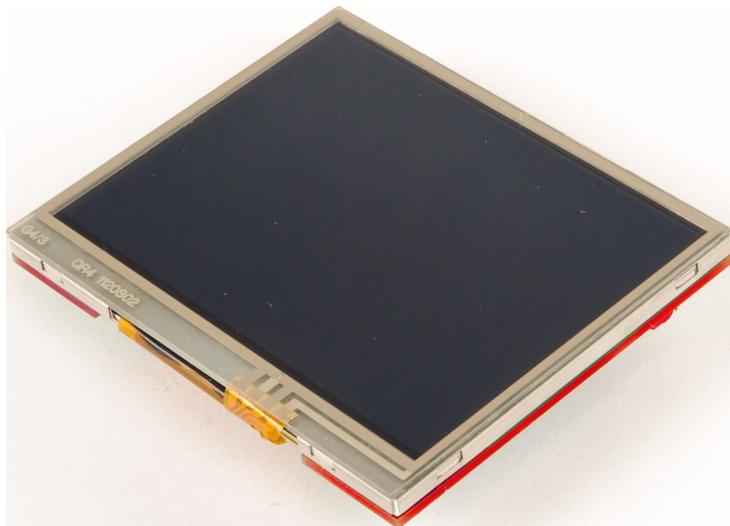


# **BOOSTXL-K350QVG-S1 QVGA Display BoosterPack™ Plug-in Module**

The BOOSTXL-K350QVG-S1 Kentec QVGA Display BoosterPack™ is an easy-to-use plug-in module for adding a touch-screen color display to your LaunchPad™ design. MCU LaunchPad developers can use this BoosterPack to start developing applications using the 320×240-pixel SPI-controlled QVGA display with resistive touch screen.



**Figure 1. BOOSTXL-K350QVG-S1 BoosterPack**

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## 1 Getting Started

### 1.1 Introduction

The BOOSTXL-K350QVG-S1 Kentec QVGA Display BoosterPack is an easy-to-use plug-in module for adding a touch-screen color display to your LaunchPad kit design. MCU LaunchPad developers can use this BoosterPack to start developing applications using the 320x240-pixel SPI-controlled TFT QVGA display with resistive touch screen.

### 1.2 Key Features

- Kentec TFT LCD (part number: K350QVG-V2-F)
  - 3.5-inch QVGA (320x240 resolution)
  - SPI communication
  - 4-wire resistive touch screen
  - White LED backlight
- LED backlight driver circuit
- Complies with the BoosterPack standard for use with 20- and 40-pin LaunchPads

### 1.3 What's Included

#### 1.3.1 Kit Contents

- One BOOSTXL-K350QVG-S1 BoosterPack Plug-in module

#### 1.3.2 Software Examples

- MSP-EXP432P401R LaunchPad + BOOSTXL-K350QVG-S1 demos (see [Section 3](#))
  - Graphics Library Example

### 1.4 Next Steps: Looking Into the Provided Code

After the EVM features have been explored, the fun can begin. It's time to open an integrated development environment (IDE) and start looking at the code examples. [Section 3](#) describes the example projects available to make it easy to understand the provided software.

