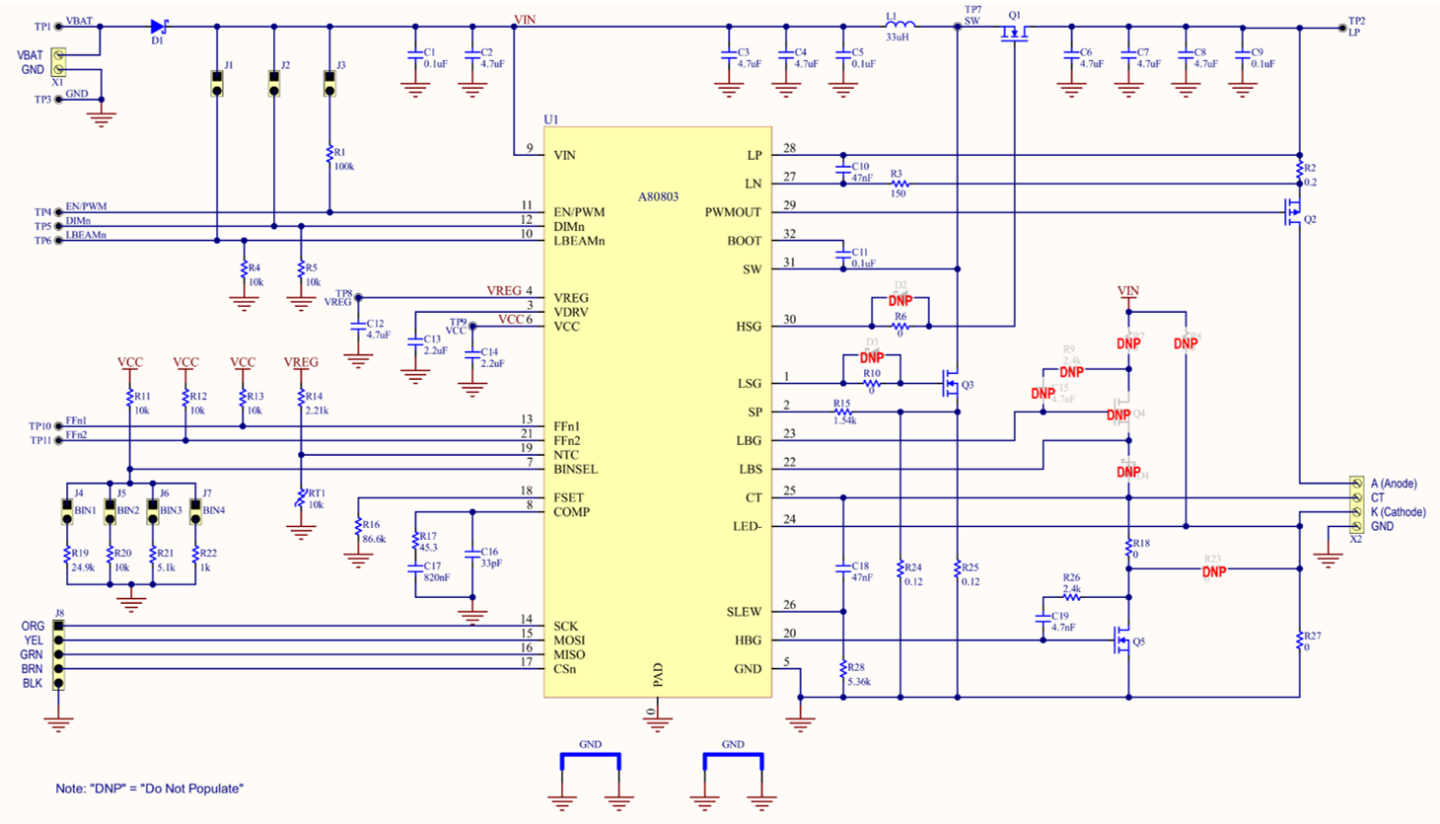

Figure 23: APEK80803KET-SF Schematic

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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 µF, 50 V, X7R, 0603	1		
C2, C3, C4	Capacitor, Ceramic, 4.7 µF, 50 V, X7R, 1210	3	Murata	GCM32ER71H475KA55K
C5, C9	Capacitor, Ceramic, 0.1 µF, 50 V, X7R, 0805	2		
C6, C7, C8	Capacitor, Ceramic, 4.7 µF, 100 V, X7R, 1210	3	TDK	CNA6P1X7R2A475K250AE
C10	Capacitor, Ceramic, 47 nF, 25 V, X7R, 0402	1		
C11	Capacitor, Ceramic, 0.1 µF, 16 V, X7R, 0402	1		
C12	Capacitor, Ceramic, 4.7 µF, 16 V, X7R, 0805	1		
C13, C14	Capacitor, Ceramic, 2.2 µF, 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	Wurth	61300211121
J8	Connector, Header, 5 Position, 0.1"	1	Wurth	61300511121
L1	Inductor, 33 µH, ±20%, 8 A sat, 85.5 mΩ 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 kΩ, 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 kΩ, 1/16 W, 1%, 0402	6		
R6, R10	Resistor, 0 Ω, 1/16 W, 1%, 0402	2		
R14	Resistor, 2.21 kΩ, 1/16 W, 1%, 0402	1		
R15	Resistor, 1.54 kΩ, 1/16 W, 1%, 0402	1		
R16	Resistor, 86.6 kΩ, 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 kΩ, 1/16 W, 1%, 0402	1		
R21	Resistor, 5.1 kΩ, 1/16 W, 1%, 0402	1		
R22	Resistor, 1 kΩ, 1/16 W, 1%, 0402	1		
R24, R25	Resistor, 0.12 Ω, 1 W, 1%, 2512	2		
R26	Resistor, 2.4 kΩ, 1/16 W, 1%, 0402	1		
R28	Resistor, 5.36 kΩ, 1/16 W, 1%, 0402	1		
RT1	Thermistor, NTC, 10 kΩ, 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

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BOOST ONLY EVALUATION BOARD

The boost only configuration operates in boost mode without an option for low-beam or high-beam. The Evaluation Board 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 Evaluation Board 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.

