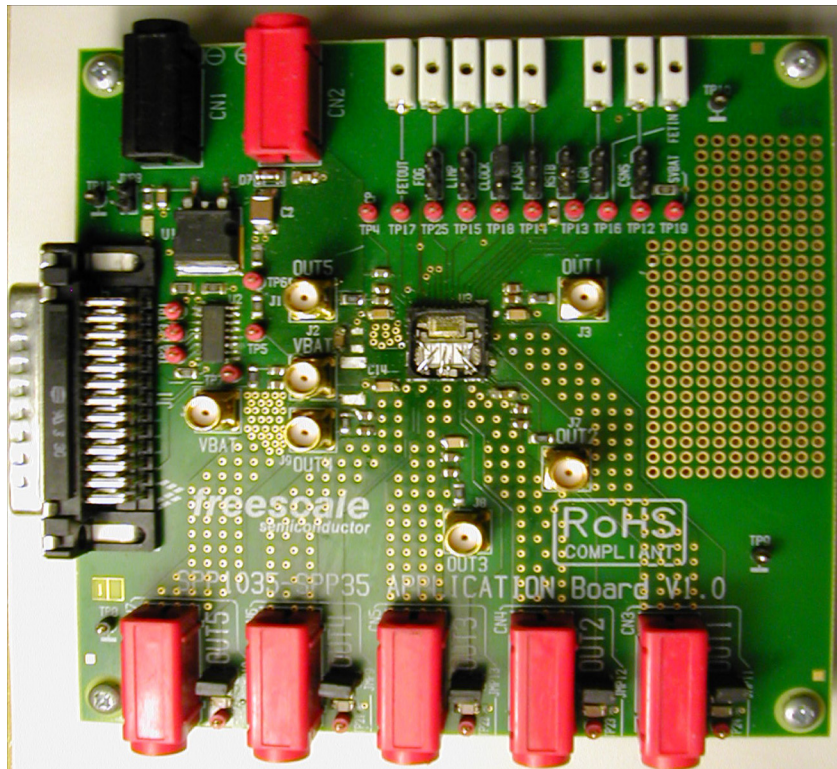


# KIT06XS3517EVBE Evaluation Board User Guide

Featuring the 06XS3517 Smart High Side Switch Module



**Figure 1. KIT06XS3517EVBE Evaluation Board**

## Table of Contents

1	Kit Contents / Packing List	2
2	Important Notice	3
3	Introduction	4
4	Evaluation Board Features	4
5	Required Equipment	5
6	Evaluation Board Configuration	6
7	Using Hardware	7
8	Schematic	9
9	Board Layout	10
10	Bill of Material	15
11	References	16
12	Revision History	16

# 1 Kit Contents / Packing List

- Evaluation Board
- CD
- 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.

Freescale reserves the right to make changes without further notice to any products herein. Freescale makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does Freescale assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation consequential or incidental damages. "Typical" parameters can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typical", must be validated for each customer application by customer's technical experts.

Freescale does not convey any license under its patent rights nor the rights of others. Freescale products are not designed, intended, or authorized for use as components in systems intended for surgical implant into the body, or other applications intended to support or sustain life, or for any other application in which the failure of the Freescale product could create a situation where personal injury or death may occur.

Should the buyer purchase or use Freescale products for any such unintended or unauthorized application, the buyer shall indemnify and hold Freescale and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that Freescale was negligent regarding the design or manufacture of the part. Freescale and the Freescale logo are trademarks of Freescale Semiconductor, Inc. All other product or service names are the property of their respective owners.  
© Freescale Semiconductor, Inc. 2012.

## 3 Introduction

This Evaluation Board demonstrates the capability of the MC06XS3517AFK combines five 12 V high side switches together with integrated control and a high number of protective and diagnostic functions. The board is designed for low-voltage automotive and industrial lighting applications. Its five low  $R_{DS(ON)}$  MOSFETs can control the high sides of five separate resistive loads (bulbs, Xenon-HID modules and LEDs). Control, device configuration, and diagnostics are performed through a 16-bit SPI interface, allowing easy integration into existing applications.

