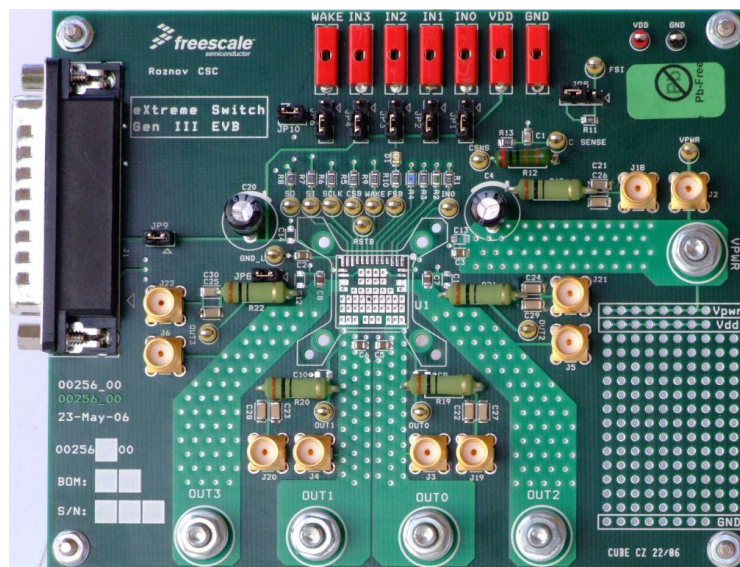


## KIT eXtreme Switch Evaluation Board



**Figure 1. Extreme Switch Evaluation Board (EVB)**

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# 1 Kit Contents / Packing List

- Assembled and tested evaluation board/module in anti-static bag.
- CD-ROM containing:
  - Supporting documentation for featured device (including data sheet and user's guide)
  - SPIGen software
- Warranty card

## 2 Important Notice

Freescale provides the enclosed product(s) under the following conditions:

This evaluation kit is intended for use of ENGINEERING DEVELOPMENT OR EVALUATION PURPOSES ONLY. It is provided as a sample IC pre-soldered to a printed circuit board to make it easier to access inputs, outputs, and supply terminals. This EVB may be used with any development system or other source of I/O signals by simply connecting it to the host MCU or computer board via off-the-shelf cables. This EVB is not a Reference Design and is not intended to represent a final design recommendation for any particular application. Final device in an application will be heavily dependent on proper printed circuit board layout and heat sinking design as well as attention to supply filtering, transient suppression, and I/O signal quality.

The goods provided may not be complete in terms of required design, marketing, and or manufacturing related protective considerations, including product safety measures typically found in the end product incorporating the goods. Due to the open construction of the product, it is the user's responsibility to take any and all appropriate precautions with regard to electrostatic discharge. In order to minimize risks associated with the customers applications, adequate design and operating safeguards must be provided by the customer to minimize inherent or procedural hazards. For any safety concerns, contact Freescale sales and technical support services.

Should this evaluation kit not meet the specifications indicated in the kit, it may be returned within 30 days from the date of delivery and will be replaced by a new kit.

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## 3 Introduction

### 3.1 Evaluation Board Features

This family of devices is designed for low-voltage automotive lighting applications. Its four low RDS(ON) MOSFETs can control:

- Four separate 55W / 28W bulbs
- Four separate Xenon modules
- Four separate LEDs
- Four separate Other type of loads

In addition, this family of devices has the following features:

- Programming, control, and diagnostics are accomplished using a 16-bit SPI interface.
- Its output with selectable slew-rate allows to satisfy electromagnetic compatibility (EMC) requirements.
- Each output can be controlled with an internal PWM modulated clock signal, instead of an external clock.

### 3.2 Device Features

- Four protected high-side switches
- Operating voltage range of 6.0V to 20V with sleep current  $< 5.0\mu\text{A}$ , extended mode from 4.0V to 28V
- 8 MHz 16-bit 3.3V and 5V SPI control and status reporting with daisy chain capability
- PWM module using external clock or calibratable internal oscillator with programmable outputs delay management
- Smart over-current shutdown, severe short-circuit, over-temperature protections with time limited auto-retry, and fail-safe mode in case of MCU damage
- Output OFF or ON open-load detection compliant to bulbs or LEDs and short-to-battery detection. Analog current feedback with selectable ratio and board temperature feedback.

### 3.3 KITUSBSPIEVME USB-to-Parallel Converter Board

The KITUSBSPIEVME board converts from USB to SPI and from USB to parallel data transmission. The main function provided by this board is to allow a PC that may not have a parallel port to communicate with other Freescale Evaluation Boards via a USB port.

