

C2000 LED BoosterPack

User's Guide



Literature Number: SPRUHH9
July 2012

1	C2000™ LED BoosterPack Overview	4
1.1	Overview	4
2	Getting Familiar With the Kit	5
2.1	Kit Contents	5
2.2	Kit Specifications	5
3	Hardware Overview	5
3.1	Subsystems	6
3.2	Powering the Board	7
3.3	Boot Modes	8
4	Getting Started	8
4.1	PC GUI Demo	8
4.2	Capacitive Touch Demo	10
5	Hardware Resource Mapping	12
5.1	Resource Allocation	12
5.2	Jumpers, Connectors, and Switches	13

List of Figures

1	LED BoosterPack (BOOSTXL-C2KLED)	4
2	Lighting System Topology	5
3	LED BoosterPack Circuit Diagram.....	6
4	LED BoosterPack Subsystem Locations	7
5	LED BoosterPack GUI	9
6	GUI Setup Connections Window	10
7	LED BoosterPack With C2000 LaunchPad and MSP430 Capacitive Touch BoosterPack	11
8	LED BoosterPack Circuit Diagram	13
9	LED BoosterPack Jumper, Connector, and Switch Locations.....	14

List of Tables

1	Boot Options	8
2	PWM and ADC Resource Allocation.....	12
3	Description of Jumpers, Connectors, and Switches	13

C2000 LED BoosterPack

1 C2000™ LED BoosterPack Overview

1.1 Overview

The LED BoosterPack is an add-on board designed to fit the C2000 LaunchPad and the other 40-pin based LaunchPads. This BoosterPack provides users with a way to accurately control a series of LED strings while efficiently controlling the power stages needed to make the LEDs work. This user's guide discusses the LED BoosterPack kit contents, the board hardware details, and also explains the functions and locations of jumpers and connectors present on the board. Step-by-step instructions for two demo examples are also included.

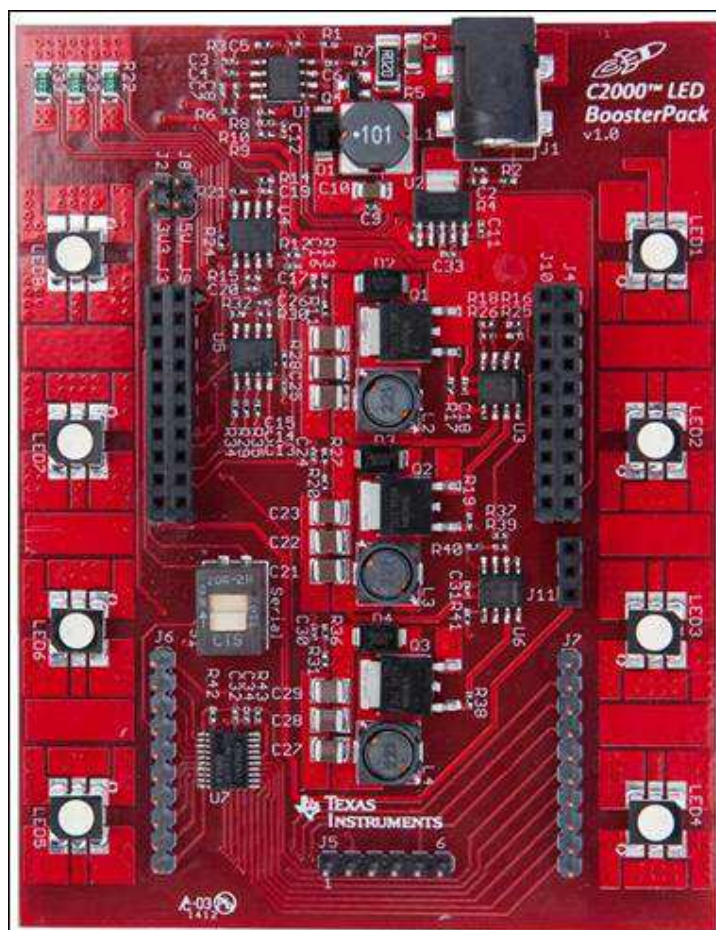


Figure 1. LED BoosterPack (BOOSTXL-C2KLED)

C2000, LaunchPad, controlSUITE, Code Composer Studio are trademarks of Texas Instruments. Microsoft is a registered trademark of Microsoft Corporation in the United States and/or other countries. All other trademarks are the property of their respective owners.

2 Getting Familiar With the Kit

2.1 Kit Contents

The kit consists of:

- LED BoosterPack
- AC/DC Power Adapter (12 V 1A)
- Quick Start Guide

2.2 Kit Specifications

The LED BoosterPack has the following specifications:

- Power Input:
 - 6 V minimum @ 1.2A
 - 20 V maximum @ 360 mA
- Boost Stages (each):
 - Input
 - 6 V minimum @ 400 mA
 - 20 V maximum @ 120 mA
 - Output
 - 24 V nominal @ 100 mA

3 Hardware Overview

[Figure 2](#) illustrates a LED lighting system running from DC power.