## 4 Evaluation Board Features

This product is designed for low-voltage automotive lighting applications. Its five low  $R_{DS(ON)}$  MOSFETs can control:

- Five separate 55 W / 28 W bulbs
- Five separate Xenon modules
- Five separate LEDs
- Five separate other type of loads

In addition, this product has the following features:

- Programming, control, and diagnostics are accomplished using a 16-bit SPI interface.
- Input voltage operation range from 7 V to 20 V, with extended operating range of 6 V to 28 V
- Penta high side switches
- 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.

### 4.1 MC06XS3517 Device Description / Features

Programming, control, and diagnostics are accomplished using a 16-bit SPI interface (3.3 V or 5.0 V). Each output has its own PWM control via the SPI. The MC06XS3517AFK has highly sophisticated failure mode handling to provide high availability of the outputs. Its multi-phase control and output edge shaping improves electromagnetic compatibility (EMC) behavior.

#### 4.1.1 Features

- Five high side switches
- 16-bit SPI communication interface with daisy chain capability
- Current sense output with SPI-programmable multiplex switch and board temperature feedback
- Digital diagnosis feature
- PWM module with multi-phase feature including prescaler
- LEDs control including accurate current sensing and low duty-cycle capability
- Fully-protected switches
- Over-current shutdown detection
- Power net and reverse polarity protection

- Low-power mode
- Fail mode functions including auto restart feature
- External smart power switch control including current recopy

## 5 Required Equipment

Minimum required equipment:

- Power DC supply 40 A / 20 V
- Typical load (lamps such as bulbs, Xenon-HID modules and LEDs)

Additional equipment for SPI:

- 5.0 V Power supply, 1.0 A current capability
- USB enabled Computer with Windows XP or higher
- CD contains a Graphical User Interface (GUI) allowing control of all MC06XS3517AFK Features through the SPI
- KITUSBSPIEVME