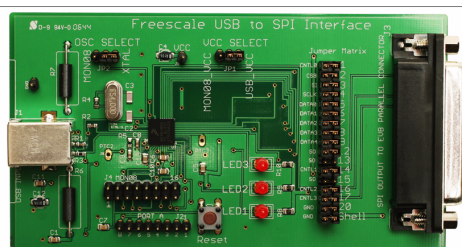


Figure 2. KITUSBSPIEVME Converter Board

## 4 Required Equipment

Minimum required equipment:

- Power DC supply 40A/20V
- 5.0 V power supply, 1.0 A current capability
- Computer with an available USB port, running Windows XP or higher
- KITUSBSPIEVME board for converting from USB to SPI
- SPIGen software, which is available from the Freescale SPIGen website (also from the evaluation kit's CD-ROM)
- Ty

## 5 Evaluation Board Configuration

The typical evaluation board (EVB) shown below utilizes the KITUSBSPIEVME as an alternate communication interface to a PC, instead of a 25 pin parallel I/O connector/cable. These EVBs have been designed to use SPIGen software in order to communicate and control the device functions on the evaluation board. The figure below illustrates a typical EVB and how you would configure it to work with a KITUSBSPIEVME interface board, for a USB connection to a PC.

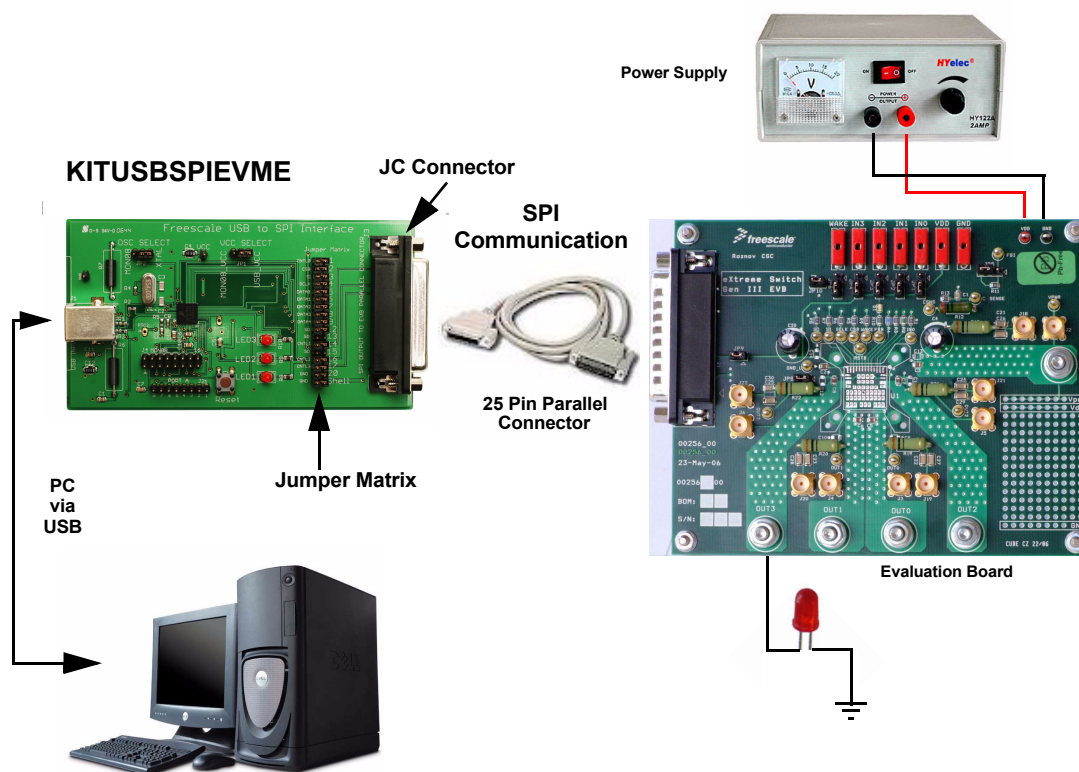


Figure 3. Evaluation Board Setup

Verify that the SI signal (Slave Input of the Serial Peripheral Input bus) on the EVB connects to the 25-pin parallel connector on pin 3. If instead it is on pin 6, then the jumper matrix (Figure 4) of the KITUSBSPIEVM will have to be configured in the following way:

1. Remove the jumper between pins SI and 3.
2. Remove the jumper between pins Data1 and 6.
3. Connect a jumper between pin SI and pin 6



**Figure 4.** KITUSBSPIEVM Converter Board Jumper Matrix

## 6 Installing SPIGen Freeware on your Computer

The latest version of SPIGen can be downloaded from the SPIGen web page at [www.freescale.com](http://www.freescale.com) (see the [References](#) section) and is designed to run on any Windows 7, Vista or XP-based operating system. SPIGen is also included on the CD-ROM supplied with the board, though this version may not be as up-to-date as that available from the SPIGen web page.