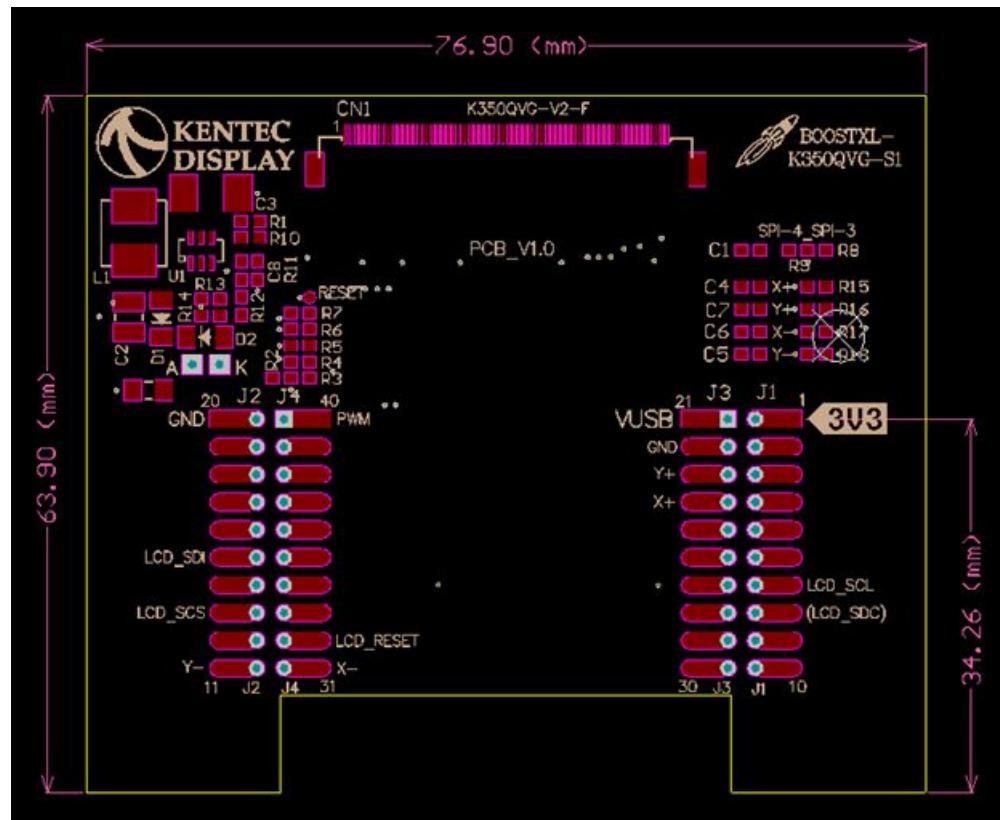
## 2 Hardware



**Figure 2. BOOSTXL-K350QVG-S1 Overview**

### 2.1 Hardware Features

#### 2.1.1 BoosterPack Pinout



**Figure 3. BoosterPack Pinout (View From Bottom of PCB)**

The Kentec QVGA Display BoosterPack adheres to the 40-pin LaunchPad and BoosterPack pinout standard. A standard was created to aid compatibility between LaunchPad and BoosterPack tools across the TI ecosystem.

The 40-pin standard is compatible with the 20-pin standard that is used by other LaunchPad kits like the [MSP-EXP430FR4133](#). However, this BoosterPack is intended for use with 40-pin LaunchPad kits. If compatibility is needed with a 20-pin LaunchPad, some modifications must be made for access to certain pins and to provide 5 V for the LCD backlight circuitry.

More information about compatibility can also be found at <http://www.ti.com/launchpad>.

### 2.1.2 Kentec QVGA Display (K350QVG-V2-F)

The Kentec TFT display has the following features:

- 3.5-inch diagonal screen
- 320x240-pixel resolution
- Full color (262000 colors) RGB display
- 4-wire resistive touch screen
- Integrated SSD2119 LCD driver/controller
- SPI interface by default, but supports many interface types

Additional information about the K350QVG-V2-F display can be found on the [Kentec website](#).

### 2.1.3 SSD2119 LCD Driver

The SSD2119 LCD driver is integrated into the display. In order to use the display effectively, a deep understanding of this driver is required. The [SSD2119 data sheet](#) contains information about the communication interface and the supported commands.

### 2.1.4 LCD Backlight Circuitry

Most of the circuitry seen on the BoosterPack is a boost converter to power the LCD backlight. The LCD requires approximately 20 V to power the LCD backlight due to the serial voltage drops of the LEDs. This power is derived from the 5-V (VUSB) power rail.

### 2.1.5 SPI Configuration

By default the BOOSTXL-K350QVG-S1 comes configured as a "4-wire" 8-bit SPI. This is the standard SPI on most MCUs with a hardware SPI peripheral. The user can reconfigure R2/R3 and R8/R9 to instead use "3-wire" 9-bit SPI. In this configuration, each SPI write is 9 bits instead of 8, allowing one fewer GPIO pin to be used.