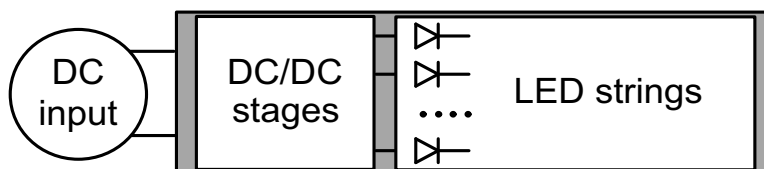


Figure 2. Lighting System Topology

There are multiple ways of controlling LEDs. This board uses the C2000 devices to control a separate DC supply for each of the LED strings. Brightness control is accomplished using the C2000 devices by independently varying the output power of each DC/DC stage. This allows the user to control the average current passing through each LED string. Since average current is roughly proportional to lumen output, each LED string's brightness is controlled. [Figure 3](#) shows the circuit diagram for the LED BoosterPack.



- **Power Supplies** – Power is supplied to the board via a 12 V AC/DC wall adapter. This power is stepped down using the Buck regulator to generate 5 V. The 5 V is used to power a 3.3 V LDO that supplies power to the 3.3 V device present on the BoosterPack. Both the 3.3 V and 5 V power domains can be selectively jumpered (via J2 and J8, respectively) to supply power to the LaunchPadXL headers.
- **Boost Converters** – Boost converters are used to step up the 12 V input voltage to a voltage high enough to forward bias the LEDs. The boost converters are driven by the EPWM peripheral present on the F28027 device on the C2000 LaunchPad™.
- **Current Feedback** – Shunt resistors at the base of each LED string are used to convert the LED current into a voltage that can be measured. The voltage from the sense resistors is passed to a set of op-amps to amplify and filter the current feedback signal. They also serve the purpose of driving the analog-to-digital converter (ADC) inputs.
- **MSP430 Capacitive Touch** – The LED BoosterPack includes an MSP430 device and headers such that a Capacitive Touch BoosterPack can be plugged into the LED BoosterPack and used to control the LEDs. Switch S1 can be used to connect or disconnect the MSP430's serial peripheral to the F28027 device's serial peripheral present on the C2000 LaunchPad. If the user wishes to use the capacitive touch demo, ensure S1 is in the up position while S4 on the LaunchPad is in the down position.
 - Advanced users can reprogram the MSP430 present on the LED BoosterPack by using J5.

Figure 4 illustrates the position of these subsystems on the board. The use of a subsystem approach, for different power stages, enables easy debug and testing of one stage at a time.