Before you install the program, refer to the SPIGen README.txt file to check the compatibility of the installation program and your computer operating system. For each operating system, README.txt describes where the software should be installed.

For computers running Windows 7, Vista, or Windows XP, download the SPIGen 7 install program from the SPIGen website. When the download is complete, run the install program. Several temporary files will be copied to your computer, and then the Installation Wizard will guide you through the rest of the process.

To install the software from the CD-ROM, insert the CD-ROM into your CD drive.

To use SPIGen, go to the Windows Start menu, then Programs, then SPIGen, and click on the SPIGen icon. The SPIGen Graphic User Interface (GUI) will appear. Go to the File menu in the upper left hand corner of the GUI, and select Open. In the file selection window that appears, set the “Files of type:” drop-down menu to “All Files (\*.\*)”. Next, browse the CD-ROM from the evaluation board kit and select the file called “SPIGen Config File.txt”. Click Open, and SPIGen will open a specifically configured SPI command generator for your EVB.

The GUI is shown in [Figure 5](#). The text at the top is the name of the configuration file loaded. (As an exceptional case, the file name has a .txt extension for the boards covered by this user’s guide. In other cases, the standard .spi extension will be evident.) The left side panel displays folders that group user interfaces. The boards associated with this guide will all make use of the Generic user interfaces. (The other pre-installed folders contain interfaces for boards unrelated to this document.) The process of loading the configuration files has assigned a list of “Extra Pins” as well as a list “Quick Commands”, all of which are specific to the board in use.

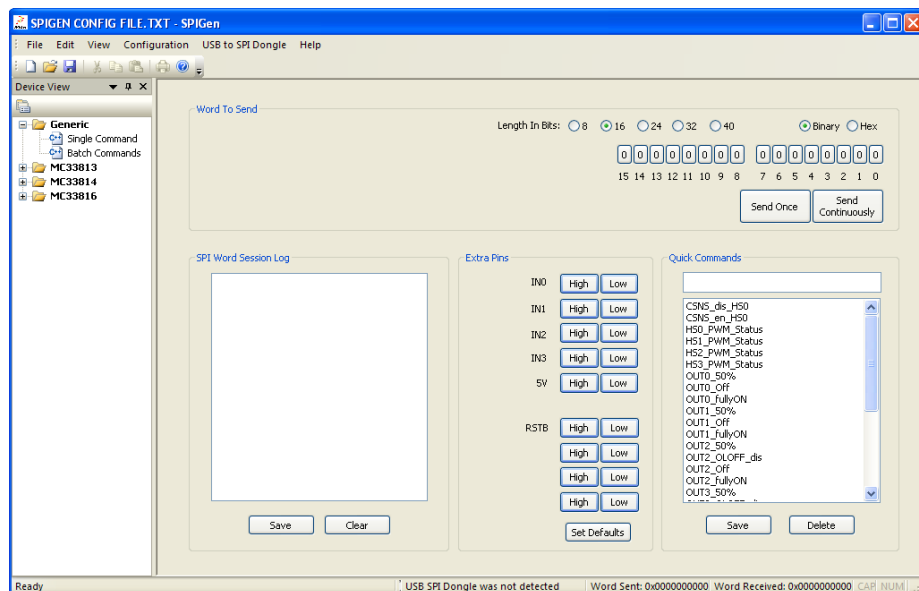


Figure 5. SPIGen GUI

## 7 Setup and Using the Hardware

Warning: Always wear safety glasses when working around electronic modules and when soldering.

Please remove the capacitor C4 when testing reverse supply on Vpwr.

1. The EVB allows the customer to quickly evaluate features of the device with a simple bench top setup. All switch inputs may be evaluated using the onboard switch banks or actual system switches connected to the switch input edge connector.
2. Using a standard 25 pin Sub-D parallel port cable and the enclosed SPIGen SPI software, you can use a personal computer to provide the Serial Peripheral Interface (SPI) communication with this EVB (see SETUP\_EVB).
3. Connect power supply to the VPWR and GND terminals on the EVB. Make sure the voltages provided are in accordance with the device data sheet and that the supply currents are sufficient to supply the switch contact wetting current. A voltage of +5V is needed for SPI communication. This voltage can be provided from PC via parallel cable (JP9 must be inserted) or through an external power supply via connector VDD. Without +5V the device will be in fail-safe mode.
4. Connect desired external load between one of the output (OUT0 - OUT3) and power supply ground.
5. For direct control of the outputs apply +5V on connectors IN0 - IN3. Corresponding HS output turns-on. Each IN input wakes the device.
6. For preparing the evaluation board for SPIGen, place jumpers JP9, JP10 to 1-2 position.
7. For instructions on installing the SPIGen software and loading the configuration file, see "[Installing SPIGen Freeware on your Computer](#)". The configuration file will set all parameters for SPI signals from the PC and provide a list of commands that may be sent to the EVB.
8. To set up the device to read switch inputs the user may use the batch commands from the Batch Commands view. To send a batch of commands to the EVB, select the batch command from the "Batch Name" drop-down box and click the Send Once button. To quickly evaluate the EVB and device, simply click on the Single Command view, select the switch status command from the Quick Commands list and click the Send Continuous button. The opening and closing of switches may now be seen on the Word Received bits window field. Refer to the device data sheet for detailed information on I/O communication and device operation.