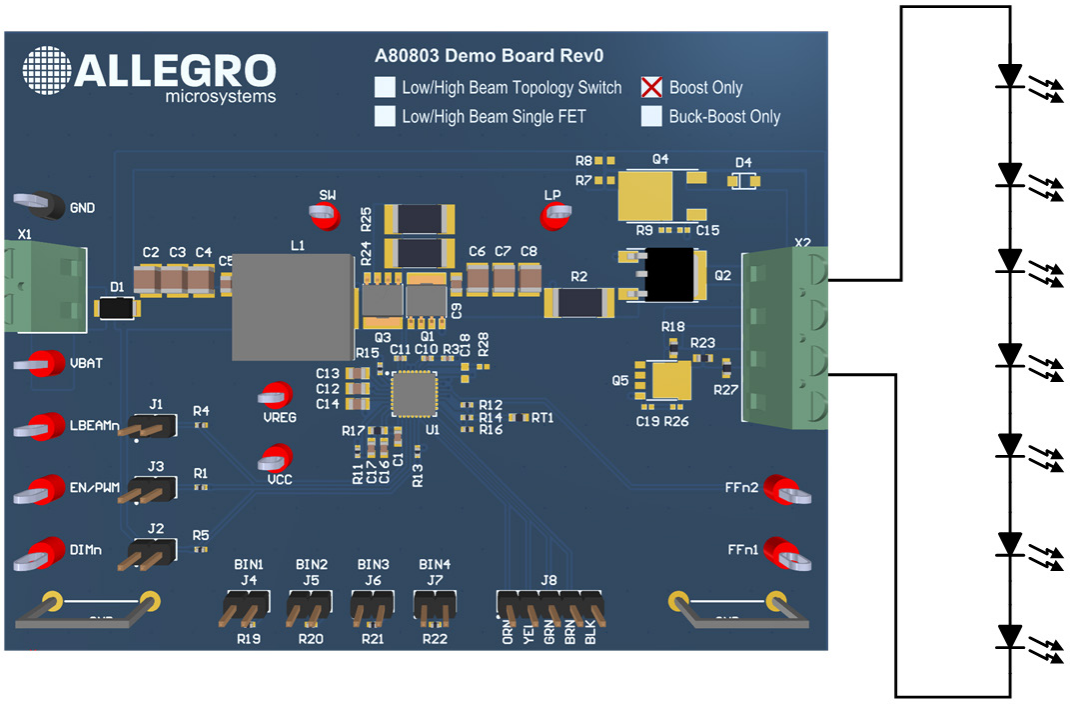

Figure 24: APEK80803KET-BO PCB with LED Connection

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

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APEK80803KET-BO SCHEMATIC

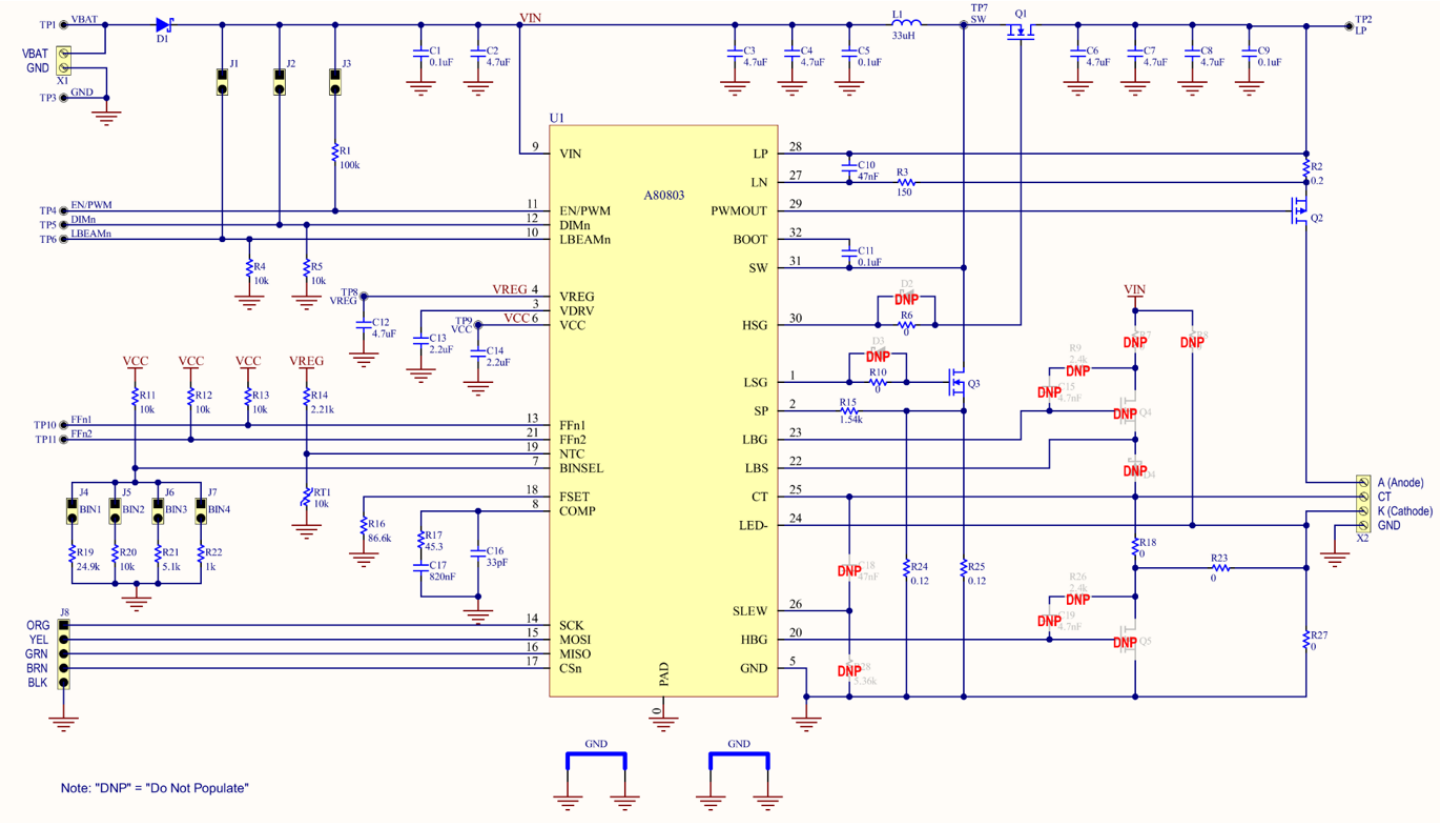

Figure 25: APEK80803KET-BO Schematic

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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 µF, 50 V, X7R, 0603	1		
C2, C3, C4	Capacitor, Ceramic, 4.7 µF, 50 V, X7R, 1210	3	Murata	GCM32ER71H475KA55K
C5, C9	Capacitor, Ceramic, 0.1 µF, 50 V, X7R, 0805	2		
C6, C7, C8	Capacitor, Ceramic, 4.7 µF, 100 V, X7R, 1210	3	TDK	CNA6P1X7R2A475K250AE
C10	Capacitor, Ceramic, 47 nF, 25 V, X7R, 0402	1		
C11	Capacitor, Ceramic, 0.1 µF, 16 V, X7R, 0402	1		
C12	Capacitor, Ceramic, 4.7 µF, 16 V, X7R, 0805	1		
C13, C14	Capacitor, Ceramic, 2.2 µF, 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	Wurth	61300211121
J8	Connector, Header, 5 Position, 0.1"	1	Wurth	61300511121
L1	Inductor, 33 µH, ±20%, 8 A sat, 85.5 mΩ 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 kΩ, 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 kΩ, 1/16 W, 1%, 0402	6		
R6, R10	Resistor, 0 Ω, 1/16 W, 1%, 0402	2		
R14	Resistor, 2.21 kΩ, 1/16 W, 1%, 0402	1		
R15	Resistor, 1.54 kΩ, 1/16 W, 1%, 0402	1		
R16	Resistor, 86.6 kΩ, 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 kΩ, 1/16 W, 1%, 0402	1		
R21	Resistor, 5.1 kΩ, 1/16 W, 1%, 0402	1		
R22	Resistor, 1 kΩ, 1/16 W, 1%, 0402	1		
R24, R25	Resistor, 0.12 Ω, 1 W, 1%, 2512	2		
RT1	Thermistor, NTC, 10 kΩ, 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

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BUCK-BOOST ONLY EVALUATION BOARD

The buck-boost only configuration operates in buck-boost mode without an option for low-beam or high-beam. The Evaluation Board 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 27, 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 Evaluation Board 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.

