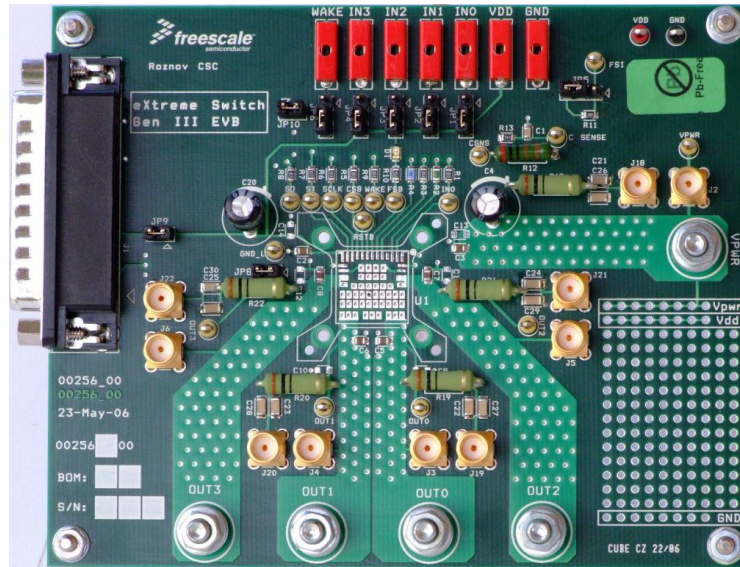


# KIT eXtreme Switch Evaluation Board



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

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# 1 Kit Contents / Packing List

- Evaluation Board
- Parallel Cable

## 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 EVB 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 Description/Features

- Four protected high-side switches
- Operating voltage range of 6.0V to 20V with sleep current < 5.0 $\mu$ 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.

## 4 Required Equipment

Minimum required equipment:

- Power DC supply 40A/20V
- Optional DC supply 1A/ 5V
- Typical load (lamps,...)
- Parallel port enabled Computer with Windows XP or higher

## 5 Installing SPIGen Freeware on your Computer

There are two different versions of SPIGen. One is designed to run on Windows 95/98/Me, and the other is designed to run on Windows NT/2000/XP. Be sure to choose the appropriate installation program for your computer.

Each version of SPIGen includes a README.txt file which will describe the operating systems that the software should be installed on. 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.

To install the software from the CD-ROM, insert the CD-ROM into your CD drive. Click the Start button, and then click "Run...".

If you are running Windows 95, Windows 98, or Windows Me, type "D:\SPIGen\_Win\_95\_98\_Me\Setup.exe" in the box, and then click "OK".

If you are running Windows NT, Windows 2000, or Windows XP, type "D:\SPIGen\_Win\_NT\_2000\_XP\Setup.exe" in the box, and then click "OK".

Several temporary files will be copied to your computer, and then the Installation Wizard will guide you through the rest of the process.

To use SPIGen, Go to the Windows Start menu, then Programs, then SPIGen, and click on the SPIGen icon. The SPIGen "Generic SPI Generator" GUI will appear. Go to the File menu in the upper left hand corner of the GUI, and select Open, then browse the CD to find and select the SPIGen Configuration ".spi" file for the EVB you are using. Click Open, and SPIGen will open a specifically configured SPI command generator for your EVB.