## 6 Evaluation Board Configuration

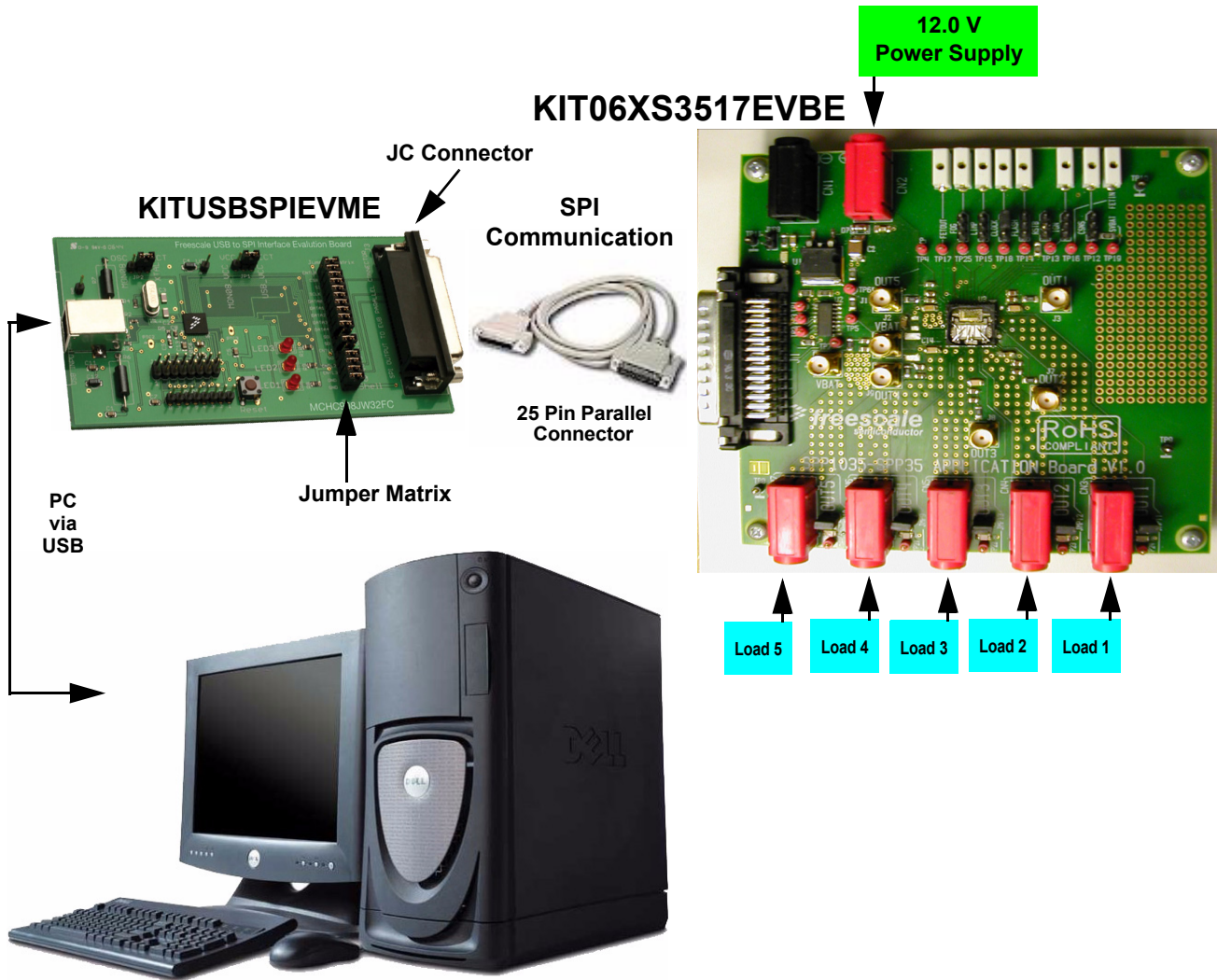


Figure 2. Evaluation Board Setup

**NOTE:** For the KITUSBSPIEVME kit, please remove the jumpers on pin SI/3 and on pin Data 1/6 on the Jumper Matrix. Add a wire between pin SI and pin 6.

## 7 Using Hardware

**WARNING: Always wear Safety Glasses when working around electronic modules and when soldering.**

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 to provide the Serial Peripheral Interface (SPI) communication with this EVB (see the file SETUP\_EVB file in your accompanying CD).
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
4. Connect desired external load between one of the output (OUT1 - OUT5) and power supply ground.
5. For direct control of the outputs apply +5.0 V on connectors IGN, FLASH and FOG. Corresponding HS output turns-on. Each IN input wakes the device.