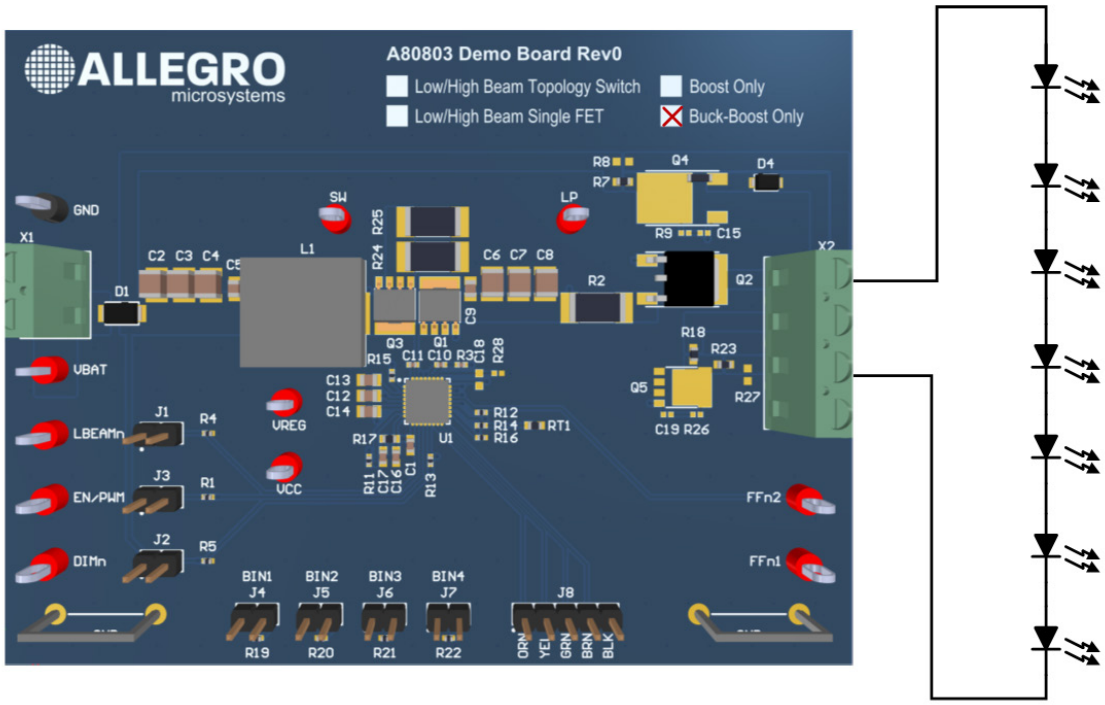

Figure 26: APEK80803KET-BB PCB with LED Connection

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

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APEK80803KET-BB SCHEMATIC

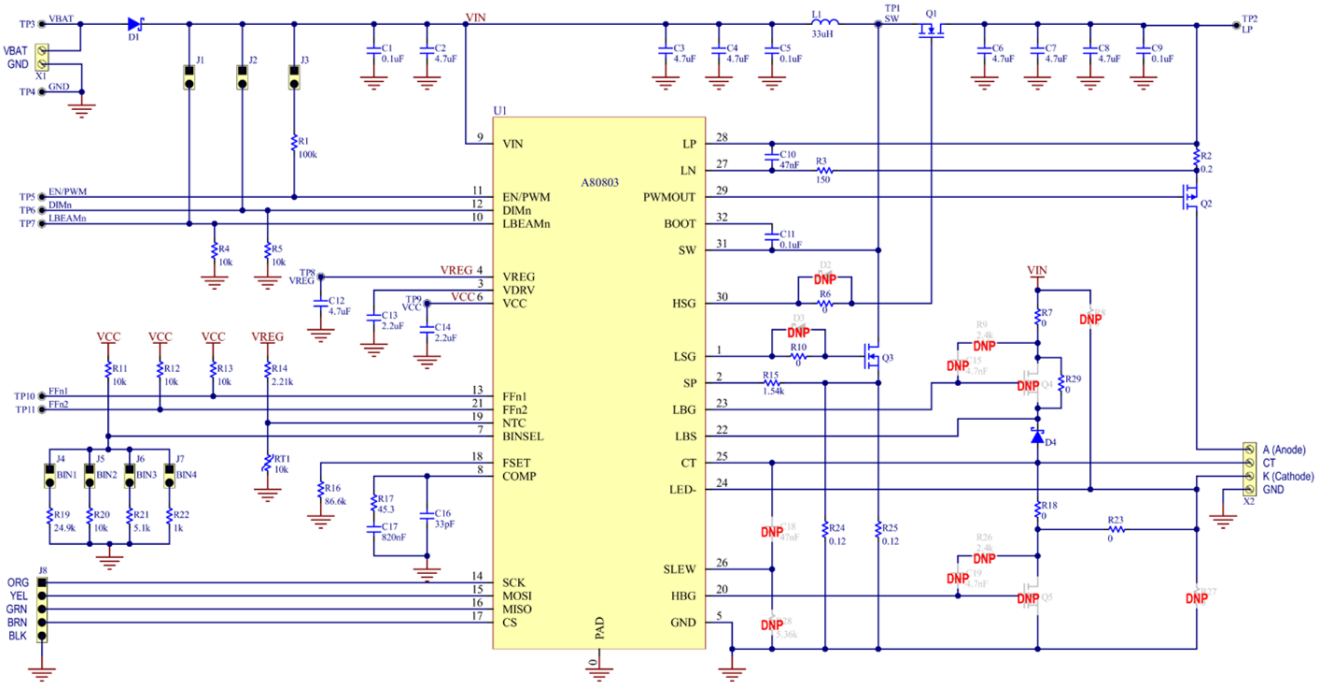

Figure 27: APEK80803KET-BB Schematic

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

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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 µF, 50 V, X7R, 0603	1		
C2, C3, C4	Capacitor, Ceramic, 4.7 µF, 50 V, X7R, 1210	3	Murata	GCM32ER71H475KA55K
C5, C9	Capacitor, Ceramic, 0.1 µF, 50 V, X7R, 0805	2		
C6, C7, C8	Capacitor, Ceramic, 4.7 µF, 100 V, X7R, 1210	3	TDK	CNA6P1X7R2A475K250AE
C10	Capacitor, Ceramic, 47 µF, 25 V, X7R, 0402	1		
C11	Capacitor, Ceramic, 0.1 µF, 16 V, X7R, 0402	1		
C12	Capacitor, Ceramic, 4.7 µF, 16 V, X7R, 0805	1		
C13, C14	Capacitor, Ceramic, 2.2 µF, 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	Wurth	61300211121
J8	Connector, Header, 5 Position, 0.1"	1	Wurth	61300511121
L1	Inductor, 33 µH, ±20%, 8 A sat, 85.5 mΩ 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 kΩ, 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 kΩ, 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 kΩ, 1/16 W, 1%, 0402	1		
R15	Resistor, 1.54 kΩ, 1/16 W, 1%, 0402	1		
R16	Resistor, 86.6 kΩ, 1/16 W, 1%, 0402	1		
R17	Resistor, 45.3 Ω, 1/10 W, 1%, 0603	1		
R19	Resistor, 24.9 kΩ, 1/16 W, 1%, 0402	1		
R21	Resistor, 5.1 kΩ, 1/16 W, 1%, 0402	1		
R22	Resistor, 1 kΩ, 1/16 W, 1%, 0402	1		
R24, R25	Resistor, 0.12 Ω, 1 W, 1%, 2512	2		
RT1	Thermistor, NTC, 10 kΩ, 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