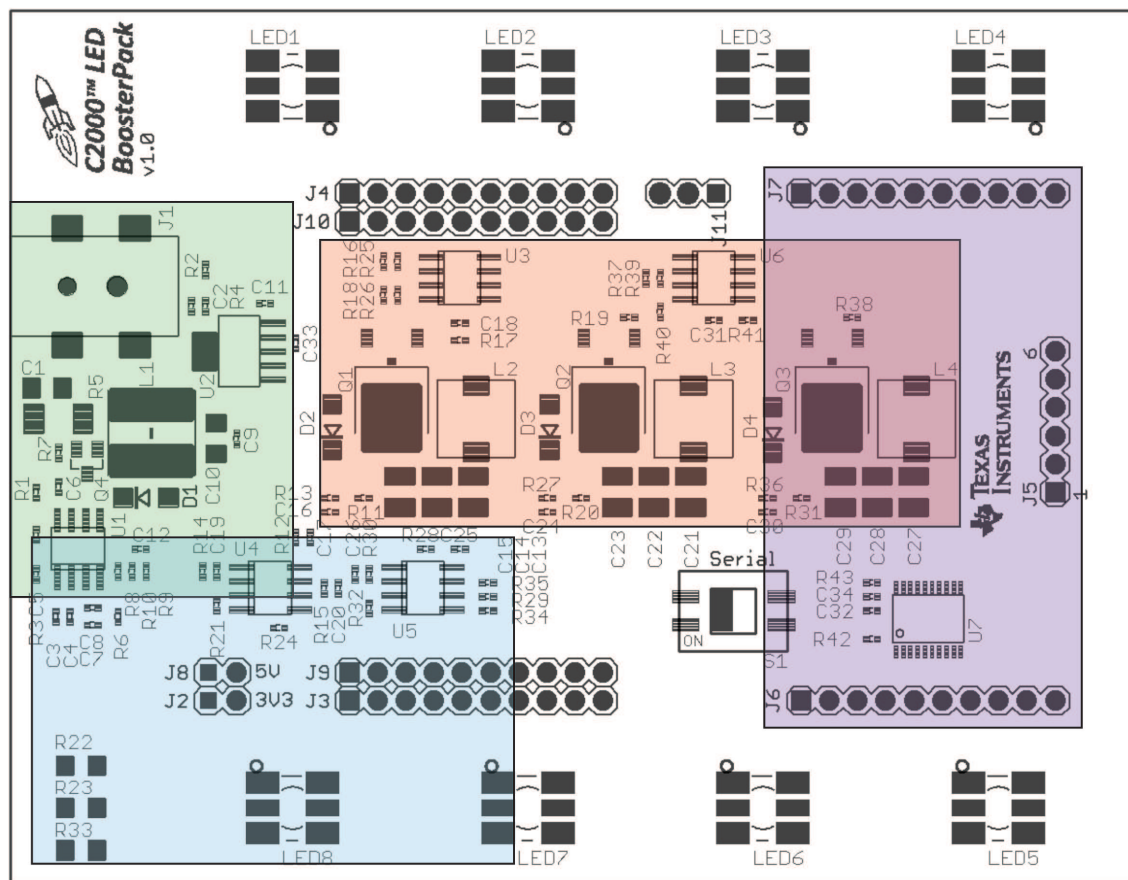


Figure 4. LED BoosterPack Subsystem Locations

3.2 Powering the Board

The LED BoosterPack has three separate power domains and two major modes of operation: two power domains are the primary power rails that feeds the three DC/DC power stages and the auxiliary power supply rails that power all of the support chips, and is used to power the LaunchPad. The question of which mode of operation should be used depends on whether the board is being used for evaluation or for experimentation.

- Non-Isolated – Used to quickly show how the boards function with the supplied firmware. Power for the LaunchPad is supplied via the USB. Power for the LED BoosterPack is supplied via the included 12 V AC/DC adapter. With this configuration, your PC's USB port is connected to the same ground as both the LaunchPad and LED BoosterPack.
 - Jumpers JP1, JP2, and JP3 on the LaunchPad should have jumpers placed on each post.
 - Jumpers J2 and J8 on the LED BoosterPack should NOT have jumpers placed on each post.
 - Connect the USB to the LaunchPad.
 - Connect the included power adapter to the LED BoosterPacks' J1.

- Isolated/Standalone – Used to protect the host PC while debugging the application, which may present dangerous voltages to a PC or when the user wants to run a standalone application with a single supply. Power for the entire system (both LaunchPad and LED BoosterPack) is supplied from the 12 V AC/DC wall adapter. The USB can be optionally connected if the user wants to debug the application; in this case, power for the emulator is supplied via USB. This mode provides the user with 2500 Vrms of isolation to protect the computer in the event that dangerous transient voltages are present on the board.
 - Jumpers JP1, JP2, and JP3 on the LaunchPad should NOT have jumpers placed on each post.
 - Jumpers J2 and J8 on the LED BoosterPack should have jumpers placed on each post.
 - Connect the USB (optional, only used for debugging) to the LaunchPad.
 - Connect the included power adapter to the LED BoosterPacks' J1.

3.3 Boot Modes

Table 1 describes the switch settings that are needed for emulation boots as well as booting from FLASH or SCI for the board.

Table 1. Boot Options

	Emulation Boot	Boot From FLASH	Boot From SCI
F2802x	SW1 on LaunchPad Position 1 = up Position 2 = up Position 3 = up	SW1 on LaunchPad Position 1 = up Position 2 = up Position 3 = down	SW1 on LaunchPad Position 1 = up Position 2 = down Position 3 = down

4 Getting Started

4.1 PC GUI Demo

The LED BoosterPack experimenter's kit comes with a GUI that provides a convenient way to evaluate the functionality of this kit and the F28027 device without having to learn and configure the underlying project software. The interactive interface using sliders, buttons, and textboxes allows LED lighting with the C2000 device to be demonstrated quickly and easily.

4.1.1 Hardware Setup for PC GUI Demo

Perform or verify the following steps to prepare the LED BoosterPack for use with the included GUI:

1. Verify the following jumper and switch settings on the LED BoosterPack.
 - (a) A jumper is not placed on J2.
 - (b) A jumper is not placed on J8.
 - (c) The switch S1 is in the down position.
2. Verify the following jumper and switch settings on the C2000 LaunchPad:
 - (a) A jumper is placed on JP1.
 - (b) A jumper is placed on JP2.
 - (c) A jumper is placed on JP3.
 - (d) Switches in S1 are all in the up position.
 - (e) The switch S4 is in the up position.
3. Insert a C2000 LaunchPad into the header marked J3, J9 and J4, J10.
4. Connect the LED BoosterPack to the included power adapter and plug in the adapter to the mains power.
5. Connect the LaunchPad to the PC using the USB cable included with the C2000 LaunchPad.

4.1.2 Software Setup for PC GUI Demo

The GUI for evaluating this kit is named *LED_BOOST_PC_GUI.exe* and can be found in the C2000 LaunchPad controlSUITE™ package. This GUI is all the software necessary to do a quick evaluation of this kit. To explore deeper, the underlying reference software can be found within controlSUITE.

NOTE: The GUI requires Microsoft® .NET framework 3.0 to run. Please ensure that this software is installed prior to running this program.

If this demo is being used on a computer that uses a decimal comma, the regional settings of the computer may need to be changed to English for this demo to run correctly.

Follow these instructions to run the GUI included with the LED BoosterPack:

1. Start Code Composer Studio™ version 5.
2. In TI Resource Explorer, look for an entry called controlSUITE and expand the Development Tools section.
3. Expand the entry for *BOOSTXL-C2KLED* and look for the PC GUI application project. Follow the steps in the right pane of Resource Explorer to import, compile, program, and run the embedded half of this example.
4. Browse to and run the *LED_BOOST_PC_GUI.exe* GUI. The program shown in Figure 5 should appear. This executable resides next to the embedded example application in Resource Explorer.

