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ABSTRACT

The BOOSTXL-TECDRV BoosterPack allows users to evaluate the Texas Instruments' TPS63810 buck-boost converter as a driver for a thermoelectric cooling (TEC) module. The TPS63810 is a high efficiency, high output current buck-boost converter programmable through I²C interface. The BoosterPack operates from input voltage of 3.3 V, and can drive the TEC with an output current of up to 2.5 A.

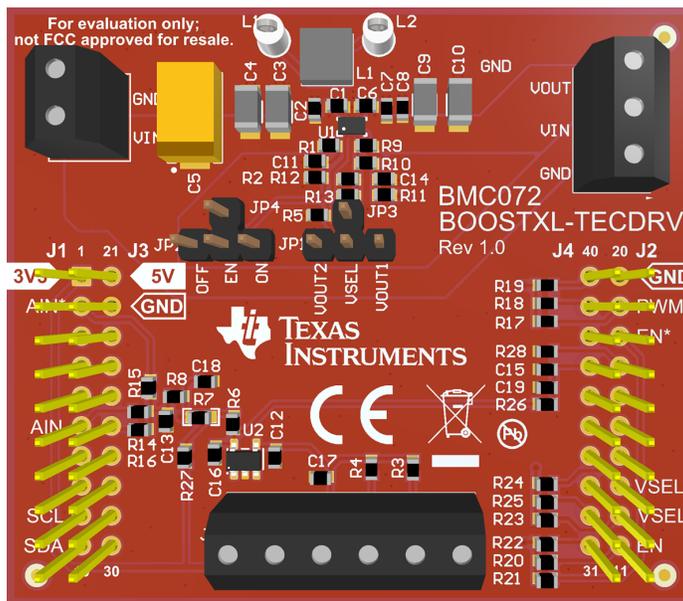


Figure 1-1. BOOSTXL-TECDRV BoosterPack

This user's guide includes a detailed description of the hardware (HW), bill of materials (BOM), schematic, and software (code and GUI) when using the LaunchPad MSP-EXP432P401R.

Table 1-1. Related Documentation

| Device | Literature Number |
|---------------------------------|-------------------------|
| TPS63810 | SLVSEK4 |
| MSP-EXP432P401R | SLAU597 |

Table of Contents

| | |
|---|----------|
| 1 Introduction | 3 |
| 2 Quick Start | 4 |
| 2.1 Step 1: Software Installation..... | 4 |
| 2.2 Step 2: Firmware Completion and Flashing..... | 4 |
| 2.3 Step 3: Hardware Setup..... | 4 |
| 2.4 Step 4: GUI..... | 4 |
| 3 System Overview | 6 |
| 4 Hardware Overview | 7 |
| 4.1 Buck-Boost Converter..... | 7 |

| | |
|--|-----------|
| 4.2 Thermoelectric Cooler (TEC)..... | 7 |
| 4.3 LaunchPad..... | 8 |
| 4.4 Voltage Reference..... | 8 |
| 4.5 Temperature Sensor..... | 9 |
| 5 Firmware Overview..... | 10 |
| 6 Graphical User Interface (GUI)..... | 11 |
| 7 Setup Details..... | 12 |
| 8 Bill of Materials, PCB Layout, and Schematic..... | 14 |
| 8.1 Bill of Materials..... | 14 |
| 8.2 PCB Layout..... | 16 |
| 8.3 Schematic..... | 18 |

List of Figures

| | |
|--|----|
| Figure 1-1. BOOSTXL-TECDRV BoosterPack..... | 1 |
| Figure 1-1. BOOSTXL-TECDRV Block Diagram..... | 3 |
| Figure 2-1. LaunchPad and BoosterPack Combo..... | 4 |
| Figure 3-1. TEC System Block Diagram..... | 6 |
| Figure 4-1. Buck-Boost Converter as TEC Driver..... | 7 |
| Figure 4-2. Typical TEC Module..... | 7 |
| Figure 4-3. TPS63810 Operating Area When Driving TEC Module..... | 8 |
| Figure 5-1. Firmware Flow Chart..... | 10 |
| Figure 6-1. GUI Interface Window..... | 11 |
| Figure 7-1. Hardware Setup..... | 12 |
| Figure 8-1. Assembly Layer..... | 16 |
| Figure 8-2. Top Layer..... | 16 |
| Figure 8-3. Bottom Layer (Top View)..... | 17 |
| Figure 8-4. BOOSTXL-TECDRV Schematic..... | 18 |

List of Tables

| | |
|---------------------------------------|----|
| Table 1-1. Related Documentation..... | 1 |
| Table 8-1. Bill of Materials..... | 14 |

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1 Introduction

The BOOSTXL-TECDRV BoosterPack is an evaluation platform designated to highlight the TPS63810 use as a driver for a thermoelectric cooling (TEC) module.

The BOOSTXL-TECDRV interfaces to LaunchPad development platforms using the XL connector format. To use the BOOSTXL-TECDRV BoosterPack GUI a specific LaunchPad (the MSP-EXP432P401R) must be used. The LaunchPad communicates to the TPS63810 through its I²C interface and also acts as a USB-to-PC GUI communication bridge.

Note

The BOOSTXL-TECDRV requires a LaunchPad or external master controller to evaluate the TPS63810.

The MSP-EXP432P401R LaunchPad is controlled by commands received from the BOOSTXL-TECDRV BoosterPack GUI. The LaunchPad sends data to the GUI for display. If a LaunchPad is not used, the BoosterPack plug-in module format allows an alternate external host to communicate with the TPS63810 using the LaunchPad connectors.

The BOOSTXL-TECDRV incorporates circuitry and components with the following features:

- The TPS63810 high efficiency, high output current buck-boost converter with I²C interface.
 - On board precision 2.5-V voltage reference.
 - External power supply and temperature sensors can be connected through screw terminal blocks.
 - I²C interface for the TPS63810 device configuration and communication.
-

Note

The BOOSTXL-TECDRV requires an external 3.3-V power supply to power the TPS63810.

Figure 1-1 shows the BOOSTXL-TECDRV architecture along with the key components and blocks listed in the features.