### 7.1 Jumper Connections

**JMP1 Allows connecting current sensing resistor**

1-2 selection: CSNS terminal connected to JP1 connector

2-3 selection: CSNS terminal connected through 1k Ohm resistor to ground

**JMP2 Allows connecting ignition signal**

1-2 selection: IGN terminal connected to JP2 connector

2-3 selection: 5V applied directly to IGN terminal

**JMP3 Allows connecting flasher signal**

1-2 selection: FLASHER terminal connected to JP3 connector

2-3 selection: 5V applied directly to FLASHER terminal

**JMP4 Allows connecting limp home signal**

1-2 selection: LIMP terminal connected to JP4 connector

2-3 selection: 5V applied directly to LIMP terminal

**JMP5 Allows connecting PWM clock signal**

1-2 selection: CLOCK terminal connected to JP7 connector

2-3 selection: CLOCK terminal connected to DB25 connector

**JMP6 Allows connecting reset signal**

1-2 selection: RSTB terminal connected to DB25 connector

2-3 selection: 5V applied directly to RSTB terminal

**JMP7 Allows connecting fog signal**

1-2 selection: FOG terminal connected to JP8 connector

2-3 selection: 5V applied directly to FOG terminal

**JMP8** Allows disconnecting 5V reference voltage

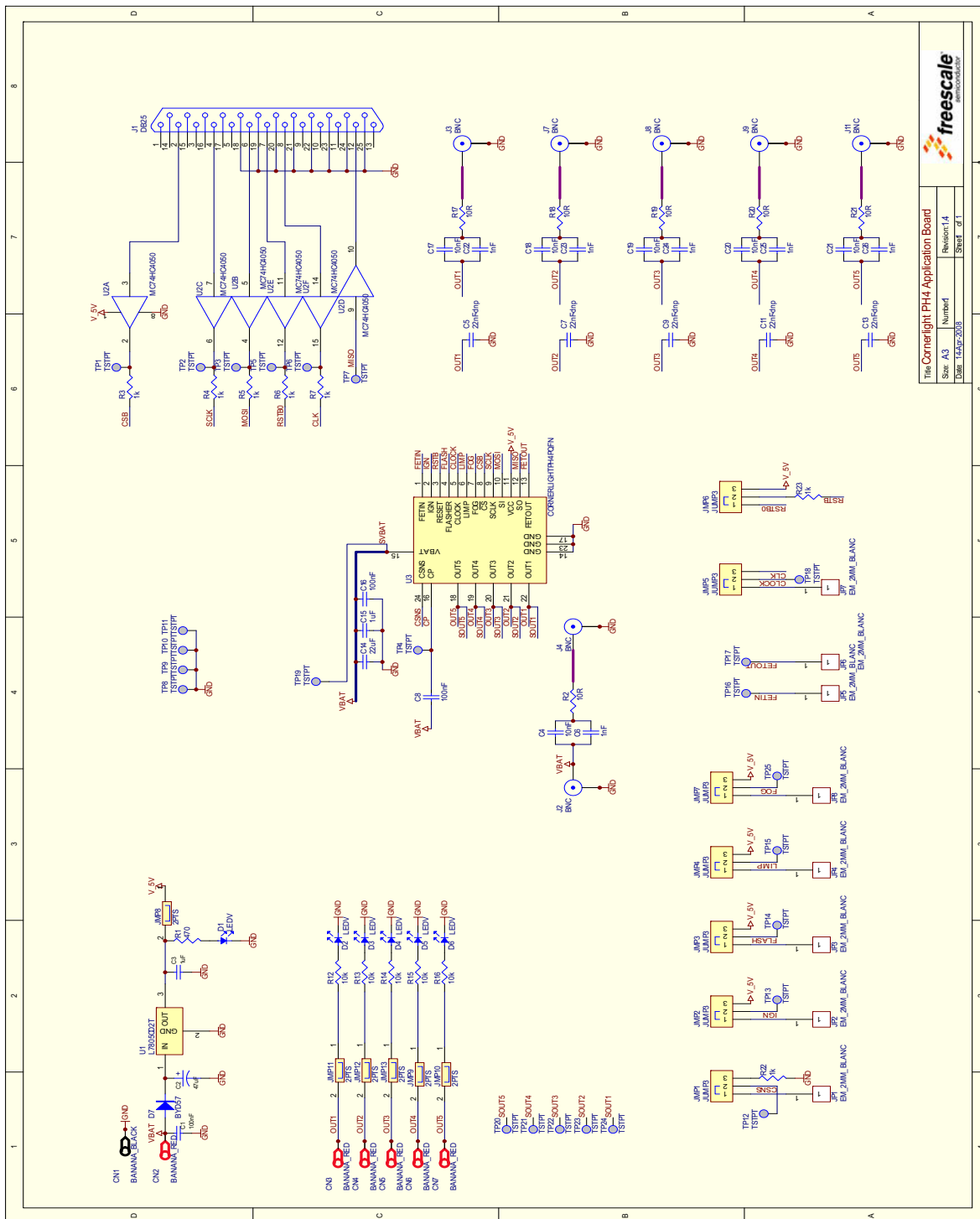
**JMP9 to JMP13** Allows disconnecting the LED on the corresponding output OUT1-5

#### **TEST POINTS**

Several test points are presented on the evaluation board to check some signals using oscilloscope if necessary.