## 8 Hardware Description

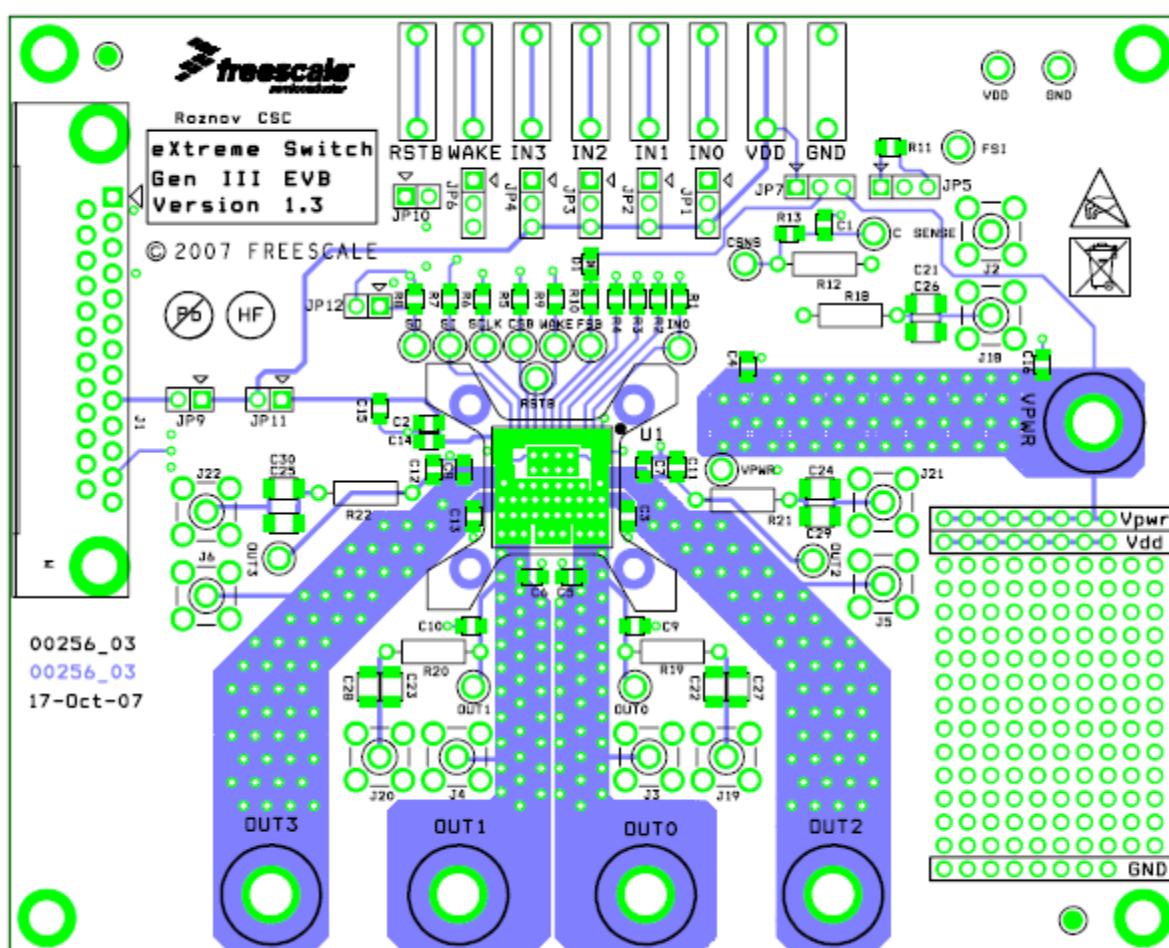
**Table 1: Jumper Connections**

| Name        | Description                                                                                                                                                                                        |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| JP1         | Allows independent control of each high-side switch output                                                                                                                                         |
| JP2         | 1-2 selection: outputs are controlled via SPIGen or connectors J7 - J10                                                                                                                            |
| JP3         | 2-3 selection: direct control of the output, appropriate output is ON                                                                                                                              |
| JP4         |                                                                                                                                                                                                    |
| JP5         | FSI selection<br>1-2: FSI terminal connected through 6k8 Ohm resistor to ground<br>2-3: FSI terminal connected to ground                                                                           |
| JP6         | Allows wake up function of IC.<br>1-2 selection will give external control through connector J12.<br>2-3 selection is to wake up from battery voltage, i.e. in the case of ignition.               |
| JP7         | Selection of supplying of FSB LED<br>1-2: FSB LED D1 connected to VDD (5V)<br>2-3: FSB LED D1 connected to Vpwr (12V)                                                                              |
| JP9         | Source of VDD (+5V)<br>1-2: +5V is provided by PC via parallel cable<br>Floating: +5V must be connected to J11, otherwise the device is in fail-safe mode (the output states depend on R11 value). |
| JP10        | Connection of RSTB input<br>1-2 position: control through SPIGen<br>Floating: RSTB is ground. This means that the IC is in sleep mode.                                                             |
| JP11        | Connection of VDD to the device<br>1-2 position: VDD connected to the device<br>Floating: Device without VDD                                                                                       |
| JP12        | R8 bypassing<br>1-2 position: R8 is bypassed with 0Ohms. For higher speed of SPI (MCU control of the device only)<br>Floating: Low speed SPI operation with SPIGen software                        |
| TEST POINTS | Several test points are presented on the evaluation board to check some signals using oscilloscope if necessary.                                                                                   |