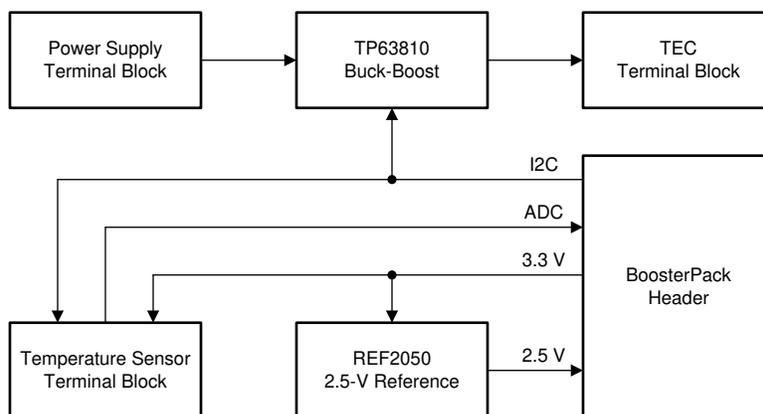


Figure 1-1. BOOSTXL-TECDRV Block Diagram

2 Quick Start

The quick start presented in this section is a minimalist view of the startup procedure to get the system up and running. More details regarding the hardware and software setup can be found in [Section 7](#).

2.1 Step 1: Software Installation

Download the LaunchPad firmware from the BOOSTXL-TECDRV tools folder . Download and install Energia IDE from the Energia [website](#). The LaunchPad firmware is written in Energia, and needs to be modified for the particular temperature sensor and the TEC module that are used. Alternatively, the Energia code can be used and modified using the cloud CCS tool.

2.2 Step 2: Firmware Completion and Flashing

Depending on the used temperature sensor and the TEC module, the LaunchPad firmware needs to be completed. This can be done using the Energia IDE or the cloud version of the CCS IDE. The completed firmware then needs to be downloaded to the LaunchPad using the micro USB cable provided with the LaunchPad kit. Details regarding these steps can be found in [Section 7](#).

2.3 Step 3: Hardware Setup

After the firmware file has successfully downloaded to the LaunchPad, unplug the USB cable from the LaunchPad. Align properly the connectors (as shown in [Figure 2-1](#)) and attach the BOOSTXL-TECDRV BoosterPack to the bottom set of connectors on the LaunchPad.

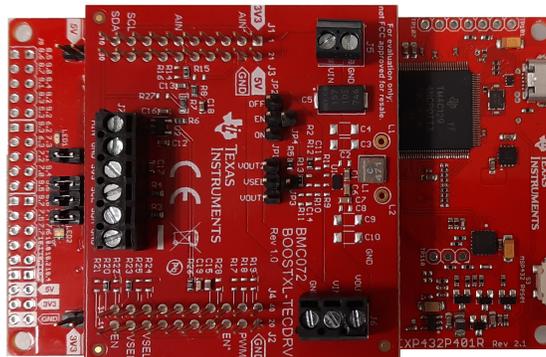


Figure 2-1. LaunchPad and BoosterPack Combo

When the BoosterPack is attached, plug the USB cable into the bottom connector of the LaunchPad and also to the PC. A green LED lights up indicating that the LaunchPad is powered. The LaunchPad communication to the PC is USB communications device class (CDC) using a virtual COM port. Windows® 10 automatically installs the required driver. Earlier versions of the operating system may require a manual driver installation.

Connect the temperature sensor to the sensor input terminal block J7 on the BoosterPack. Depending on the temperature sensor, different connectors need to be used. Details regarding these steps can be found in [Section 7](#). Make sure that the jumper on JP2 header is connecting EN and ON pins, and that the jumper on JP1 header is connecting VSEL and VOUT1 pins.

Connect the TEC module to the output terminal block J6 on the BoosterPack, minding the TEC module polarity.

Connect the 3.3-V power supply to the input power terminal block on the BoosterPack, and turn the power supply on.

2.4 Step 4: GUI

From the Windows Start menu, go to the Texas Instruments folder and under BOOSTXL-TECDRV start the GUI application. A cloud version of the GUI is also available from [dev.ti.com](#) in the software gallery. The communication between the GUI and the LaunchPad should be automatically established. If the hardware does not connect, manually try to make the connection by clicking on the connect icon in the lower left portion of the GUI. If the correct serial COM port cannot be found, the desired port can be selected from the Options drop

down menu and selecting Serial Port. When the firmware program is successfully downloaded, the GUI software can now communicate with the LaunchPad.

3 System Overview

Thermoelectric cooler (TEC) is a device that operates using the Peltier effect to create a heat flux at the junction of two different types of materials. It is a solid-state active heat pump which transfers heat from one side of the device to the other, depending on the direction of the current. Therefore, depending on the direction of the heat flow, TEC can be used for heating or for cooling.

With a feedback circuitry, TEC can be used to implement a highly stable temperature controller to maintain a precise and stable temperature of a material, component or system. A block diagram of such a controller is shown in [Figure 3-1](#).

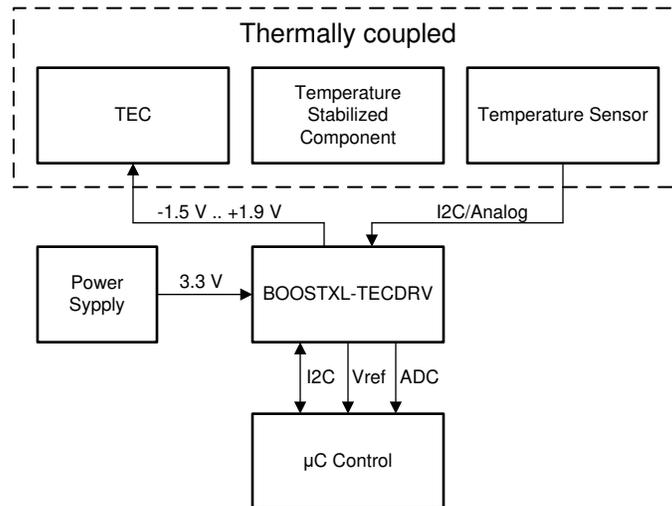


Figure 3-1. TEC System Block Diagram

The temperature is measured using an analog or digital temperature sensor. The sensor is interfaced to the LaunchPad through the BOOSTXL-TECDRV BoosterPack, either through the analog-to-digital converter (ADC) or through the I²C interface of the LaunchPad. The LaunchPad reads out the temperature and implements a control algorithm that generates the driving signal needed to perform temperature stabilization. The driving signal is sent back to the BoosterPack and is used to set the output voltage of the TPS63810 buck-boost converter. The TPS63810 sets the voltage across the TEC and control the direction and amount of heat flow, heating or cooling the target that is thermally coupled to the TEC.