# 8 Schematic



The Cornelight PH4 Application Board

Size: A3	Number:	Revision: 1.4
Date: 14/02/2013	Sheet: 1 of 1	

Figure 3. Schematic

## 9 Board Layout

### 9.1 Assembly Layer Top

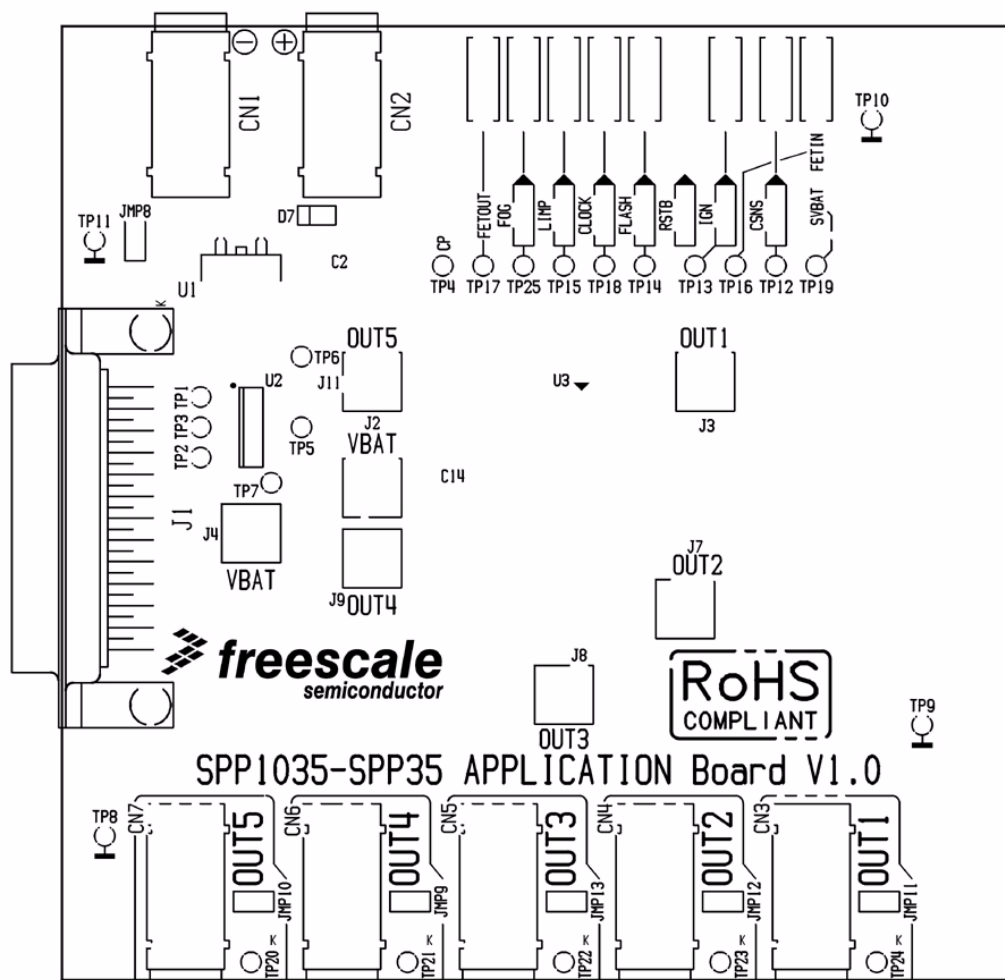


Figure 4. Assembly Layer Top

## 9.2 Assembly Layer Bottom

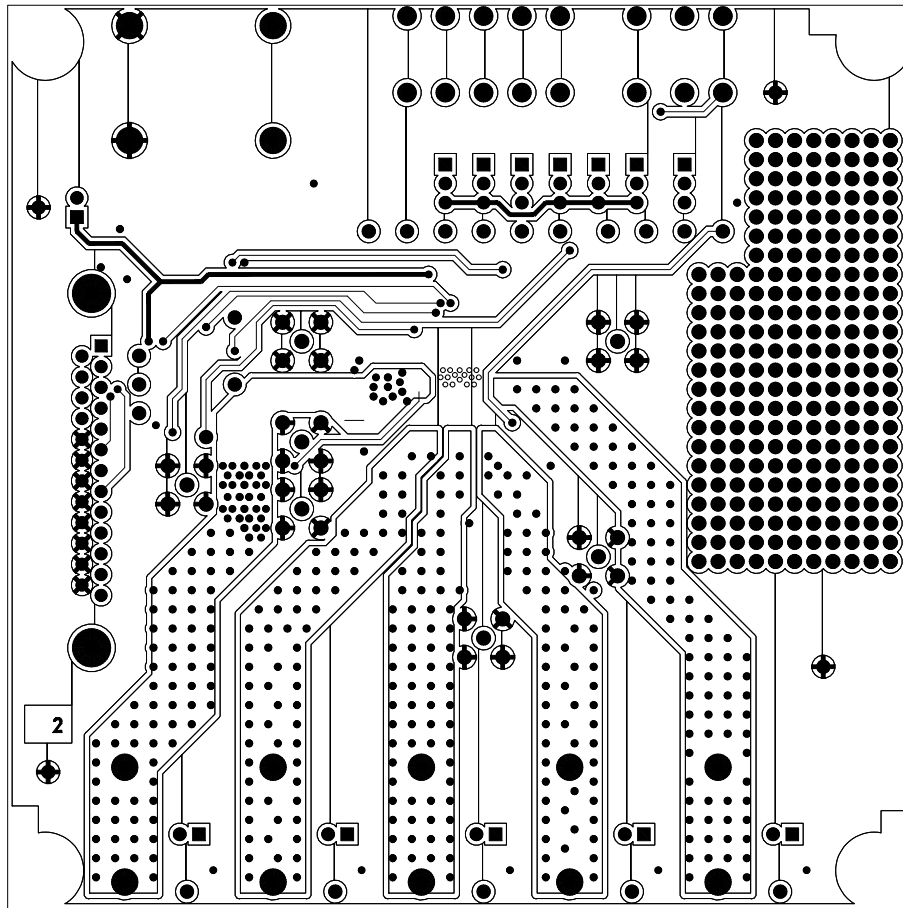


Figure 5. Assembly Layer Bottom