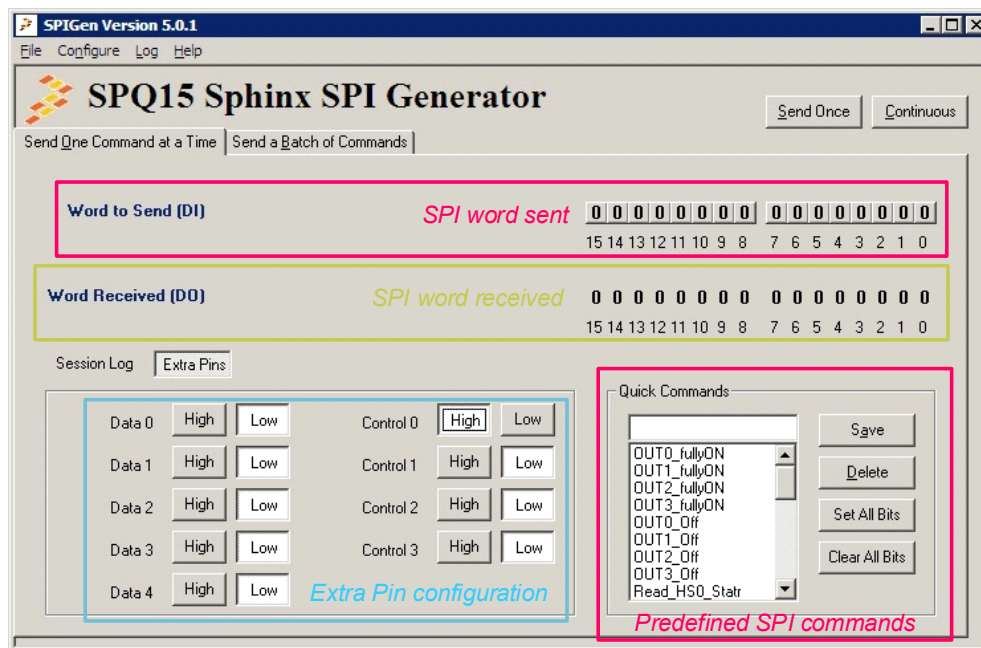


Figure 2. SPIGen GUI

## 6 EVB Setup

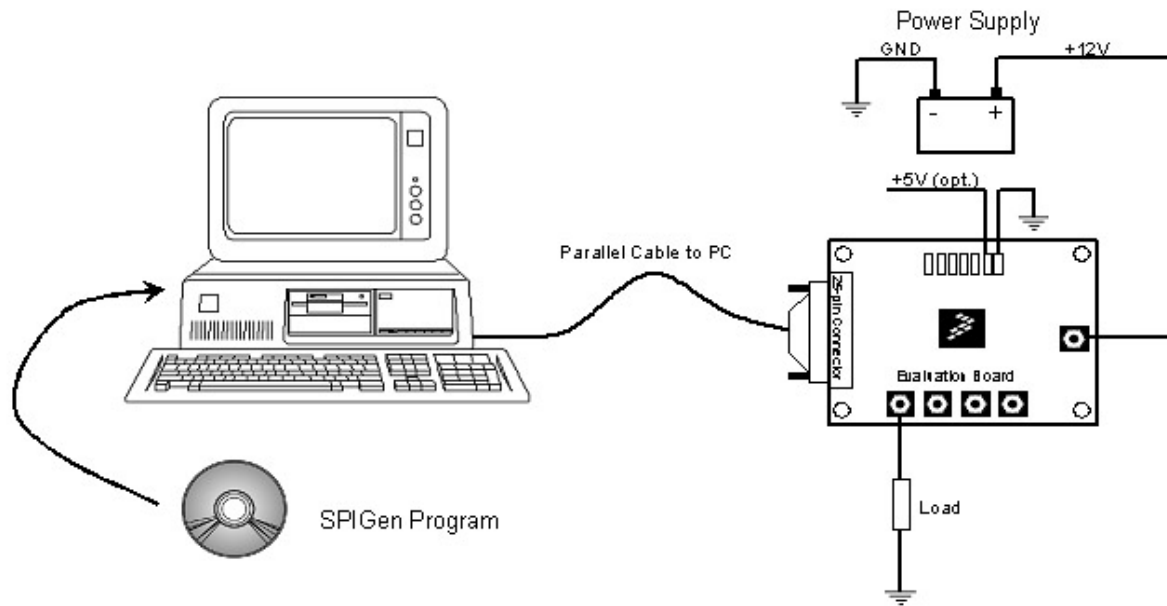


Figure 3. EVB Setup

## 7 Using the EVB

**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 Driver 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. For the SPI communication is needed +5V. This voltage can be provided from PC via parallel cable (JP9 must be inserted) or through 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. To use SPIGen, Go to the Windows Start menu, then Programs, then SPIGen, and click on the SPIGen icon. The SPIGen "Generic SPI Generator" GUI will appear. Go to the File menu in the upper left hand corner of the GUI, and select Open, then browse the CD to find and select the *Device\_EVB\_CONFIGURATION\_FILE.spi*. file for the Kit. Click Open, and SPIGen will open a specifically configured SPI command generator for the Kit. 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 "Send a Batch of Commands" tab. In the "Send a Batch of Commands" window, the Full Initialize batch will appear. To send the batch of commands to the EVB, click the Send Once tab. To quickly evaluate the EVB and device, simply click on the "Send one Command at a Time" tab, select the switch status command from the Quick Commands list, and click the Send Continuous tab. 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 Jumper Connections

| Name                     | Description  |
|--------------------------|--|
| JP1<br>JP2<br>JP3<br>JP4 | Allows independent control of each high-side switch output<br>1-2 selection: outputs are controlled via SPIGen or connectors J7 - J10<br>2-3 selection: direct control of the output, appropriate output is ON |
| 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