4 Hardware Overview

4.1 Buck-Boost Converter

The TPS63810 is a buck-boost converter with an I²C interface. The ability of the buck-boost converter to increase or decrease the input voltage can be used to drive a TEC with positive or negative voltage. In this way, the heat flow through the TEC can be controlled in order to heat or cool the target device. Figure 4-1 shows how the TEC can be driven using the buck-boost converter. When the converter operates in buck mode, V_{OUT} is lower than V_{IN}, and V_{TEC} and I_{TEC} are therefore positive. It should be noted that in this mode, I_{TEC} flows from V_{IN} into V_{OUT} pin of the TPS63810, therefore the TPS63810 output is sinking the TEC current. When the converter operates in boost mode, V_{OUT} is higher than V_{IN}, and V_{TEC} and I_{TEC} are therefore negative. It should be noted that in this mode, I_{TEC} flows from V_{OUT} pin of the TPS63810 back to the power source V_{IN}, therefore the TPS63810 output is sourcing the TEC current.

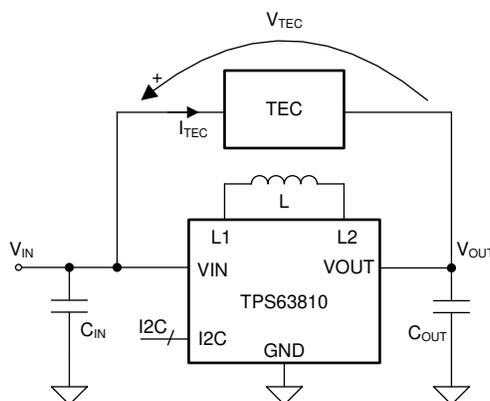


Figure 4-1. Buck-Boost Converter as TEC Driver

With the TPS63810, the TEC voltage can be easily changed via I²C interface. This reduces the component count when compared to conventional voltage scaling approaches, where a dedicated DAC or a PWM signal with associated filters and scaling resistors is used.

4.2 Thermoelectric Cooler (TEC)

As mentioned, thermoelectric cooler (TEC) is a solid-state heat pump which transfers heat from one side of the device to the other. The direction of the heat flow depends on the polarity of the applied voltage. Figure 4-2 shows a typical TEC module. Typically, when connecting the positive end of the power supply to the red wire, and the negative end to the black wire, the top side of the TEC will be cold and the bottom side will be hot.

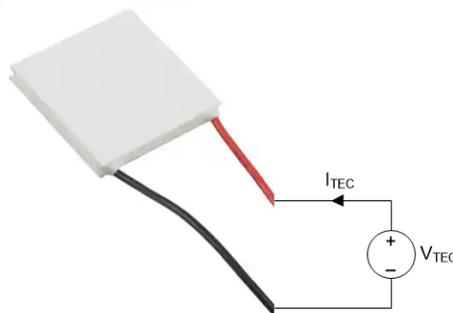


Figure 4-2. Typical TEC Module

TEC modules differ in power that they can handle and the operating resistance they have. A TEC module with appropriate power rating should be used to maintain the goal system temperature under all conditions. To fully leverage the voltage/current capabilities of the TPS63810, there is an optimal range of resistance that the selected TEC should meet. The shaded area in Figure 4-3 shows the operating area, for example, the output voltage and current, of the TPS63810 when driving the TEC module, when the input voltage is 3.3 V. The specific operating points for several values of the TEC element resistance are shown with different lines. The

TPS63810 can drive the TEC module with up to 5.3 W when operating in forward direction (when sourcing current), and up to 1.5 W when operating in reverse (when sinking current). The user can determine if cooling or heating is more important, and appropriately configure the polarity of the TEC module.

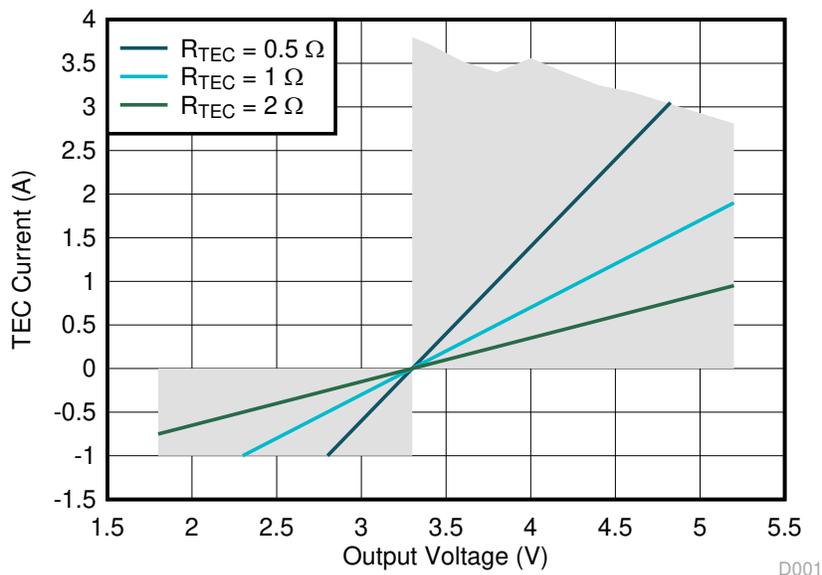


Figure 4-3. TPS63810 Operating Area When Driving TEC Module

4.3 LaunchPad

The BOOSTXL-TECDRV requires the MSP-EXP432P401R LaunchPad for control. The MSP-EXP432P401R LaunchPad features the SimpleLink MSP432P401R microcontroller (MCU) with an integrated 16-bit precision ADC, delivering ultra-low-power performance including 80 μ A/MHz in active power and 660 nA in standby power with FPU and DSP extensions.