### 9.3 Top Layer Routing

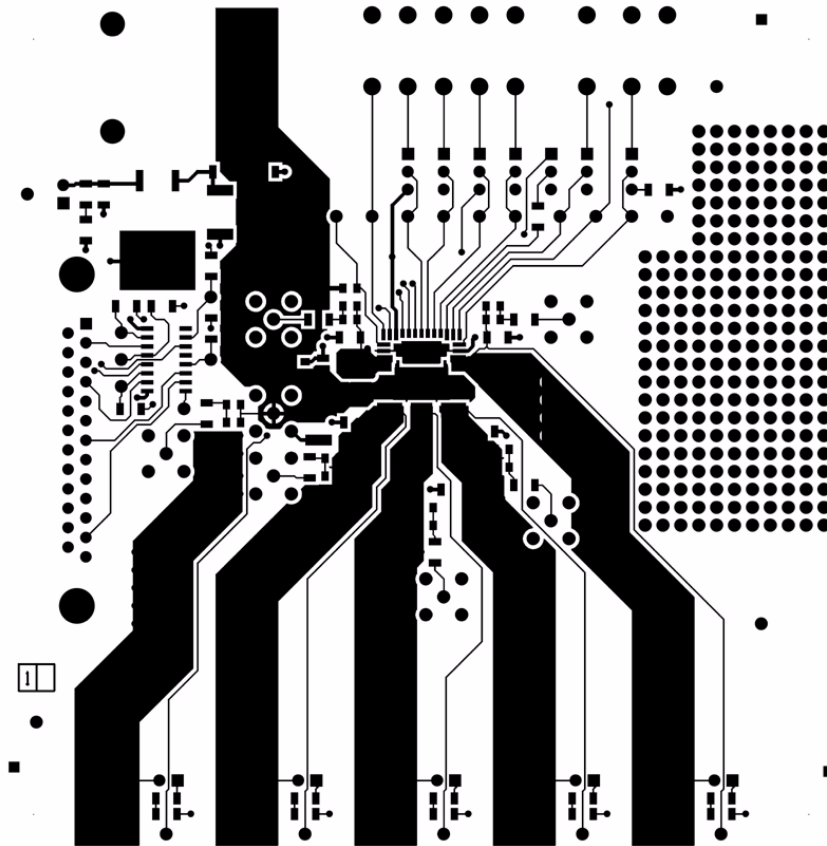


Figure 6. Top Layer Routing

## 9.4 Bottom Layer Routing

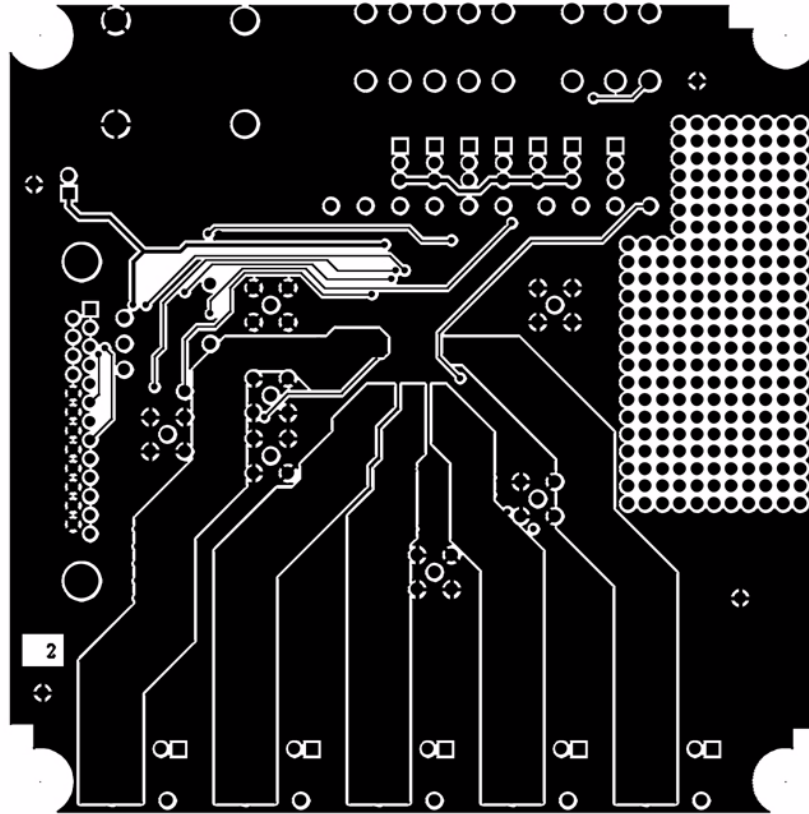
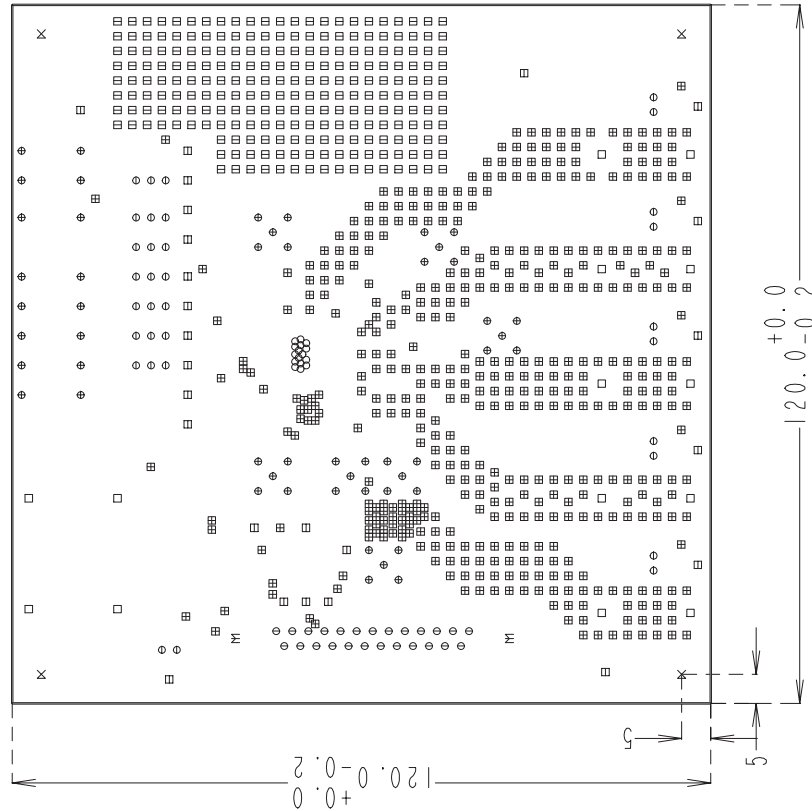


Figure 7. Bottom, Layer Routing

## 9.5 Drill Location

TABEAU DES Ø DE PERÇAGE, METALLISATION FINIE.

SYMBOLE	DIA.	QUANT.	METAL.	TOL.
○	0.25	16	OUI	---
⊞	0.50	445	OUI	---
⊕	0.90	25	OUI	---
⊞	1.00	25	OUI	---
⊖	1.10	33	OUI	---
⊞	1.20	232	OUI	---
⊕	1.30	51	OUI	---
□	2.20	14	OUI	---
M	3.20	2	OUI	---
K	3.20	4	NON	---



**FABRICATION CLASSE 4**

TOL. USIN.: UTE C 93703 § 6.7  
 FLECHE MAX: 0.1 %  
 MASQUE: VERNIS PHOTO-IMAGEABLE VERT  
 MARQUAGE: ENCRE BLANCHE THERMODURCISSABLE  
 PROTECTION: Ni/Au Chimique