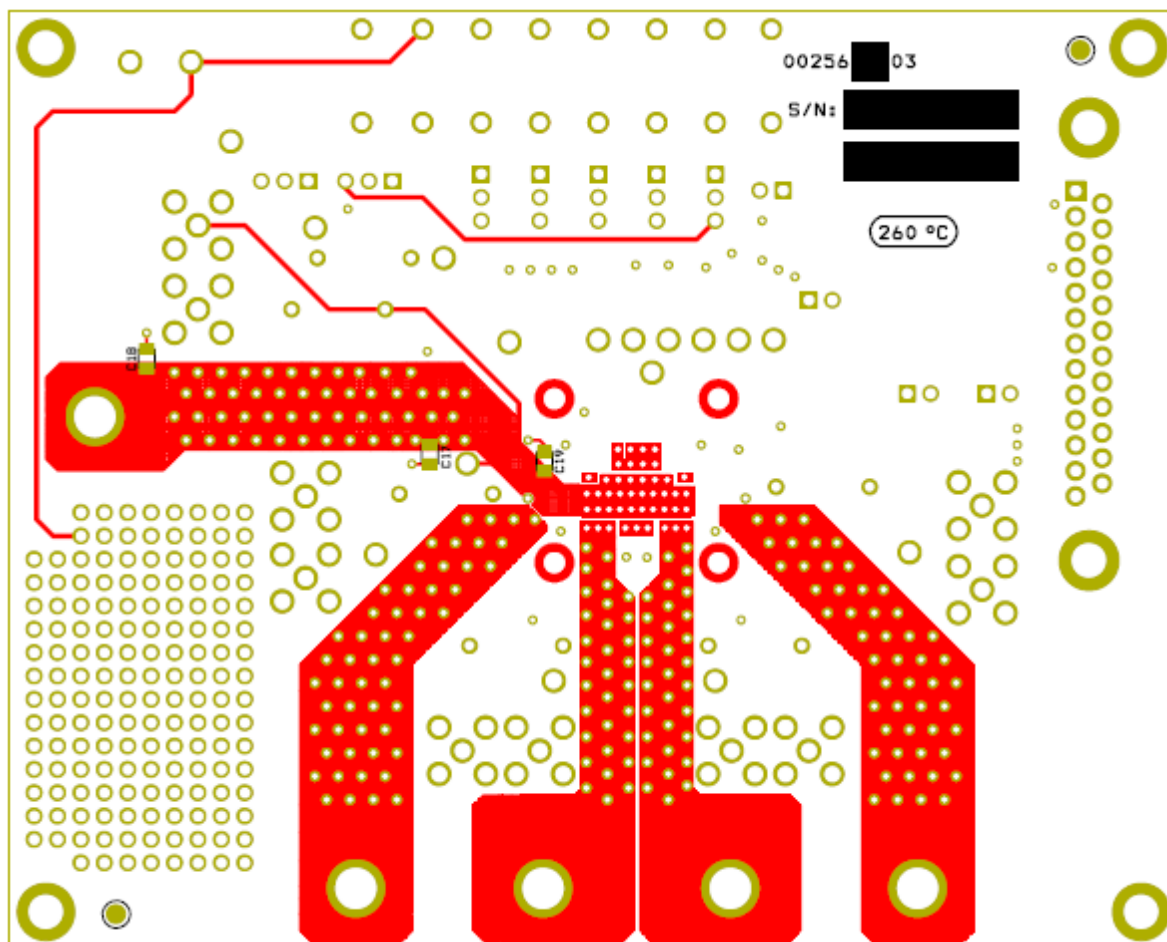


## 10 Board Layout

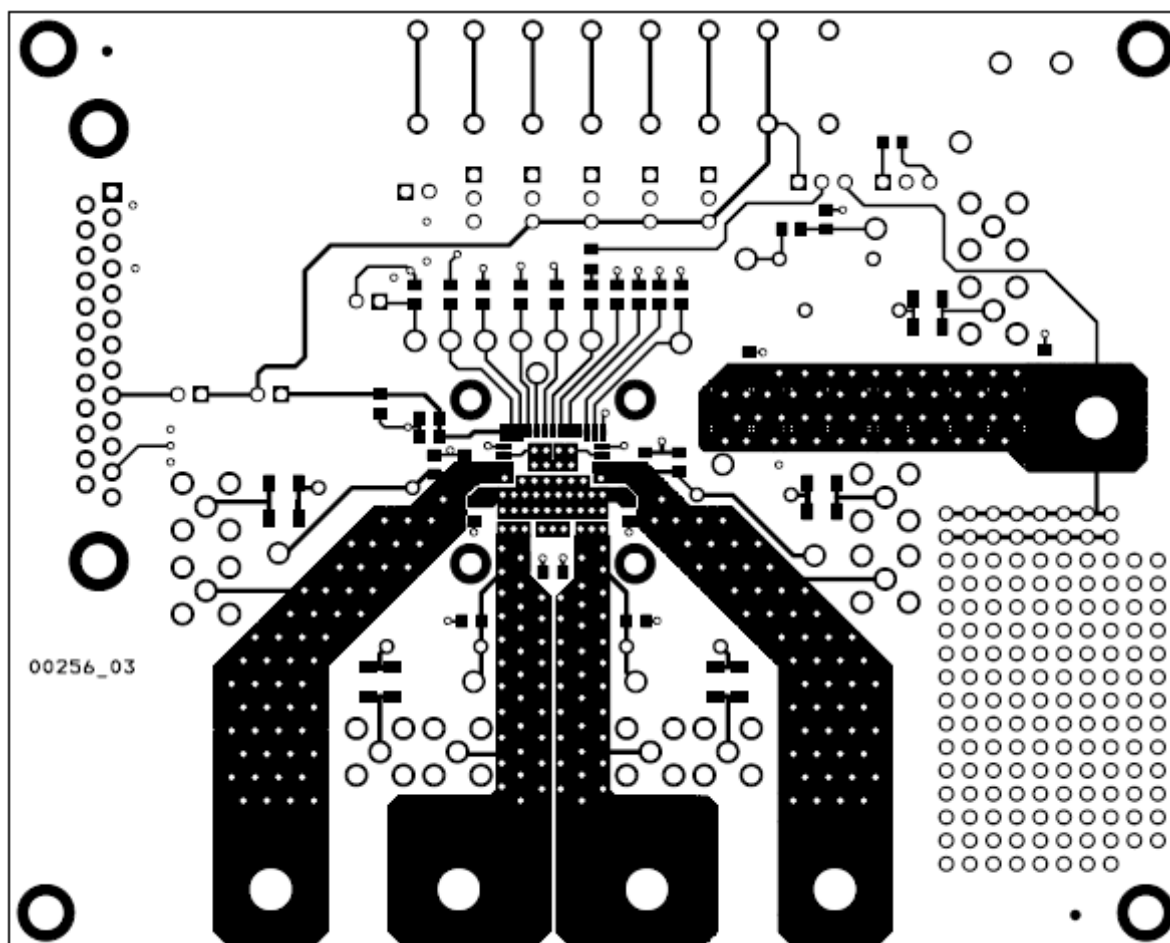
### 10.1 Top Assembly Layer



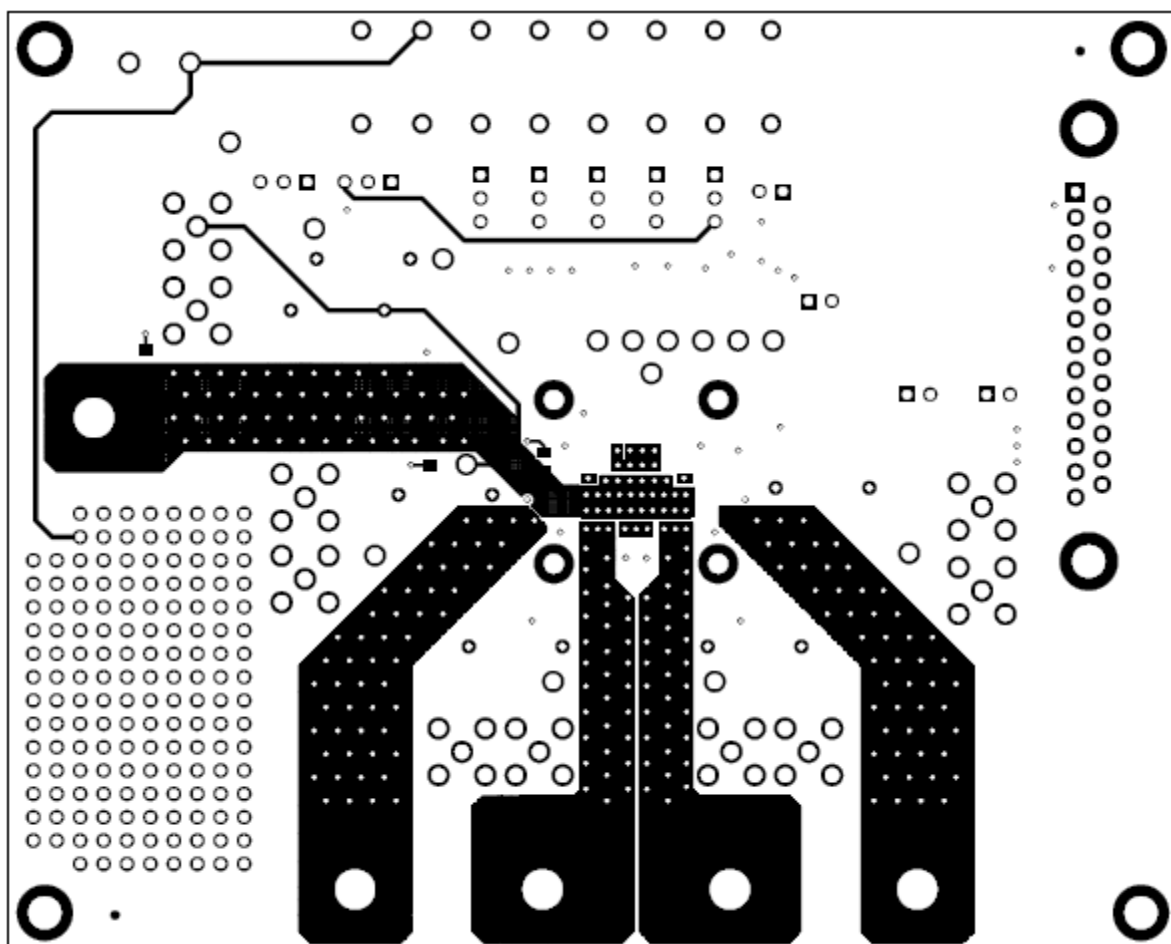
## 10.2 Bottom Assembly Layer



## 10.3 PCB Top Layer



## 10.4 PCB Bottom Layer



# 11 Bill of Material

| Item | Qty | Part No.     | Ref.                                                                                               | Package              | Description                                                   | Populated | Rohs               | Manufacturer |
|------|-----|--------------|----------------------------------------------------------------------------------------------------|----------------------|---------------------------------------------------------------|-----------|--------------------|--------------|
| 1    | 1   | SPQ15        | U1                                                                                                 | PQFN                 | Quad High-Side Switch                                         | Yes       | Yes                | Freescall    |
| 2    | 1   |              | C1                                                                                                 | SMD 0805             | 10nF 50V Ceramic Capacitor                                    | Yes       | Yes                | AVX          |
| 3    | 5   |              | C26,C27,C28,C29,C30                                                                                | SMD 1206             | 10nF 50V Ceramic Capacitor                                    | No        | Yes                | AVX          |
| 4    | 4   |              | C2,C3, C13,C15                                                                                     | SMD 0805             | 100nF 50V Ceramic Capacitor                                   | Yes       | Yes                | AVX          |
| 5    | 2   |              | C4,C20                                                                                             | Thru - hole 5mm      | 10uF 63V Electrolytic Capacitor                               | No        | Yes                | Jamicon      |
| 6    | 4   |              | C5,C6,C7,C8                                                                                        | SMD 0805             | 22nF 50V Ceramic Capacitor                                    | Yes       | Yes                | AVX          |