**Table 1. SPI Resistor Configuration**

LCD Interface	Resistor Configuration			
	R2	R3	R8	R9
4-wire SPI, 8-bit (default)	DNP	0	DNP	0
3-wire SPI, 9-bit	0	DNP	0	DNP
Other (such as parallel)	Pins PS0, PS1, PS2, PS3 as indicated in LCD data sheet. This may require cutting and soldering these traces (not common)			

[Table 2](#) describes the SPI configuration pin functions.

**Table 2. SPI Pin Definition**

LCD Interface	Pin Name			
	LCD_SCS	LCD_SCL	LCD_SDI	LCD_SDC
4-wire SPI, 8-bit (default)	SPI Chip Select	SPI Clock	SPI Data In (no support for data out)	GPIO to indicate data or command Data = 1 Command = 0
3-wire SPI, 9-bit	SPI Chip Select	SPI Clock	SPI Data In (no support for data out)	N/A – controlled by extra bit (first bit)

## 2.2 Design Files

### 2.2.1 Hardware

Schematics can be found in [Section 5](#). All design files including schematics, layout, bill of materials (BOM), Gerber files, and documentation are available in a zip folder ([SLAR098](#)). This hardware design was done in Altium Designer, a free viewer is available from <http://techdocs.altium.com/display/ADOH/Altium+Designer+Viewer>.

### 2.2.2 Software

All design files including TI-TXT object-code firmware images, software example projects, and documentation are available in the LaunchPad specific software folders. To see which LaunchPad kits feature BOOSTXL-K350QVG-S1 examples, refer to the "What's Included" section on the [tool folder](#).

## 2.3 Hardware Change log

**Table 3. Hardware Change Log**

PCB Revision	Description
Rev 1.0	Initial Release

## 3 Software Examples

### 3.1 BOOSTXL-K350QVG-S1 + MSP-EXP432P401R Graphics Library Example

This software is available in the [MSP-EXP432P401R Software Examples](#) or is more easily accessible through MSPWare (see [Section 4.3](#)).

The demo shows how to use the [MSP Graphics Library](#) ("grlib") in a project with the Kentec display. This demo shows the user how to enable the touch screen, create buttons, and use graphics primitives including colors and images.

The program begins by calibrating the touch screen. There is a routine that detects the four corner coordinates to determine if an eligible rectangle boundary is formed. If the calibration was incorrect, a message displays on the screen indicating the calibration failed. When successful, the calibration provides a reference for all button presses throughout the rest of the program.

The next step is to select the mode of the program: display primitives or images. Each mode simply cycles through without user interaction to show features of the display. In the graphics primitives mode, the following primitives are shown:

- Pixels
- Lines
- Circles
- Rectangles

- Text

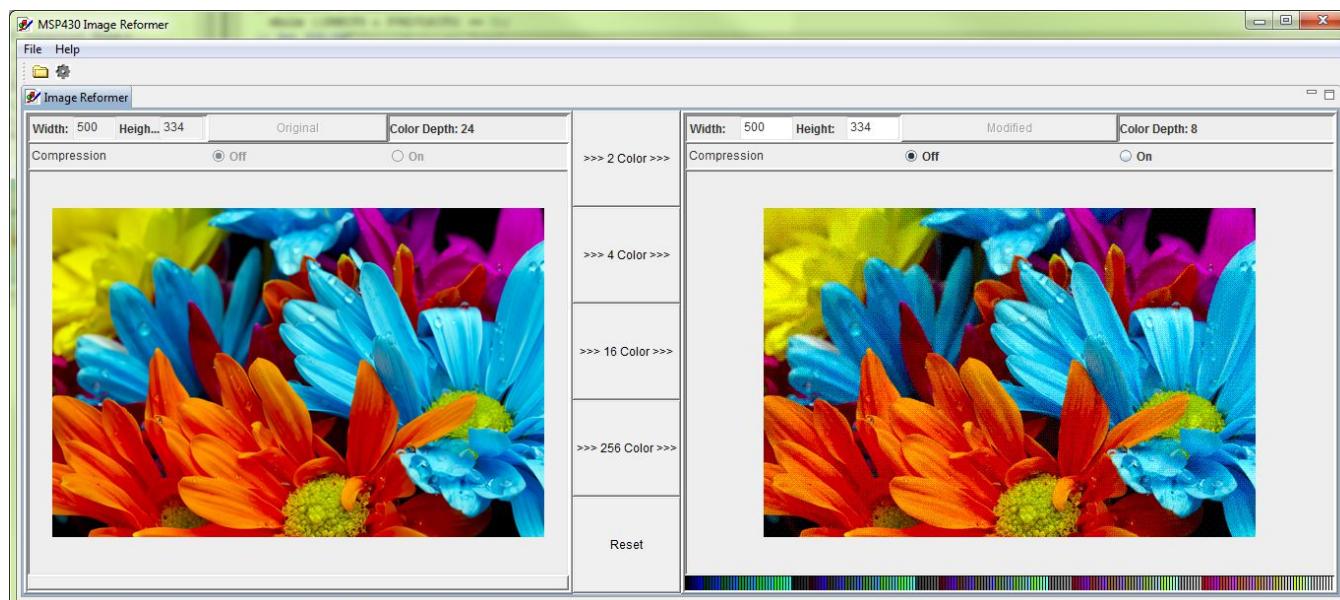
The application is heavily commented to ensure it is very clear how to use the glib APIs. The above primitives are shown as well as the underlying concepts of glib including background and foreground colors, context, fonts, opacity, and more.

The images mode shows the drawing of a few different images both compressed and uncompressed. Image compression can have a big impact to drawing speeds for simple images. To draw images with the MSP Graphics Library, they must first be converted into the right file format. These files can be generated by the Image Reformer tool that comes packaged with glib. Launch this tool (.exe) from the glib folder or directly from TI Resource Explorer.

File Path: <glib root>\utils\image-reformer\imageresformer.exe

TI Resource Explorer > MSPWare > Libraries > Graphics Library > MSP430 Image Reformer

The Image Reformer tool allows you to import images and output into glib specific files to add to your glib project. Image Reformer does not manipulate any images (including color modifications, rotation, and cropping)—any image manipulation must be done before importing into the Image Reformer tool. More information about MSP glib and the Image Reformer tool can be found in the application report *Design Considerations When Using MSP430 Graphics Library* ([SLAA548](#)).



**Figure 4. MSP430 Image Reformer**

## 4 Additional Resources

### 4.1 TI LaunchPad Portal

More information about LaunchPad kits, supported BoosterPack modules, and available resources can be found at:

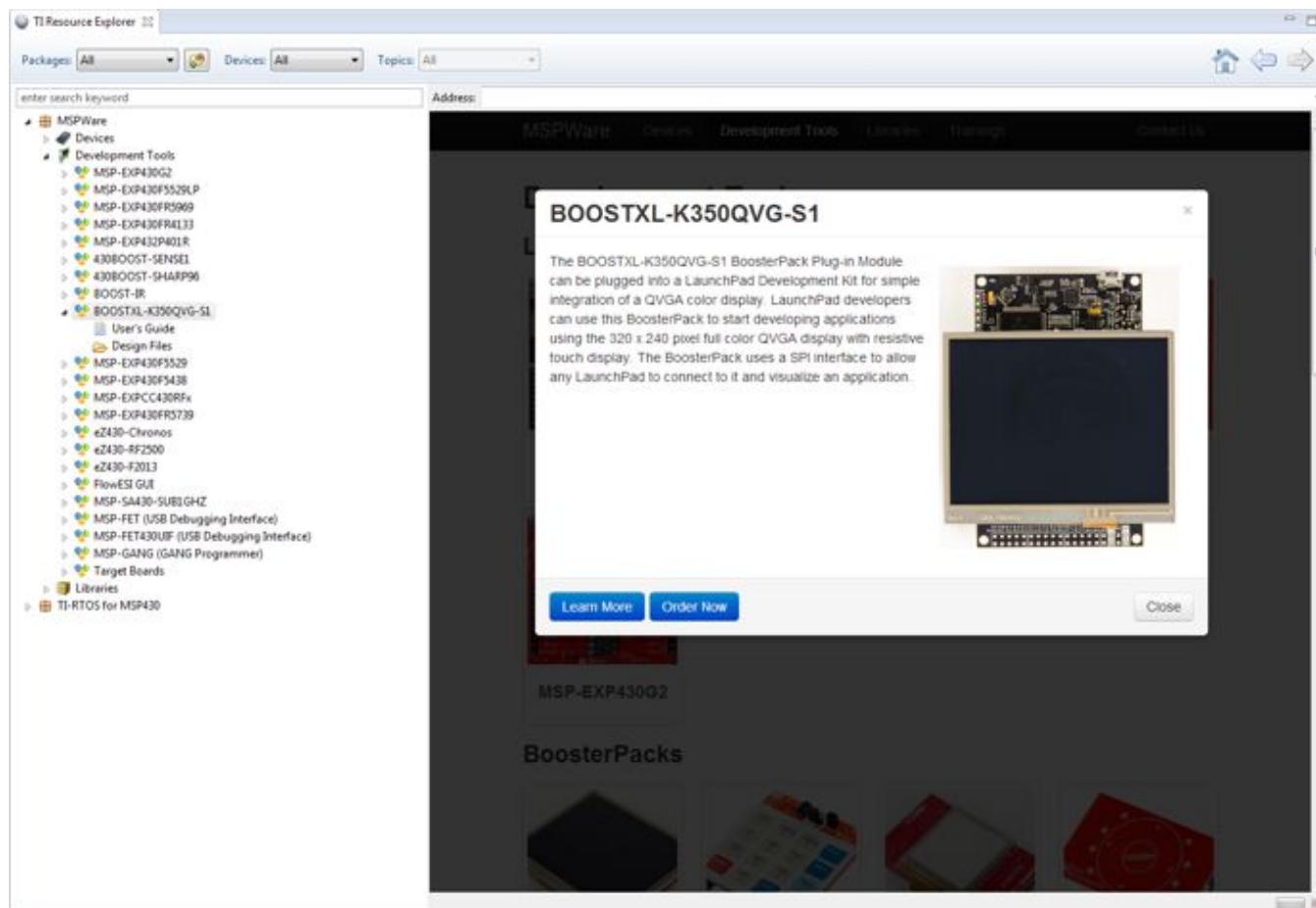
- [TI's LaunchPad portal](#): information about all LaunchPad kits from TI for all MCUs

### 4.2 Download CCS, IAR, Keil, or Energia

Although the files can be viewed with any text editor, more can be done with the projects if they are opened with a [development environment](#) like Code Composer Studio™ (CCS) IDE, IAR Embedded Workbench, Keil, or Energia.

#### 4.3 MSPWare and TI Resource Explorer

[MSPWare](#) is a complete collection of libraries and tools. It includes a driver library (driverlib), graphics library (grlib), and many other software tools. MSPWare is optionally included in a CCS installation or can be downloaded separately. IAR users must download it separately.



**Figure 5. BOOSTXL-K350QVG-S1 Software Examples in TI Resource Explorer**

Inside TI Resource Explorer, these examples and many more can be found and easily imported into CCS with one click.