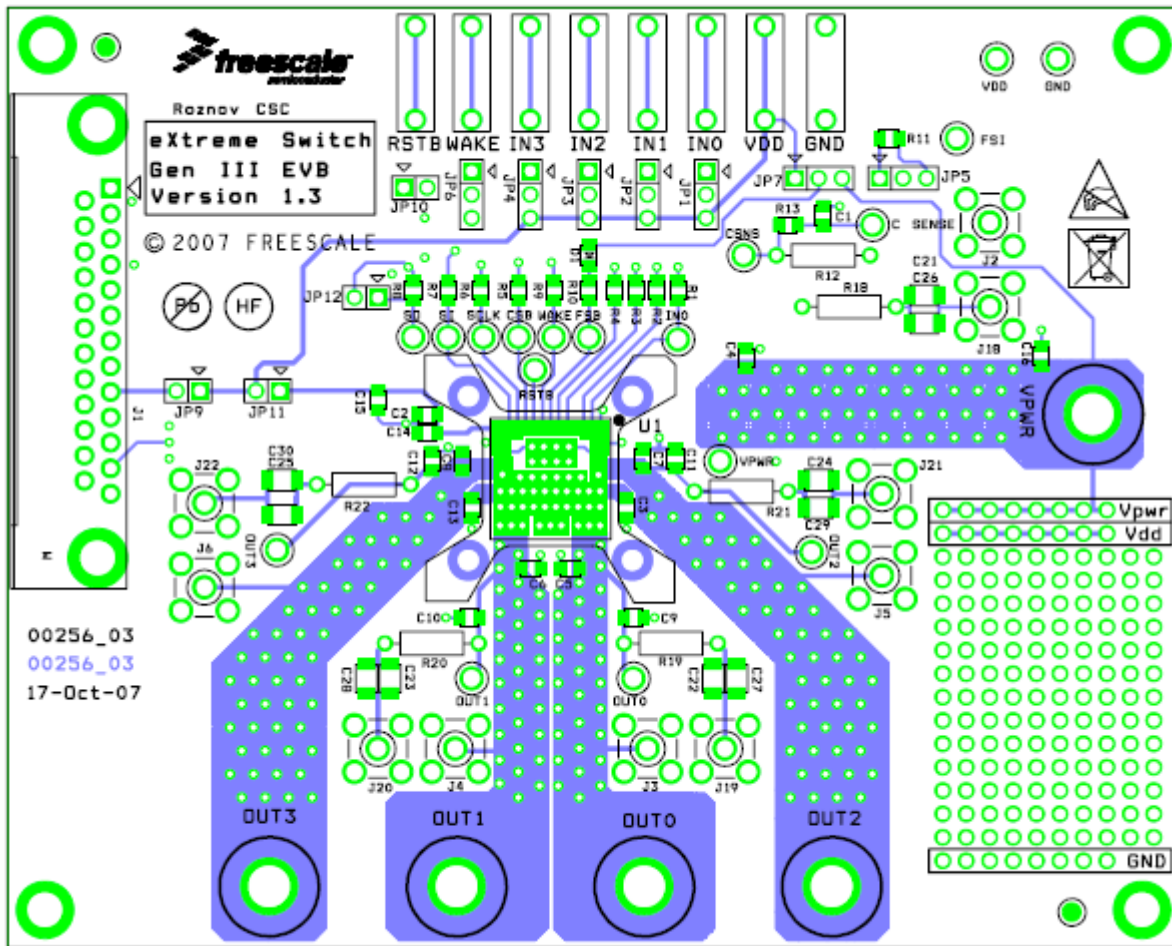


Figure 4. Top Assembly Layer

## 10.2 Bottom Assembly Layer

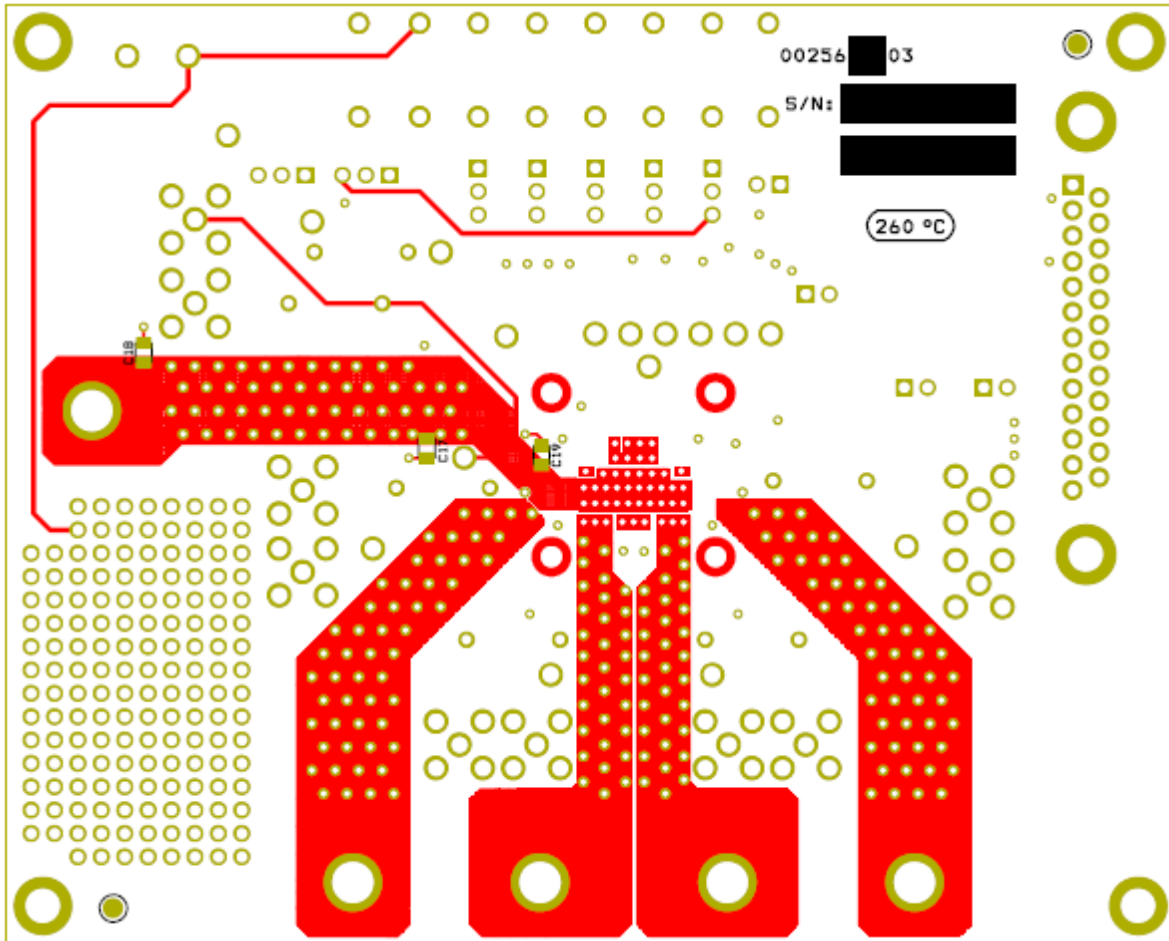


Figure 5. Bottom Assembly Layer

## 10.3 PCB Top Layer

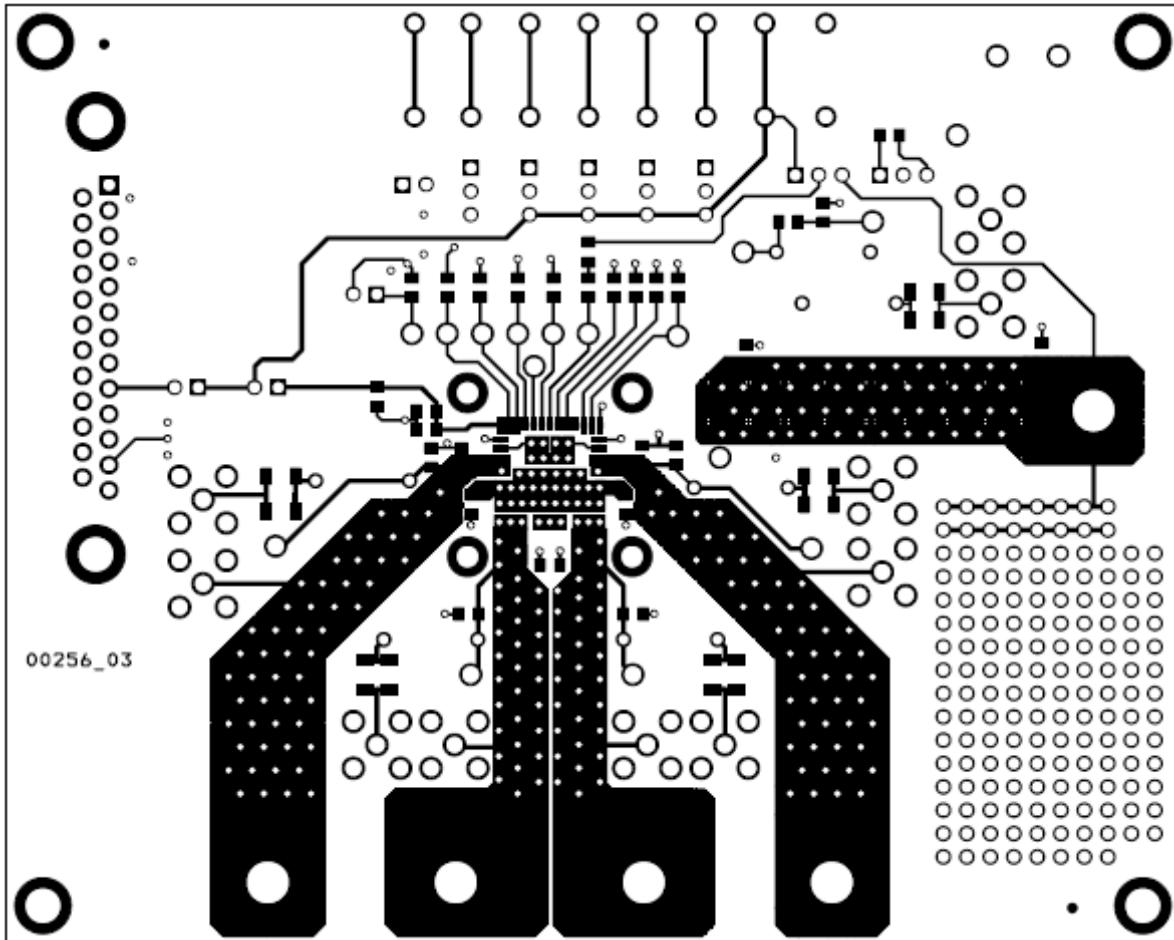


Figure 6. PCB Top Layer

## 10.4 PCB Bottom Layer

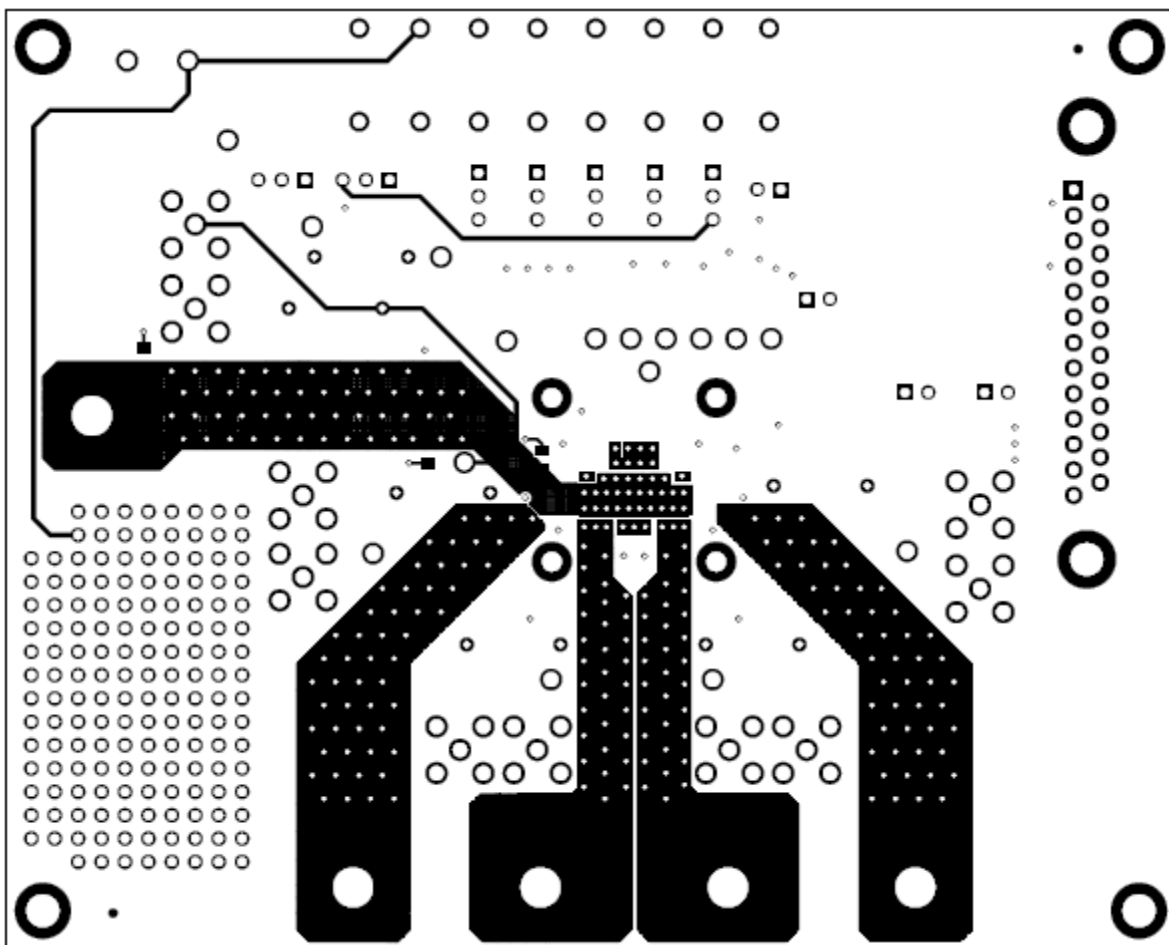


Figure 7. PCB Bottom Layer

# 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                   | Freescale    |
| 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<br>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,<br>C16, C17,C18,C19   | SMD 0805                | Ceramic Capacitor (for