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BOARD LAYOUT

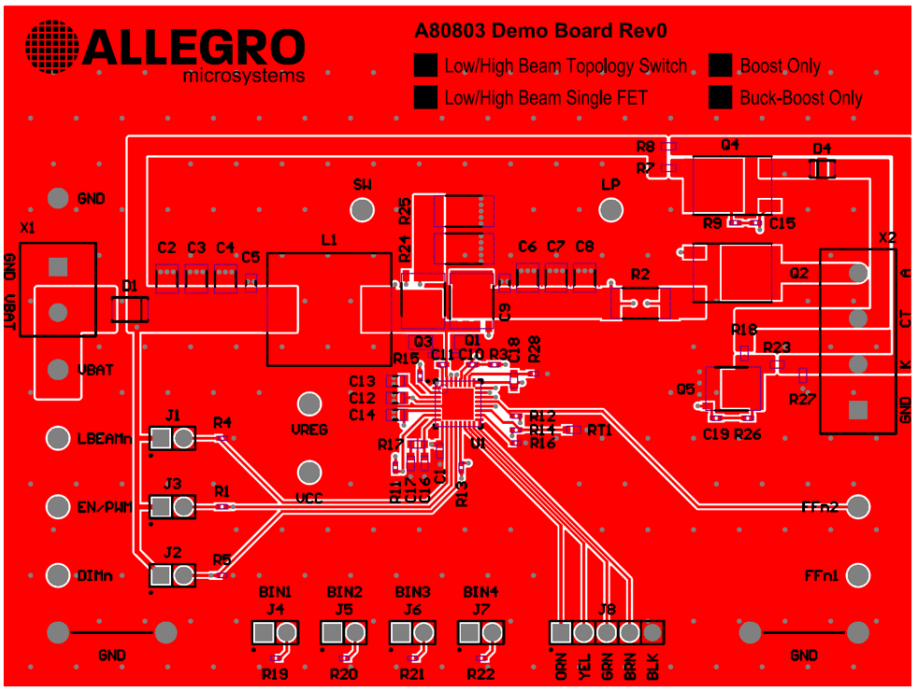

Figure 28: Top Layer

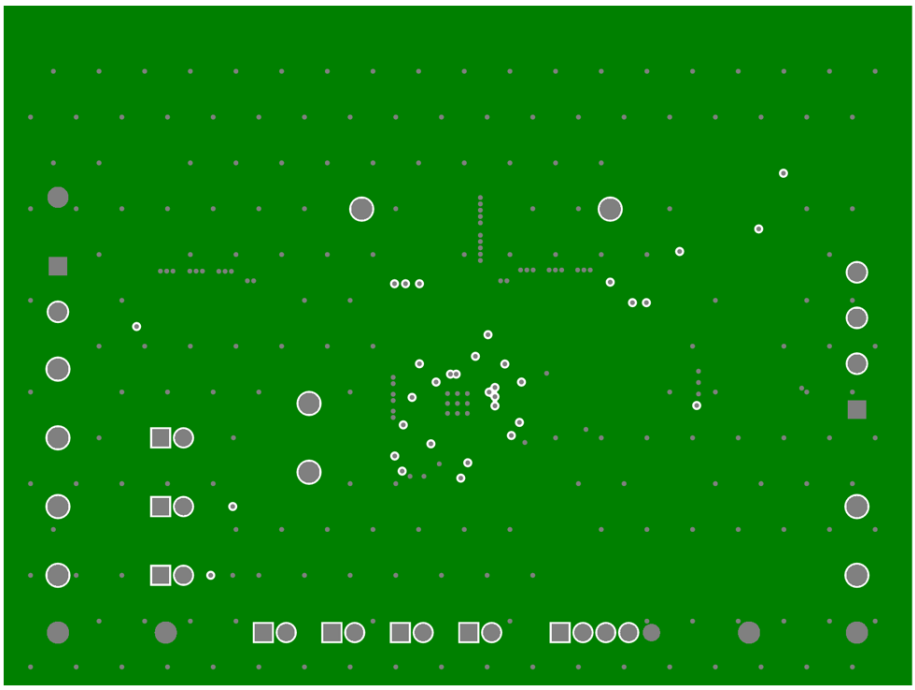

Figure 29: Inner Layer 1 (GND Plane)