The MSP-EXP432P401R LaunchPad provides an I²C interface for controlling the TPS63810. Additionally, the I²C interface can also be used to connect a digital I²C temperature sensor. Alternatively, analog temperature sensors can be interfaced to the integrated 16-bit ADC. The MSP-EXP432P401R LaunchPad is supported by Energia, an open-source electronics prototyping platform. The advantage of the MSP-EXP432P401R LaunchPad is that the ADC external reference pin is available on the BoosterPack pinout, enabling the use of a more precise external voltage reference instead of the integrated one.

Other LaunchPads can be used as well with the BOOSTXL-TECDRV. If so, attention should be given to the Launchpad's pinout. If the ADC external reference pin is not available on the BoosterPack pinout, a hardware modification is needed. Otherwise, the internal reference can be used for the ADC. It should be noted that this may affect the temperature accuracy, as the external voltage references are typically more accurate and stable than the integrated voltage reference of the MCU. The control and sensing lines of the BoosterPack can be re-routed to different header pins, as explained in [Section 8.3](#).

The MSP-EXP432P401R LaunchPad also provides a 3.3-V supply used for the voltage reference and the digital temperature sensor, if used.

4.4 Voltage Reference

The BOOSTXL-TECDRV BoosterPack includes a REF2025 voltage reference. The REF2025 is a low-power band-gap voltage reference with initial accuracy of $\pm 0.05\%$, and very low temperature drift of 8 ppm/ $^{\circ}$ C. This reference is connected to the VeREF+ pin of the MSP-EXP432P401R LaunchPad's MCU, to be used as voltage reference for the integrated 16-bit ADC. Using the precision external reference instead of the integrated voltage reference of the MCU improves the accuracy and stability of the temperature tracking.

4.5 Temperature Sensor

Different types of temperature sensors can be used with the BOOSTXL-TECDRV BoosterPack. The sensors can be connected to the screw terminal on the BoosterPack to interface them to the I²C interface or the ADC of the LaunchPad's MCU.

By default, the provided firmware is intended to be used with the TMP117 temperature sensor. The TMP117 is a high-precision digital temperature sensor. The TMP117 provides a 16-bit temperature result with a resolution of 0.0078°C and an accuracy of up to ±0.1°C across the temperature range of -20°C to 50°C with no calibration. The TMP117 has an I²C-compatible interface. The low power consumption of the TMP117 minimizes the impact of self-heating on measurement accuracy. The TMP117 operates from 1.8 V to 5.5 V and typically consumes 3.5 µA.

An analog temperature sensor can also be used. The analog sensor is interfaced to the 16-bit ADC integrated into the MSP-EXP432P401R LaunchPad. The provided firmware is already prepared for reading the analog input. The user only has to provide the conversion equation to translate the ADC value into the temperature. Typically, three types of analog temperature sensors are used:

1. Linear analog temperature sensors, which provides a voltage output that changes linearly with the temperature. An example is the LMT70, an ultra-small, high-precision, low-power CMOS analog temperature sensor with NTC output slope of -5.19 mV/°C and accuracy of ±0.05°C.
2. Positive temperature coefficient (PTC) thermistor, which is a resistor whose resistance increases as temperature rises. An example is the TMP61, a ±1% 10-kΩ silicon-based thermistor offering linearity and consistent sensitivity across temperature.
3. Negative temperature coefficient (NTC) thermistor, which is a resistor whose resistance decreases as temperature rises.

Note that PTC and NTC thermistors require a biasing resistor to form a resistive voltage divider whose output voltage depends on the temperature. The BOOSTXL-TECDRV BoosterPack has already included place for this resistor on board. It should also be noted that PTC thermistors have benefits over NTC thermistors such as no extra linearization circuitry, minimized calibration, less resistance tolerance variation, larger sensitivity at high temperatures, and simplified conversion methods to save time and memory in the processor. Use the [thermistor design tool](#) to view resistance tables and begin your design with example temperature conversion methods and code.

5 Firmware Overview

The firmware for the MSP-EXP432P401R LaunchPad is implemented in Energia. While this firmware is meant to be used with the MSP-EXP432P401R only, it can be easily modified for other TI LaunchPads. For this reason the BOOSTXL-TECDRV BoosterPack has multiple connection options for the BoosterPack header. By moving the jumper resistors, the signal and control lines can be re-routed between multiple pins. This is shown in more details in the schematic in [Section 8.3](#).

Figure 5-1 shows the firmware flow chart.

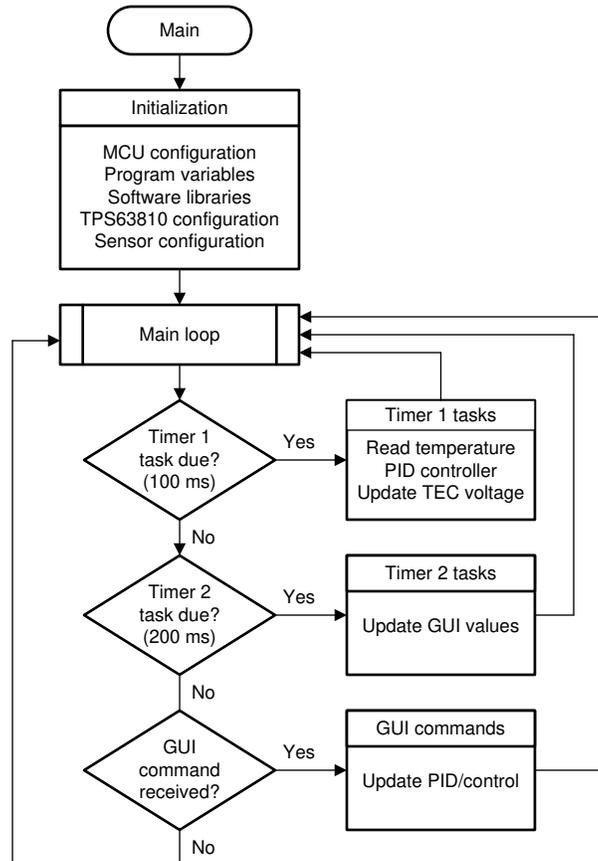


Figure 5-1. Firmware Flow Chart

The code starts by initializing various variables, configuring MCU and its peripherals, and configuring digital sensors. After that the main loop takes care of three main processes:

1. A 100-ms timer takes care of the main control process. Here, the temperature is read either from the analog sensor via ADC or the digital sensor via I²C. After that, the PID controller calculates the necessary control voltage for the TPS63810. This voltage is transmitted to the TPS63810 via the same I²C interface used for the digital temperature sensor, and the TEC voltage is updated. This period depends on the thermal dynamics of the system and can be changed in the code.
2. A 200-ms timer periodically sends the currently sensed temperature and the current output voltage of the TPS63810 to the GUI. This period can be extended in order to send less data to the GUI. When used with the BOOSTXL-TECDRV GUI, it is not recommended to send the data more than 10 times per second, as the GUI might not be able to process all the incoming data.
3. The third process checks if there is a message received from the GUI. These messages are sent from the GUI to the Launchpad on user commands, such as initializing the TPS63810 or changing the control modes and PID parameters.

6 Graphical User Interface (GUI)

A graphical user interface (GUI) is available from dev.ti.com in the software gallery, allowing a simple and convenient interface to the BOOSTXL-TECDRV BoosterPack through the MSP-EXP432P401R LaunchPad. A standalone version of the GUI can be downloaded or the web-based version can be used directly from the browser.

This section gives an overview of the BOOSTXL-TECDRV GUI. [Figure 6-1](#) shows the layout of the BOOSTXL-TECDRV GUI. The left portion of the GUI is used to control and monitor the system operation. The right part of the GUI shows a time chart of the measured temperature.

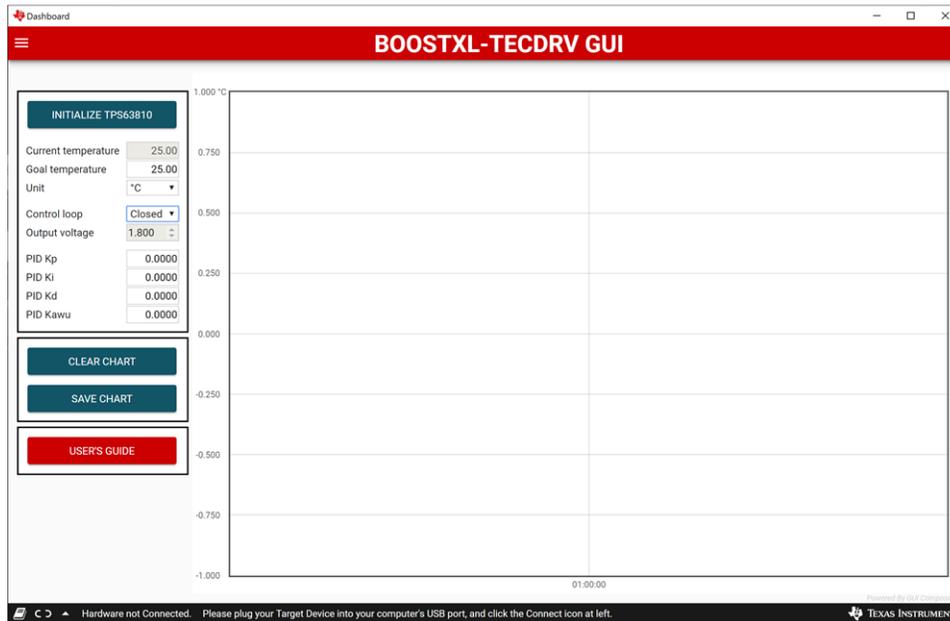


Figure 6-1. GUI Interface Window

Upon startup, the GUI automatically connects to the EVM. If not, click on the Connect button in the lower left corner of the GUI window.

To select the correct serial COM port for communication with the LaunchPad, the desired port can be selected from the Options drop down menu in the upper left corner by selecting Serial Port.

Once the communication is established and the hardware is connected, the temperature control can be started by clicking on the *Initialize TPS63810* button. This will turn the TPS63810 output on, and turn on the closed loop control by starting the PID controller in the LaunchPad. In the left side of the GUI interface, the goal temperature can be set, and the actual temperature and the current output voltage of the TPS63810 can be monitored. Upon initialization, the GUI will read the default PID parameters set in the firmware and display them. If needed, these PID parameters can be changed in real time to tune the response of the system.

Alternatively, the system can be run open loop by selecting OPEN in the Control loop drop-box. In this mode the goal temperature is ignored. Instead, the output voltage of the TPS63810 can be changed manually. This can be used to create a step response for tuning the system for the particular TEC/sensor combination being used. This is explained in more details in [Section 7](#).

Clicking the *Clear chart* button clears the temperature time chart, whereas the *Save chart* button saves the currently displayed chart in CSV format. Clicking the *User's guide* button leads to the online version of this user's guide.

7 Setup Details

Figure 7-1 shows the hardware setup of the system. A 3.3-V power supply connected to J5 terminal block is used to power the BOOSTXL-TECDRV BoosterPack. Make sure that the jumper on JP2 header is connecting EN and ON pins, and that the jumper on JP1 header is connecting VSEL and VOUT1 pins. Connect the TEC module to J6 terminal block, with positive (red) wire connected to VOUT connection and negative (black) wire connected to VIN connection. In this arrangement, the sensor and the component that is thermally stabilized need to be mounted on the cold side of the TEC module. Nevertheless, when finally turning on the system, if the temperature drifts away from the set temperature, the wires of the TEC module can be simply swapped reverse the TEC polarity.