| 7    | 9   |              | C9,C10,C11,C12,C14, C16, C17,C18,C19                                                               | SMD 0805             | Ceramic Capacitor (for EMC tuning)                            | No        |                    |              |
| 8    | 5   |              | C21,C22,C23,C24,C25                                                                                | SMD 1206             | 1nF 50V Ceramic Capacitor                                     | No        | Yes                | AVX          |
| 9    | 1   |              | D1                                                                                                 | SMD 0805             | red LED diode                                                 | Yes       | Yes                | Lumex        |
| 10   | 7   |              | JP1,JP2,JP3,JP4,JP5,J P6, JP7                                                                      |                      | Header 3x1                                                    | Yes       | Yes                | Samtec       |
| 11   | 4   |              | JP9,JP10,JP11,JP12                                                                                 |                      | Header 2x1                                                    | Yes       | Yes                | Samtec       |
| 12   | 1   | ZEDB25PBA    | J1                                                                                                 |                      | 25-pin 90° PCB connector                                      | Yes       | Yes                | ITT CANNON   |
| 13   | 10  | 19-46-1-TGG  | J2, J3, J4, J5, J6, J18, J19, J20, J21, J22                                                        | SMA                  | SMA Jack                                                      | No        | Yes                | MULTICOMP    |
| 14   | 8   | 105-0752-001 | J7, J8, J9, J10, J11, J12, J23, J24                                                                | Horizontal Test jack | YES                                                           | Yes       | Johnson Components |              |
| 15   | 5   |              | J13, J14, J15, J16, J17                                                                            |                      | Screw diam. 4mm + 2 nuts + 2 washers each for power connector | Yes       | Yes                |              |
| 16   | 11  |              | R1, R2, R3, R4, R5, R6, R7, R8, R9, R10, R13                                                       | SMD 0805             | 10k 5% Resistor                                               | Yes       | Yes                |              |