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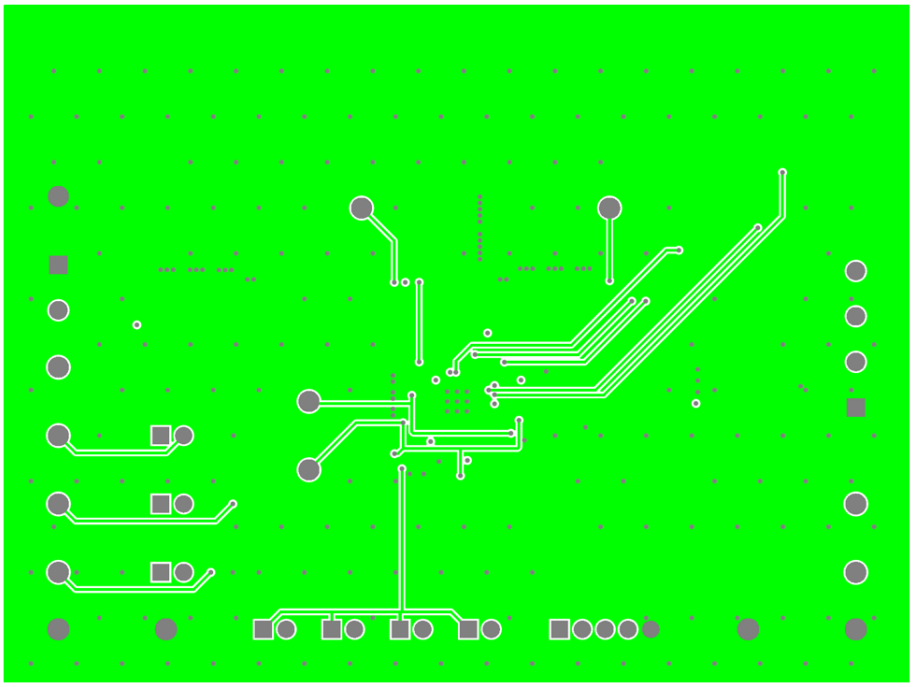

Figure 30: Inner Layer 2

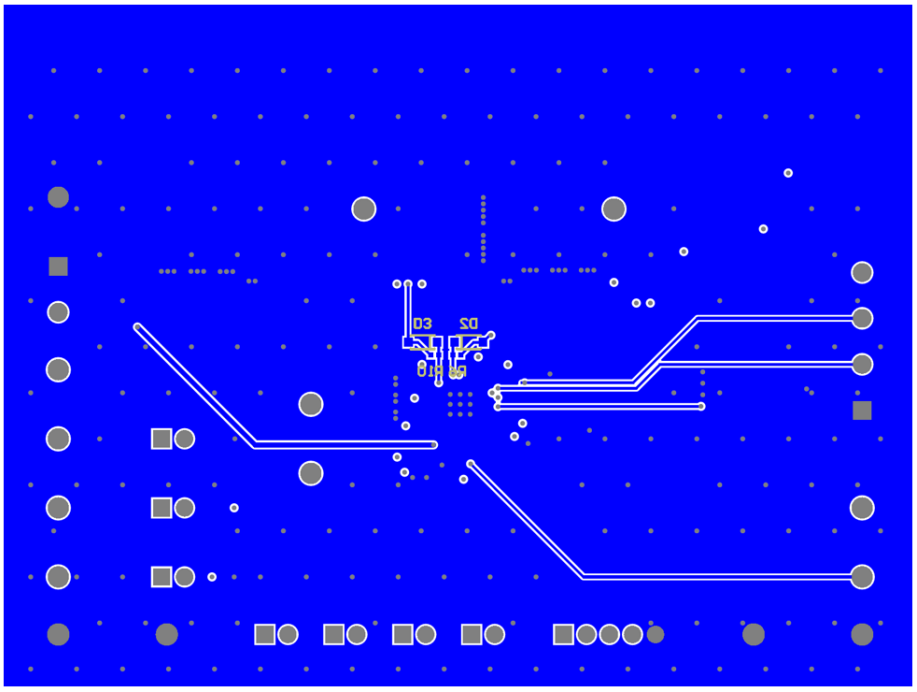

Figure 31: Bottom Layer

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RELATED LINKS

https://www.allegromicro.com/en/products/regulate/led-drivers/led-drivers-for-lighting/a80803

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Revision History

Number	Date	Description
–	June 25, 2021	Initial release
1	February 4, 2022	Corrected table 5 (page 3)
2	July 3, 2023	Updated to new template

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