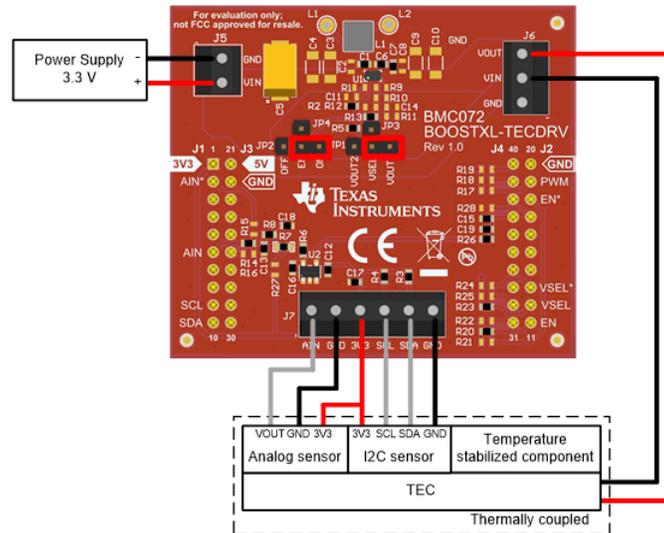


Figure 7-1. Hardware Setup

The BOOSTXL-TECDRV BoosterPack can be used with an analog or a digital I²C temperature sensor.

If an I²C temperature sensor is used, connect it to J7 block terminal using the 3V3, GND, SDA and SCL connections. Resistors R3 and R4 on the BoosterPack are the pull-up resistor for the I²C lines. 2.2-kΩ resistors are already mounted on the board, and can be removed or changed if needed.

If an analog temperature sensor is used, connect it to J7 block terminal using the 3V3, GND and AIN connections. 3V3 connection is useful in case when an active sensor that requires a power supply, such as the LMT70, is used. In case a PTC or an NTC thermistor is used, it can be connected between AIN and GND connections. A 10-kΩ, 0.1% resistor R7 on the BoosterPack is already mounted, serving as the high side resistor that forms a voltage divider with the thermistor.

The provided firmware assumes that a digital I²C temperature sensor TMP117 is used. To change the sensor type, the sensType variable needs to be set to either SENS_TYPE_I2C for digital, or SENS_TYPE_ANL for analog sensor.

If a digital sensor is used it needs to be initialized. For the TMP117 in particular, this is done in the initialization part of the code, where it is configured for continuous conversion without averaging. The value that is read from the sensor is converted into temperature using the following conversion:

$$\text{tempSens} = \text{tmp} * 0.0078125$$

where tempSens is the sensed temperature in °C and tmp is the value received from TMP117. For more information on the TMP117, refer to the [TMP117 High-Accuracy, Low-Power, Digital Temperature Sensor with SMBus™ -and I²C-Compatible Interface data sheet](#).

If an analog temperature sensor is used, the value read from the ADC needs to be converted to temperature before being used in the PID controller. Use the [thermistor design tool](#) to view resistance tables for TI devices, and begin your design with example temperature conversion methods and code.

The initial PID controller parameters can be set by changing the PID_KP, PID_KI, PID_KD constants. It should be noted that the provided firmware implements PI controller, which is sufficient for majority of controllers for thermal processes. To prevent the integrator from saturation, an anti-windup is implemented using the back-calculation method. The anti-windup can be tuned modifying the PID_KAWU constant. All PID parameters can be changed in GUI during runtime, to fine tune the system response.

8 Bill of Materials, PCB Layout, and Schematic

This section contains the BOOSTXL-TECDRV board schematic, bill of materials (BOM), and printed circuit board (PCB) layout.

8.1 Bill of Materials

Table 8-1 lists the bill of materials (BOM) for the BOOSTXL-TECDRV.

Table 8-1. Bill of Materials

| Designator | Quantity | Value | Description | Part Number | Manufacturer |
|-------------------------|----------|---------|---|--------------------|---------------------------|
| C1 | 1 | 10uF | CAP, CERM, 10 uF, 6.3 V, +/- 20%, X5R, 0603 | GRM188R60J106ME84D | MuRata |
| C5 | 1 | 150uF | CAP, Tantalum Polymer, 150 uF, 10 V, +/- 20%, 0.005 ohm, 7343-31 SMD | T530D157M010ATE005 | Kemet |
| C6, C7 | 2 | 47uF | CAP, CERM, 47 uF, 6.3 V, +/- 20%, X5R, 0603 | GRM188R60J476ME15D | MuRata |
| C12, C13, C16, C17, C18 | 5 | 1uF | CAP, CERM, 1 uF, 25 V, +/- 10%, X7R, 0603 | GRM188R71E105KA12D | MuRata |
| C15 | 1 | 4.7uF | CAP, CERM, 4.7 uF, 10 V, +/- 20%, X7R, 0603 | GRM188Z71A475ME15D | MuRata |
| C19 | 1 | 0.047uF | CAP, CERM, 0.047 uF, 16 V, +/- 10%, X7R, 0603 | GRM188R71C473KA01D | MuRata |
| J1/J3, J2/J4 | 2 | | Receptacle, 2.54mm, 10x2, Tin, TH | SSQ-110-03-T-D | Samtec |
| J5 | 1 | | Terminal Block, 3.5mm Pitch, 2x1, TH | ED555/2DS | On-Shore Technology |
| J6 | 1 | | Terminal Block, 3.5mm Pitch, 3x1, TH | ED555/3DS | On-Shore Technology |
| J7 | 1 | | Terminal Block, 3.5mm Pitch, 6x1, TH | ED555/6DS | On-Shore Technology |
| JP1, JP2 | 2 | | Header, 2.54 mm, 3x1, Gold, TH | 61300311121 | Würth Elektronik |
| JP3, JP4 | 2 | | Header, 2.54 mm, 1x1, Gold, TH | 61300111121 | Würth Elektronik |
| L1 | 1 | 470nH | Inductor, Shielded, Composite, 470 nH, 3.5 A, 0.0076 ohm, SMD | XFL4015-471MEC | Coilcraft |
| R2, R5 | 2 | 1.00Meg | RES, 1.00 M, 1%, 0.1 W, AEC-Q200 Grade 0, 0603 | CRCW06031M00FKEA | Vishay-Dale |
| R3, R4 | 2 | 2.20k | RES, 2.20 k, 1%, 0.1 W, 0603 | RC0603FR-072K2L | Yageo |
| R6, R13, R14, R20, R23 | 5 | 0 | RES, 0, 1%, 0.1 W, AEC-Q200 Grade 0, 0603 | RMCF0603ZT0R00 | Stackpole Electronics Inc |
| R7 | 1 | 10.0k | RES, 10.0 k, 0.1%, 0.1 W, 0603 | RT0603BRD0710KL | Yageo America |
| R8 | 1 | 10.0k | RES, 10.0 k, 1%, 0.1 W, AEC-Q200 Grade 0, 0603 | CRCW060310K0FKEA | Vishay-Dale |
| R26 | 1 | 330 | RES, 330, 1%, 0.1 W, 0603 | RC0603FR-07330RL | Yageo |
| U1 | 1 | | High-Current, High-Efficiency Buck-Boost Converter with I2C Interface, YFF0015AHAN (DSBGA-15) | TPS63810YFFR | Texas Instruments |
| U2 | 1 | | 8 ppm/degC Drift, Low-Power, Dual-Output Vref and Vref/2 Voltage Reference, DDC0005A (SOT-23-T-5) | REF2025AIDDCR | Texas Instruments |
| C2 | 0 | 10uF | CAP, CERM, 10 uF, 6.3 V, +/- 20%, X5R, 0603 | GRM188R60J106ME84D | MuRata |
| C3, C4 | 0 | 22uF | CAP, CERM, 22 uF, 25 V, +/- 20%, X5R, 1206_190 | TMK316BBJ226ML-T | Taiyo Yuden |
| C8 | 0 | 47uF | CAP, CERM, 47 uF, 6.3 V, +/- 20%, X5R, 0603 | GRM188R60J476ME15D | MuRata |
| C9, C10 | 0 | 47uF | CAP, CERM, 47 uF, 10 V, +/- 20%, X5R, 1206_190 | LMK316ABJ476ML-T | Taiyo Yuden |