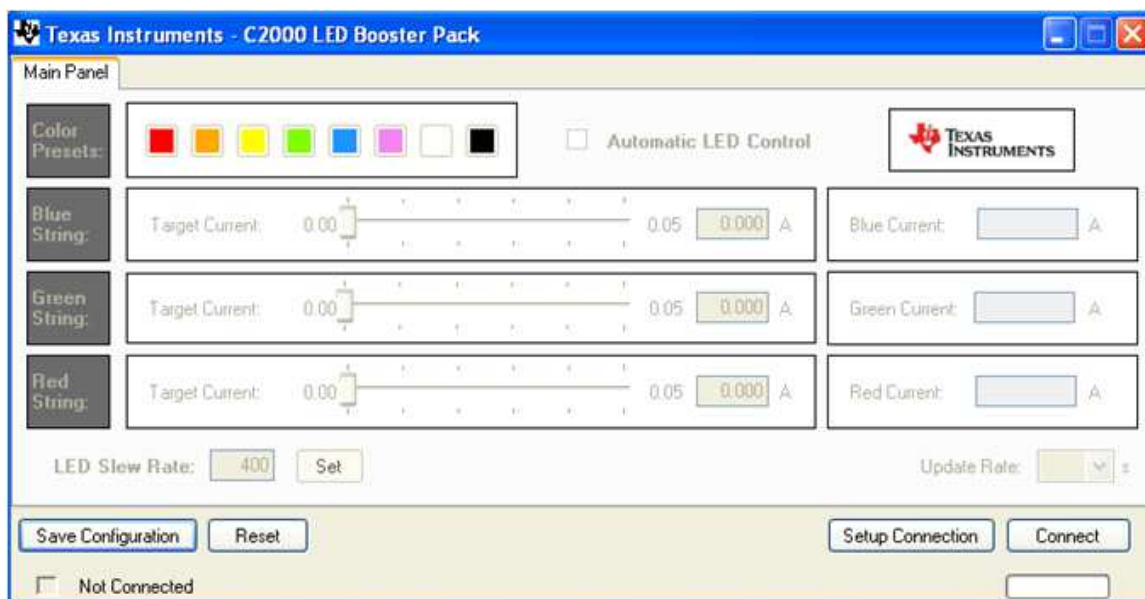


Figure 5. LED BoosterPack GUI

5. Click Setup Connection and make sure the baud rate is set to 57600 and that the Boot on Connect box is unchecked.

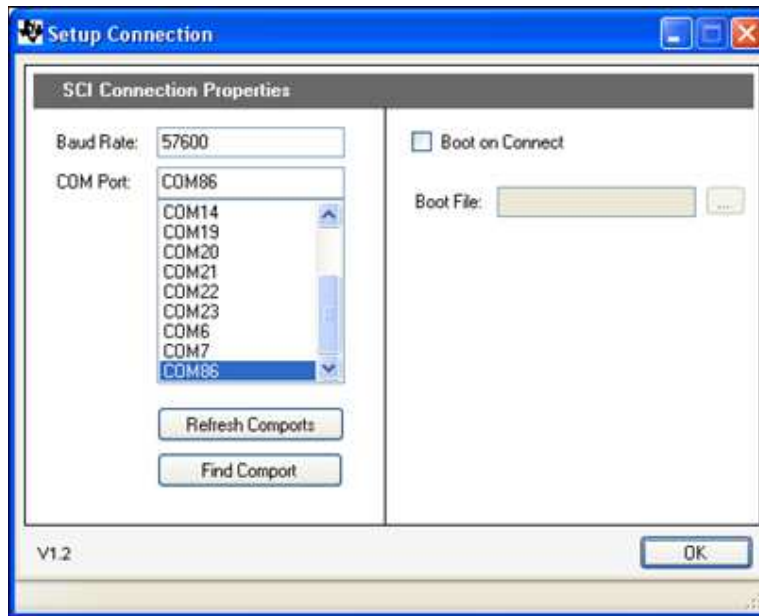


Figure 6. GUI Setup Connections Window

6. Select the serial COM port. This can be found by going to:
Control Panel → System → Hardware tab → Device Manager → Ports(COM and LPT)
Look for the COM port that is named USB Serial Port (or similar) and note the number. Select this COM port in the Setup Connection window and click OK to close the window. Hint: Try selecting the largest number or refreshing the list while connecting or disconnecting the USB cable to or from the board to see which one changes.
7. Click Connect in the GUI main window. The status bar at the bottom left corner of the GUI turns green and says Connected once the GUI is connected.
8. Use the Color Presets provided or manually adjust the current level for each LED string to vary the color generated by each LED array.
9. When finished, set each LED string's Target Current to 0.00A and press Disconnect to terminate the connection.

4.2 Capacitive Touch Demo

The LED BoosterPack experimenter's kit comes with an MSP430 device and headers such that a user can connect the Capacitive Touch BoosterPack and use it to control the LEDs. This interface is meant to demonstrate how an OEM lighting company might implement touch-based control of LED lighting applications.

No external hardware is required to run this demo, which makes it a great demo to show when one is away from a PC. To explore deeper, the underlying reference software can be found within controlSUITE.