EMC<br>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<br>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,<br>J19, J20, J21, J22  | SMA                     | SMA Jack  | No        | Yes                   | MULTICOMP    |
| 14   | 8   | 105-0752-001 | J7, J8, J9, J10, J11,<br>J12, J23, J24  | Horizontal<br>Test jack | YES   | Yes       | Johnson<br>Components |              |
| 15   | 5   |              | J13, J14, J15, J16, J17   |                         | Screw diam. 4mm + 2 nuts + 2<br>washers each for power<br>connector | Yes       | Yes                   |              |
| 16   | 11  |              | R1, R2, R3, R4, R5, R6,<br>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<br>10mm     | 2.7k 1% Resistor  | Yes       | Yes                   |              |
| 19   | 5   |              | R18,R19,R20,R21,R22   | Thru - hole<br>10mm     | 10R 5% Resistor 1W  | No        | Yes                   |              |
| 20   | 18  | 200-203      | OUT1,OUT2, OUT3,<br>WAKE, VPWR, VDD,<br>SO, SI, SCLK, RSTB,<br>OUT0, IN0, GND, FSI,<br>FSB, CSNS, CSB, C<br>Sense | PCB Test<br>Terminal    | YES   | Yes       | William<br>Hughes     |              |

## 12 References

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

| Description                                  | URL  |
|--|--|
| 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> |
| Application Notes                            | <a href="http://www.freescale.com/files/analog/doc/data_sheet/MC35XS3400.pdf">www.freescale.com/files/analog/doc/data_sheet/MC35XS3400.pdf</a>   |
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| ON Semiconductor, Inc.                       | <a href="http://www.onsemi.com/">http://www.onsemi.com/</a>  |



## 13 Revision History

| REVISION | DATE    | DESCRIPTION OF CHANGES |
|----------|---------|------------------------|
| 1.0      | 10/2008 | • Initial Release      |

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