Table 8-1. Bill of Materials (continued)

| Designator | Quantity | Value | Description | Part Number | Manufacturer |
|---|----------|-------|---|--------------------|---------------------------|
| C11 | 0 | 0.1uF | CAP, CERM, 0.1 uF, 25 V, +/- 5%, X7R, 0603 | C0603C104J3RACTU | Kemet |
| C14 | 0 | 1uF | CAP, CERM, 1 uF, 25 V, +/- 10%, X7R, 0603 | GRM188R71E105KA12D | MuRata |
| FID1, FID2, FID3 | 0 | | Fiduciary mark. There is nothing to buy or mount. | N/A | N/A |
| R1 | 0 | 75.0k | RES, 75.0 k, 1%, 0.1 W, 0603 | RC0603FR-0775KL | Yageo |
| R9 | 0 | 511k | RES, 511 k, 1%, 0.1 W, AEC-Q200 Grade 0, 0603 | CRCW0603511KFKEA | Vishay-Dale |
| R10 | 0 | 80.6k | RES, 80.6 k, 1%, 0.1 W, 0603 | RC0603FR-0780K6L | Yageo |
| R11 | 0 | 10.0k | RES, 10.0 k, 1%, 0.1 W, AEC-Q200 Grade 0, 0603 | CRCW060310K0FKEA | Vishay-Dale |
| R12 | 0 | 56.2k | RES, 56.2 k, 1%, 0.1 W, AEC-Q200 Grade 0, 0603 | CRCW060356K2FKEA | Vishay-Dale |
| R15, R16, R17, R18, R19, R21, R22, R24, R25, R27, R28 | 0 | 0 | RES, 0, 1%, 0.1 W, AEC-Q200 Grade 0, 0603 | RMCF0603ZT0R00 | Stackpole Electronics Inc |
| TP1, TP2 | 0 | | Test Point, Miniature, White, TH | 5002 | Keystone |

8.2 PCB Layout

Figure 8-1 to Figure 8-2 depict the BOOSTXL-TECDRV PCB layout.