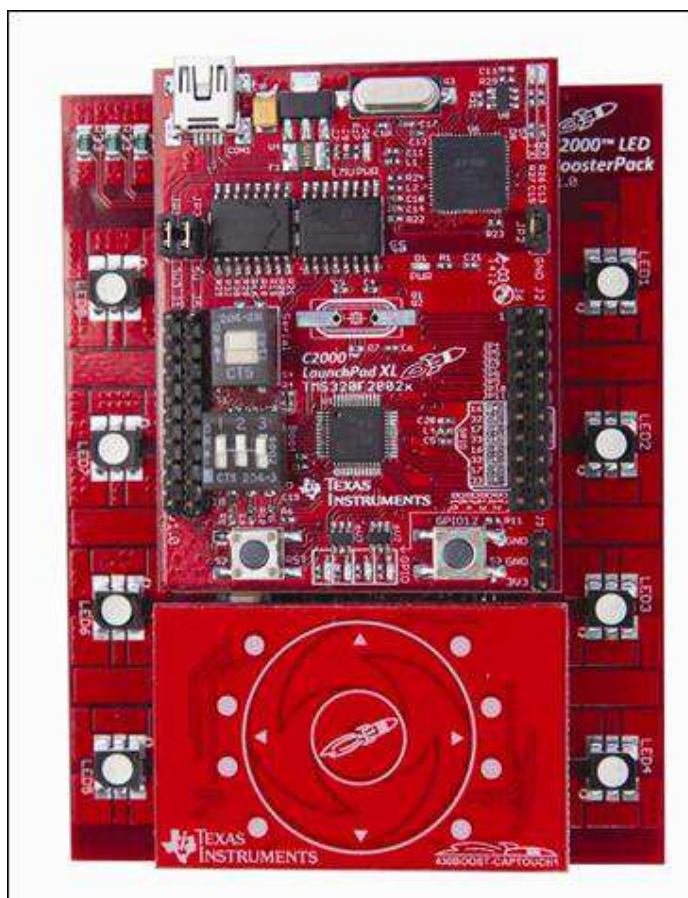


Figure 7. LED BoosterPack With C2000 LaunchPad and MSP430 Capacitive Touch BoosterPack

4.2.1 Hardware Setup for Capacitive Touch Demo

Perform or verify the following steps to prepare the LED BoosterPack for use with the MSP430 Capacitive Touch BoosterPack.

1. Verify the following jumper and switch settings on the LED BoosterPack:
 - (a) A jumper is not placed on J2.
 - (b) A jumper is not placed on J8.
 - (c) The switch S1 is in the up position.
2. Verify the following jumper and switch settings on the C2000 LaunchPad:
 - (a) A jumper is placed on JP1.
 - (b) A jumper is placed on JP2.
 - (c) A jumper is placed on JP3.
 - (d) Switches in S1 are all in the up position.
 - (e) The switch S4 is in the down position.
3. Insert a C2000 LaunchPad into the header marked J3, J9 and J4, J10 on the LED BoosterPack.
4. Insert an MSP430 Capacitive Touch BoosterPack onto the headers marked J6 and J7.
5. Connect the LED BoosterPack to the included power adapter and plug in the adapter to the mains power.
6. Connect the LaunchPad to the PC using the USB cable included with the C2000 LaunchPad.

4.2.2 Software Setup for Capacitive Touch Demo

1. Start Code Composer Studio version 5.
2. In the TI Resource Explorer, look for an entry called controlSUITE and expand the Development Tools section.
3. Expand the entry for *BOOSTXL-C2KLED* and look for the capacitive touch demo application project. Follow the steps in the right pane of Resource Explorer to import, compile, program, and run the example.
4. After the example is running, the LEDs can be controlled as follows:
 - (a) Press the Center button twice to initially turn the LEDs ON.
 - (b) Spinning one's finger around the touch wheel, while the LEDs are ON, cycles through the color spectrum.
 - (c) Pressing the Center button again turns the LEDs OFF.
 - (d) Subsequent (single) presses of the Center button turns the LEDs ON or OFF.

5 Hardware Resource Mapping

5.1 Resource Allocation

[Figure 8](#) shows the various stages of the board in a circuit diagram format and illustrates the major connections and feedback values being mapped to the C2000 MCU. [Table 2](#) lists these resources. For more detailed information, see the schematics and the device-specific data sheets.

Table 2. PWM and ADC Resource Allocation

Net Name	PWM/ADC Channel	Description
VDCIN	ADC-B6	Input voltage sense
PWM-1A	PWM-1A	Boost 1 PWM signal
PWM-1B	PWM-1B	Boost 2 PWM signal
VBLUE	ADC-B1	Boost 1 output voltage sense
VGREEN	ADC-B2	Boost 2 output voltage sense
IBLUE	ADC-A2	Boost 1 output current sense
IGREEN	ADC-A1	Boost 2 output current sense
PWM-2A	PWM-2A	Boost 3 PWM signal
VRED	ADC-B4	Boost 3 output voltage sense
IRED	ADC-A6	Boost 3 output current sense