#### 4.4 The Community

##### 4.4.1 TI E2E™ Community

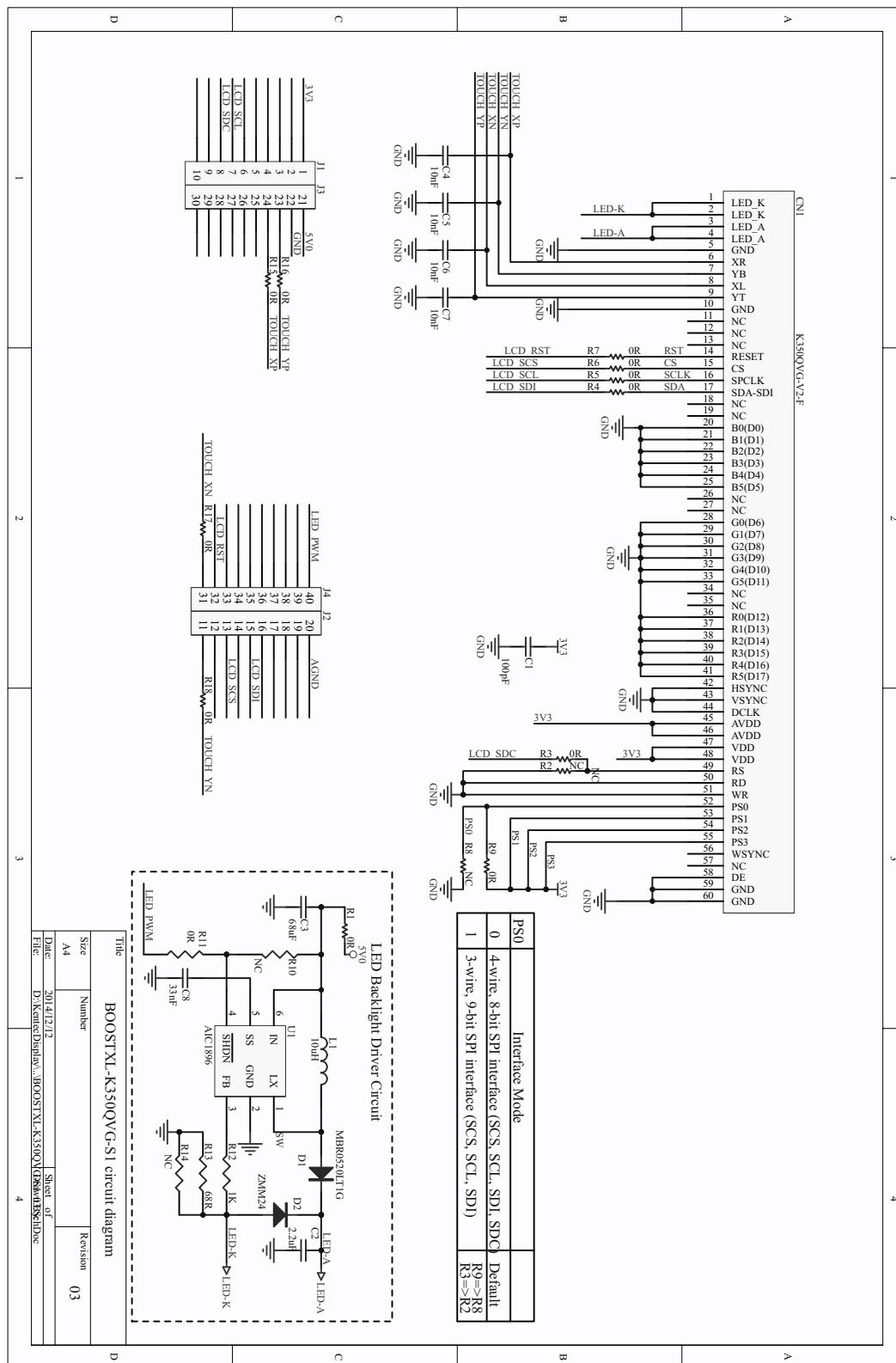
Search the forums at <http://e2e.ti.com>. If you cannot find your answer, post your question to the community.

##### 4.4.2 Community at Large

Many online communities focus on the LaunchPad and BoosterPack ecosystem – for example, [www.43oh.com](http://www.43oh.com). You can find additional tools, resources, and support from these communities.

## 5 Schematics

Hardware design files can be downloaded from [www.ti.com/lit/zip/slar098](http://www.ti.com/lit/zip/slar098).



**Figure 6. Schematics**

## Revision History

**Changes from March 19, 2015 to July 20, 2015****Page**

- Changed the link destination for the MSP-EXP432P401R Software Examples ..... 5

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

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