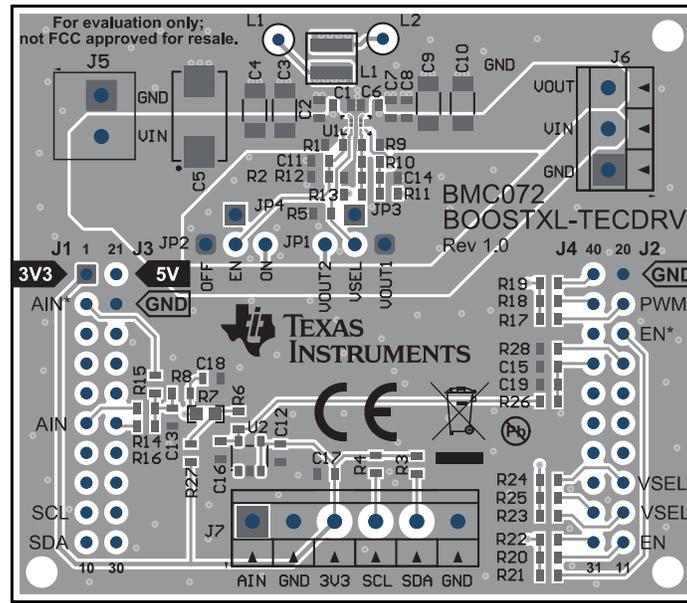


Figure 8-1. Assembly Layer

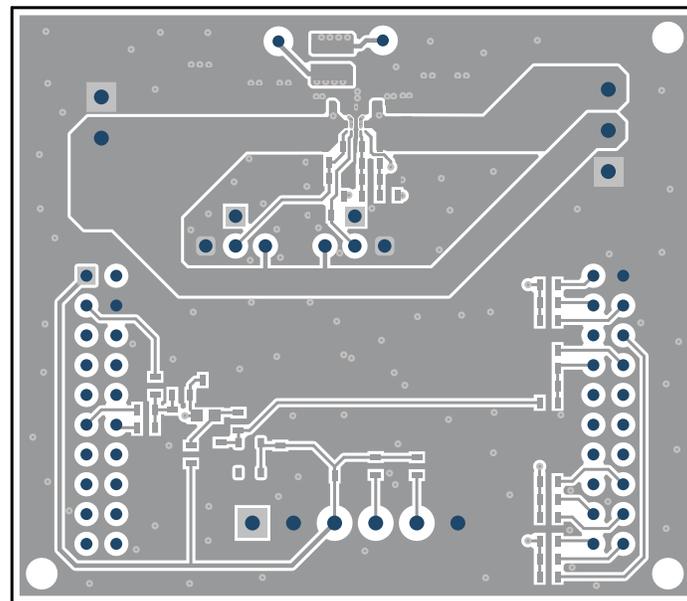


Figure 8-2. Top Layer

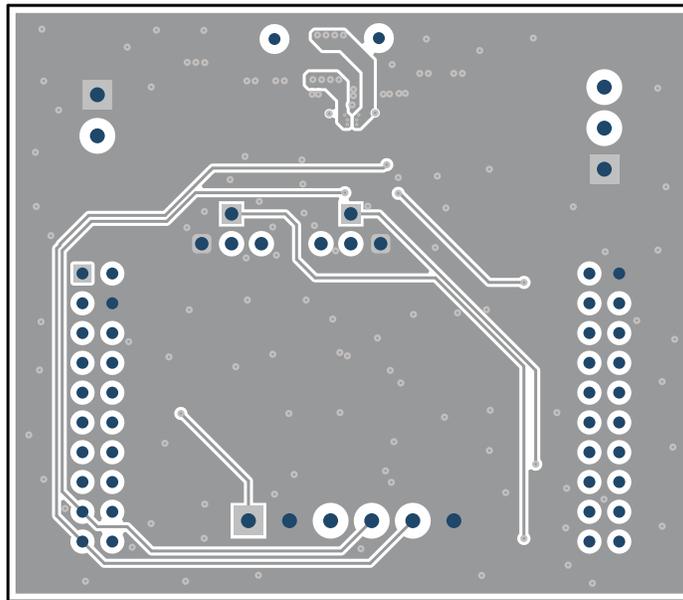


Figure 8-3. Bottom Layer (Top View)

8.3 Schematic

Figure 8-4 shows the BOOSTXL-TECDRV schematic. Note that some lines can be connected to different pins on the BoosterPack header. This is done so that the BoosterPack can be used with other TI LaunchPads. For example, the A_IN line used to interface the analog temperature sensor to the ADC on the LaunchPad is connected to the header pin BP6 via jumper resistor R14. If needed, this line can be re-routed to BP2 or BP26 pins of the BoosterPack header by removing R14 and populating R15 or R16 jumper resistors.

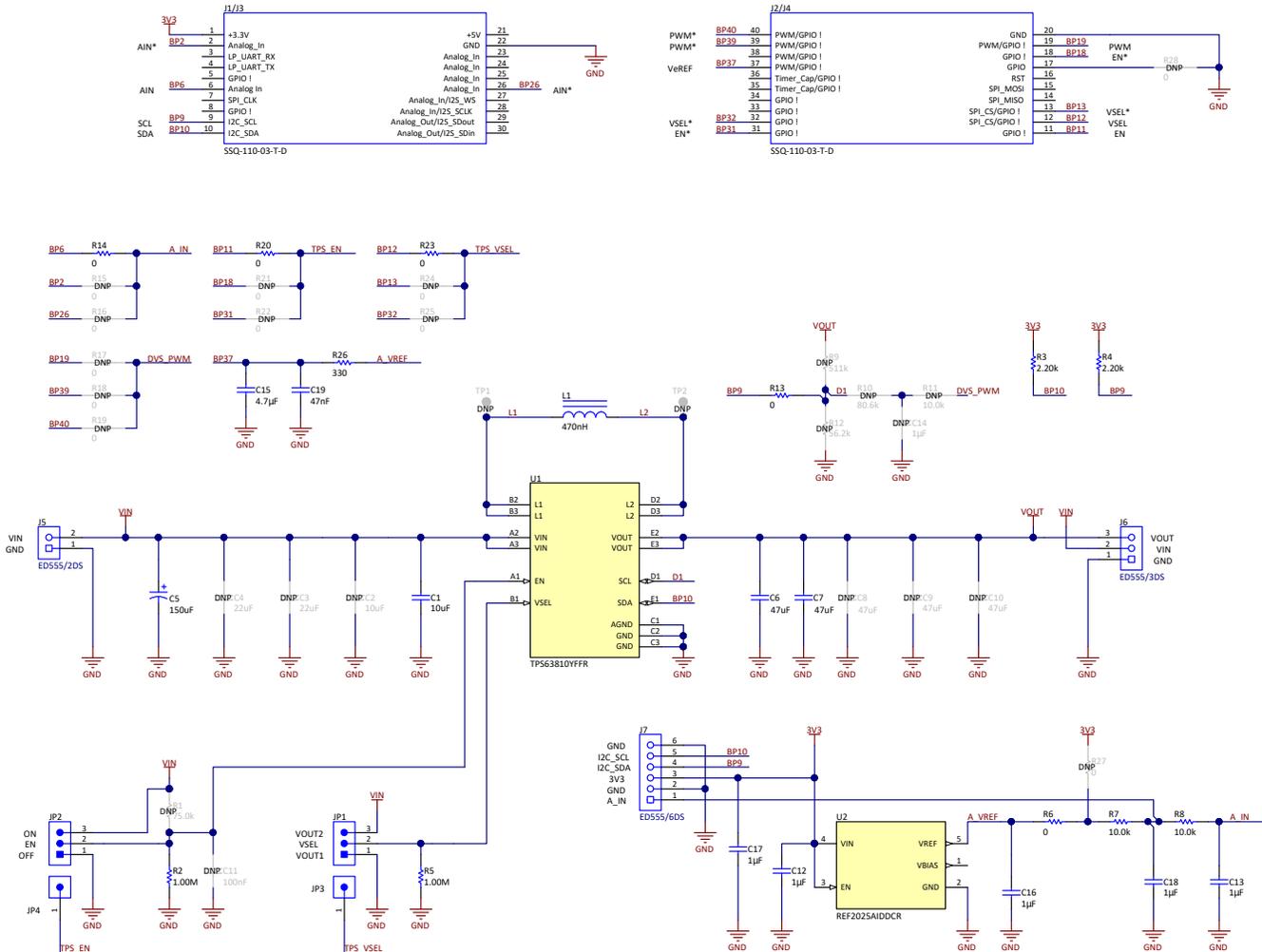


Figure 8-4. BOOSTXL-TECDRV Schematic

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