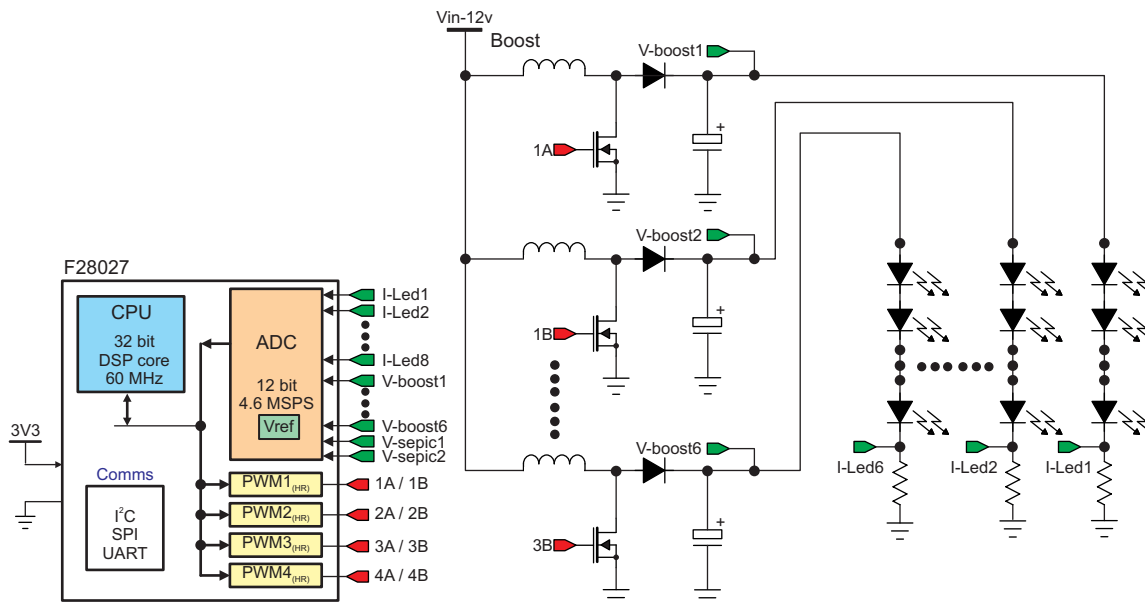


Figure 8. LED BoosterPack Circuit Diagram

5.2 Jumpers, Connectors, and Switches

Table 3 lists the jumpers, connectors, and switches available on the board. Figure 9 shows the location of these items with help of a board image.

Table 3. Description of Jumpers, Connectors, and Switches

J1	Barrel Jack for main power connection (6 V-48 V)
J2	Jumper to connect BoosterPack 3.3 V to LaunchPad Headers
J8	Jumper to connect BoosterPack 5 V to LaunchPad Headers
J3, J9 and J4, J10 and J11	LaunchPadXL Socket
J6 and J7	Capacitive Touch BoosterPack Headers
S1	MSP430 Serial Disconnect Switch
J5	MSP430 Programming Header

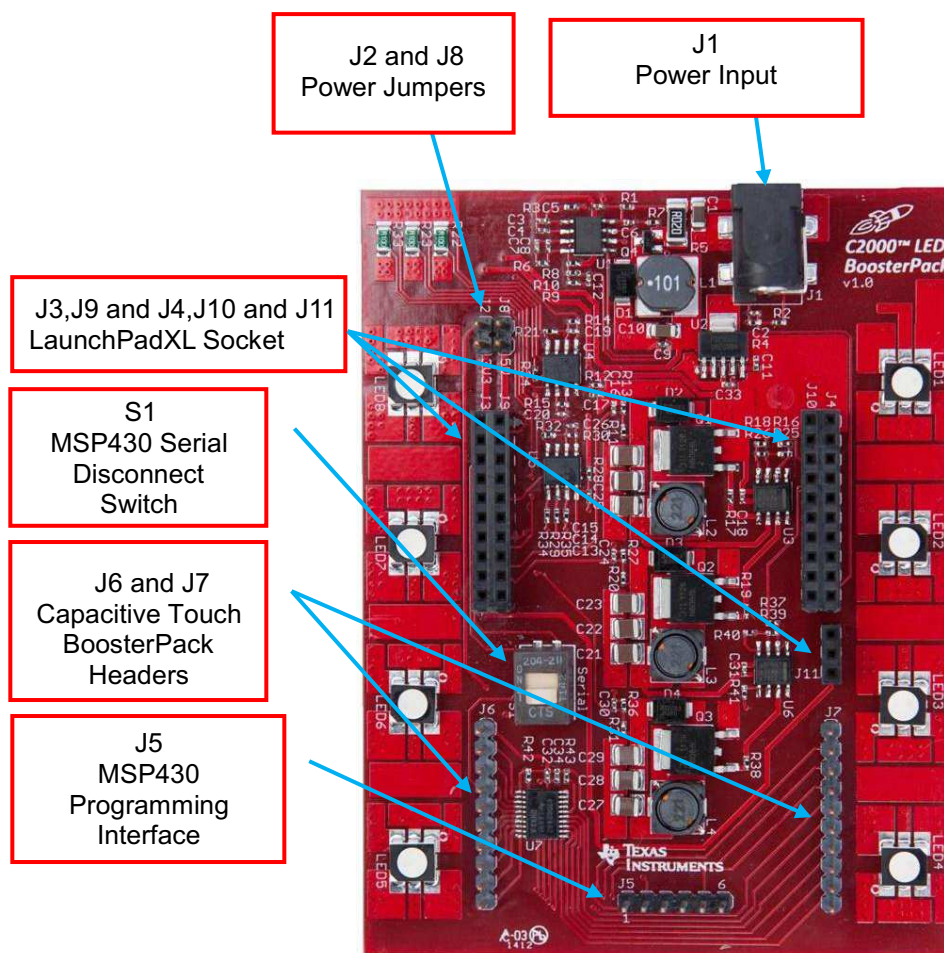


Figure 9. LED BoosterPack Jumper, Connector, and Switch Locations

EVALUATION BOARD/KIT/MODULE (EVM) ADDITIONAL TERMS

Texas Instruments (TI) provides the enclosed Evaluation Board/Kit/Module (EVM) under the following conditions:

The user assumes all responsibility and liability for proper and safe handling of the goods. Further, the user indemnifies TI from all claims arising from the handling or use of the goods.

Should this evaluation board/kit not meet the specifications indicated in the User's Guide, the board/kit may be returned within 30 days from the date of delivery for a full refund. THE FOREGOING LIMITED WARRANTY IS THE EXCLUSIVE WARRANTY MADE BY SELLER TO BUYER AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED, IMPLIED, OR STATUTORY, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE. EXCEPT TO THE EXTENT OF THE INDEMNITY SET FORTH ABOVE, NEITHER PARTY SHALL BE LIABLE TO THE OTHER FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES.

Please read the User's Guide and, specifically, the Warnings and Restrictions notice in the User's Guide prior to handling the product. This notice contains important safety information about temperatures and voltages. For additional information on TI's environmental and/or safety programs, please visit www.ti.com/esh or contact TI.

No license is granted under any patent right or other intellectual property right of TI covering or relating to any machine, process, or combination in which such TI products or services might be or are used. TI currently deals with a variety of customers for products, and therefore our arrangement with the user is not exclusive. TI assumes no liability for applications assistance, customer product design, software performance, or infringement of patents or services described herein.

REGULATORY COMPLIANCE INFORMATION

As noted in the EVM User's Guide and/or EVM itself, this EVM and/or accompanying hardware may or may not be subject to the Federal Communications Commission (FCC) and Industry Canada (IC) rules.

For EVMs **not** subject to the above rules, this evaluation board/kit/module is intended for use for ENGINEERING DEVELOPMENT, DEMONSTRATION OR EVALUATION PURPOSES ONLY and is not considered by TI to be a finished end product fit for general consumer use. It generates, uses, and can radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to part 15 of FCC or ICES-003 rules, which are designed to provide reasonable protection against radio frequency interference. Operation of the equipment may cause interference with radio communications, in which case the user at his own expense will be required to take whatever measures may be required to correct this interference.

General Statement for EVMs including a radio

User Power/Frequency Use Obligations: This radio is intended for development/professional use only in legally allocated frequency and power limits. Any use of radio frequencies and/or power availability of this EVM and its development application(s) must comply with local laws governing radio spectrum allocation and power limits for this evaluation module. It is the user's sole responsibility to only operate this radio in legally acceptable frequency space and within legally mandated power limitations. Any exceptions to this are strictly prohibited and unauthorized by Texas Instruments unless user has obtained appropriate experimental/development licenses from local regulatory authorities, which is responsibility of user including its acceptable authorization.

For EVMs annotated as FCC – FEDERAL COMMUNICATIONS COMMISSION Part 15 Compliant

Caution

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

FCC Interference Statement for Class A EVM devices

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

FCC Interference Statement for Class B EVM devices

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

For EVMs annotated as IC – INDUSTRY CANADA Compliant

This Class A or B digital apparatus complies with Canadian ICES-003.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Concerning EVMs including radio transmitters

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Concerning EVMs including detachable antennas

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.

This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Cet appareil numérique de la classe A ou B est conforme à la norme NMB-003 du Canada.

Les changements ou les modifications pas expressément approuvés par la partie responsable de la conformité ont pu vider l'autorité de l'utilisateur pour actionner l'équipement.

Concernant les EVMs avec appareils radio

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Concernant les EVMs avec antennes détachables

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante.

Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans le manuel d'usage et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.

【Important Notice for Users of this Product in Japan】

This development kit is NOT certified as Confirming to Technical Regulations of Radio Law of Japan

If you use this product in Japan, you are required by Radio Law of Japan to follow the instructions below with respect to this product:

1. Use this product in a shielded room or any other test facility as defined in the notification #173 issued by Ministry of Internal Affairs and Communications on March 28, 2006, based on Sub-section 1.1 of Article 6 of the Ministry's Rule for Enforcement of Radio Law of Japan,
2. Use this product only after you obtained the license of Test Radio Station as provided in Radio Law of Japan with respect to this product, or
3. Use of this product only after you obtained the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to this product. Also, please do not transfer this product, unless you give the same notice above to the transferee. Please note that if you could not follow the instructions above, you will be subject to penalties of Radio Law of Japan.