| 17   | 1   |              | R11                                                                                                | SMD 0805             | 6.8k 1% Resistor                                              | Yes       | Yes                |              |
| 18   | 1   |              | R12                                                                                                | Thru - hole 10mm     | 2.7k 1% Resistor                                              | Yes       | Yes                |              |
| 19   | 5   |              | R18,R19,R20,R21,R22                                                                                | Thru - hole 10mm     | 10R 5% Resistor 1W                                            | No        | Yes                |              |
| 20   | 18  | 200-203      | OUT1,OUT2, OUT3, WAKE, VPWR, VDD, SO, SI, SCLK, RSTB, OUT0, IN0, GND, FSI, FSB, CSNS, CSB, C Sense | PCB Test Terminal    | YES                                                           | Yes       | William Hughes     |              |

## 12 References

Following are URLs where you can obtain information on other Freescale products and application solutions:

| Document Number                                      | Description                           | URL                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|------------------------------------------------------|---------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| MC10XS3412<br>MC10XS3435<br>MC15XS3400<br>MC35XS3400 | Data Sheets                           | <a href="http://www.freescale.com/files/analog/doc/data_sheet/MC10XS3412.pdf">www.freescale.com/files/analog/doc/data_sheet/MC10XS3412.pdf</a><br><a href="http://www.freescale.com/files/analog/doc/data_sheet/MC10XS3435.pdf">www.freescale.com/files/analog/doc/data_sheet/MC10XS3435.pdf</a><br><a href="http://www.freescale.com/files/analog/doc/data_sheet/MC15XS3400.pdf">www.freescale.com/files/analog/doc/data_sheet/MC15XS3400.pdf</a><br><a href="http://www.freescale.com/files/analog/doc/data_sheet/MC35XS3400.pdf">www.freescale.com/files/analog/doc/data_sheet/MC35XS3400.pdf</a> |