Texas Instruments Japan Limited
(address) 24-1, Nishi-Shinjuku 6 chome, Shinjuku-ku, Tokyo, Japan

<http://www.tij.co.jp>

【ご使用にあたっての注】

本開発キットは技術基準適合証明を受けておりません。

本製品のご使用に際しては、電波法遵守のため、以下のいずれかの措置を取っていただく必要がありますのでご注意ください。

1. 電波法施行規則第6条第1項第1号に基づく平成18年3月28日総務省告示第173号で定められた電波暗室等の試験設備でご使用いただく。
2. 実験局の免許を取得後ご使用いただく。
3. 技術基準適合証明を取得後ご使用いただく。

なお、本製品は、上記の「ご使用にあたっての注意」を譲渡先、移転先に通知しない限り、譲渡、移転できないものとします。

上記を遵守頂けない場合は、電波法の罰則が適用される可能性があることをご留意ください。

日本テキサス・インスツルメンツ株式会社

東京都新宿区西新宿 6 丁目 2 4 番 1 号

西新宿三井ビル

<http://www.tij.co.jp>

EVALUATION BOARD/KIT/MODULE (EVM) WARNINGS, RESTRICTIONS AND DISCLAIMERS

For Feasibility Evaluation Only, in Laboratory/Development Environments. Unless otherwise indicated, this EVM is not a finished electrical equipment and not intended for consumer use. It is intended solely for use for preliminary feasibility evaluation in laboratory/development environments by technically qualified electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems and subsystems. It should not be used as all or part of a finished end product.

Your Sole Responsibility and Risk. You acknowledge, represent and agree that:

1. You have unique knowledge concerning Federal, State and local regulatory requirements (including but not limited to Food and Drug Administration regulations, if applicable) which relate to your products and which relate to your use (and/or that of your employees, affiliates, contractors or designees) of the EVM for evaluation, testing and other purposes.
2. You have full and exclusive responsibility to assure the safety and compliance of your products with all such laws and other applicable regulatory requirements, and also to assure the safety of any activities to be conducted by you and/or your employees, affiliates, contractors or designees, using the EVM. Further, you are responsible to assure that any interfaces (electronic and/or mechanical) between the EVM and any human body are designed with suitable isolation and means to safely limit accessible leakage currents to minimize the risk of electrical shock hazard.
3. You will employ reasonable safeguards to ensure that your use of the EVM will not result in any property damage, injury or death, even if the EVM should fail to perform as described or expected.
4. You will take care of proper disposal and recycling of the EVM's electronic components and packing materials.

Certain Instructions. It is important to operate this EVM within TI's recommended specifications and environmental considerations per the user guidelines. Exceeding the specified EVM ratings (including but not limited to input and output voltage, current, power, and environmental ranges) may cause property damage, personal injury or death. If there are questions concerning these ratings please contact a TI field representative prior to connecting interface electronics including input power and intended loads. Any loads applied outside of the specified output range may result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the EVM User's Guide prior to connecting any load to the EVM output. If there is uncertainty as to the load specification, please contact a TI field representative. During normal operation, some circuit components may have case temperatures greater than 60°C as long as the input and output are maintained at a normal ambient operating temperature. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors which can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during normal operation, please be aware that these devices may be very warm to the touch. As with all electronic evaluation tools, only qualified personnel knowledgeable in electronic measurement and diagnostics normally found in development environments should use these EVMs.

Agreement to Defend, Indemnify and Hold Harmless. You agree to defend, indemnify and hold TI, its licensors and their representatives harmless from and against any and all claims, damages, losses, expenses, costs and liabilities (collectively, "Claims") arising out of or in connection with any use of the EVM that is not in accordance with the terms of the agreement. This obligation shall apply whether Claims arise under law of tort or contract or any other legal theory, and even if the EVM fails to perform as described or expected.

Safety-Critical or Life-Critical Applications. If you intend to evaluate the components for possible use in safety critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, such as devices which are classified as FDA Class III or similar classification, then you must specifically notify TI of such intent and enter into a separate Assurance and Indemnity Agreement.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2012, Texas Instruments Incorporated

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as "components") are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI's terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers' products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers' products and applications, Buyers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI's goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or "enhanced plastic" are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have **not** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components which meet ISO/TS16949 requirements, mainly for automotive use. Components which have not been so designated are neither designed nor intended for automotive use; and TI will not be responsible for any failure of such components to meet such requirements.

Products

Audio	www.ti.com/audio
Amplifiers	amplifier.ti.com
Data Converters	dataconverter.ti.com
DLP® Products	www.dlp.com
DSP	dsp.ti.com
Clocks and Timers	www.ti.com/clocks
Interface	interface.ti.com
Logic	logic.ti.com
Power Mgmt	power.ti.com
Microcontrollers	microcontroller.ti.com
RFID	www.ti-rfid.com
OMAP Applications Processors	www.ti.com/omap
Wireless Connectivity	www.ti.com/wirelessconnectivity

Applications

Automotive and Transportation	www.ti.com/automotive
Communications and Telecom	www.ti.com/communications
Computers and Peripherals	www.ti.com/computers
Consumer Electronics	www.ti.com/consumer-apps
Energy and Lighting	www.ti.com/energy
Industrial	www.ti.com/industrial
Medical	www.ti.com/medical
Security	www.ti.com/security
Space, Avionics and Defense	www.ti.com/space-avionics-defense
Video and Imaging	www.ti.com/video

TI E2E Community

e2e.ti.com