|                                                      | KITUSBSPIEVME<br>Tool Summary Page    | <a href="http://www.freescale.com/webapp/sps/site/prod_summary.jsp?code=KITUSBSPIEVME">http://www.freescale.com/webapp/sps/site/prod_summary.jsp?code=KITUSBSPIEVME</a>                                                                                                                                                                                                                                                                                                                                                                                                                              |
|                                                      | SPIGen Reference<br>Tool Summary Page | <a href="http://www.freescale.com/files/soft_dev_tools/software/device_drivers/SPIGen.html?fsrch=1&amp;sr=11">http://www.freescale.com/files/soft_dev_tools/software/device_drivers/SPIGen.html?fsrch=1&amp;sr=11</a>                                                                                                                                                                                                                                                                                                                                                                                |
|                                                      | Analog Home Page                      | <a href="http://www.freescale.com/analog">www.freescale.com/analog</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|                                                      | Automotive Home Page                  | <a href="http://www.freescale.com/automotive">www.freescale.com/automotive</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |

## 13 Revision History

History

| Revision | Date    | Description of Changes                                                                                                                                         |
|----------|---------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1.0      | 10/2008 | <ul style="list-style-type: none"><li>• Initial Release</li></ul>                                                                                              |
| 2.0      | 8/2009  | <ul style="list-style-type: none"><li>• Replaced Schematic drawing with legible version</li></ul>                                                              |
| 3.0      | 2/2013  | <ul style="list-style-type: none"><li>• Updated Setup diagram</li><li>• Supplied new SPIGen diagram with improved software installation instructions</li></ul> |

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