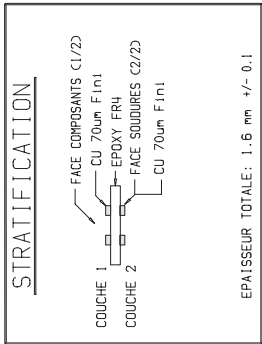


Figure 8. Holes Layer

# 10 Bill of Material

**Table 1. KIT06XS3517EVBE Bill of Material<sup>(1)</sup>**

Part	Footprint	Qty	Ref
<b>Freescale MC06XS3517AFK</b>	<b>PQFN24</b>	<b>1</b>	<b>U3</b>
BANANA RED		6	CN2 CN3 CN4 CN5 CN6 CN7
BANANA BLACK		1	CN1
Capacitor 22uF 16V 10%	1812	1	C14
DB25	SUBD_25_MC	1	J1
NXP SCHOTTKY Diode PRL5819 40V 1A	SOD87	1	D7
LED Green	LED1206	6	D1 D2 D3 D4 D5 D6
Capacitor C0805 100nF 50V 10%	C0805	2	C8 C16
Capacitor C1206 1uF 50V 10%	C1206	2	C3 C15
Capacitor 1812 47uF 10V 10%	1812	1	C2
Capacitor 1206 100nF 50V 10%	C1206	1	C1
Capacitor C1206 22nF DNP 50V 10%	C1206 DNP	5	C5 C7 C9 C11 C13
Capacitor C0805 1nF 50V 5%	C0805	6	C6 C22 C23 C24 C25 C26
Capacitor C0805 10nF 50V 10%	C0805	6	C4 C17 C18 C19 C20 C21
Test Point	5001	4	TP8 TP9 TP10 TP11
Test Point	5000	21	TP1 TP2 TP3 TP4 TP5 TP6 TP7 TP12 TP13 TP14 TP15 TP16 TP17 TP18 TP19 TP20 TP21 TP22 TP23 TP24 TP25
10k Resistor +/-1%	R1206	5	R12 R13 R14 R15 R16
NXP MC74HC4050	SO16	1	U2
STM I7805CD2T	D2PAK	1	U1
1k Resistor +/-1%	R1206	7	R3 R4 R5 R6 R7 R22 R23
Jumper	CON_2_2,54	6	JMP8 JMP9 JMP10 JMP11 JMP12 JMP13
Jumper	CON_3_2,54	7	JMP1 JMP2 JMP3 JMP4 JMP5 JMP6 JMP7
SMA Connector	SMA	7	J2 J3 J4 J7 J8 J9 J11 (Not Populated)
Resistor 10 +/-1%	R1206	6	R2 R17 R18 R19 R20 R21
Resistor 470 +/-1%	R1206	1	R1

**Notes**

1. Freescale does not assume liability, endorse, or warrant components from external manufacturers that are referenced in circuit drawings or tables. While Freescale offers component recommendations in this configuration, it is the customer's responsibility to validate their application.

## 11 References

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

Document Number	Type	Description/URL
MC06XS3517	Data Sheet	<a href="#">Smart High Side Switch Module (Triple 6.0 mOhm and Dual 17 mOhm)</a>
	Freescale Website	<a href="http://freescale.com">freescale.com</a>
	Freescale Analog Webpage	<a href="http://freescale.com/analog">freescale.com/analog</a>
	Freescale Automotive Applications Webpage	<a href="http://freescale.com/automotive">freescale.com/automotive</a>

### 11.1 Support

Visit [Freescale.com/support](http://Freescale.com/support) for a list of phone numbers within your region.

### 11.2 Warranty

Visit [Freescale.com/warranty](http://Freescale.com/warranty) for a list of phone numbers within your region.

## 12 Revision History

REVISION	DATE	DESCRIPTION OF CHANGES
1.0	8/2012	<ul style="list-style-type: none"> <li>Initial Release</li> </ul>
2.0	10/2012	<ul style="list-style-type: none"> <li>Added PCB layers: top and bottom routing, also bottom assembly</li> <li>Improved readability of PCB drill hole location diagram (Figure 8)</li> <li>Clarified text and updated format</li> </ul>





**How to Reach Us:**

**Home Page:**

freescale.com

**Web Support:**

freescale.com/support

Information in this document is provided solely to enable system and software implementers to use Freescale products. There are no express or implied copyright licenses granted hereunder to design or fabricate any integrated circuits on the information in this document.

Freescale reserves the right to make changes without further notice to any products herein. Freescale makes no warranty, representation, or guarantee regarding the suitability of its products for any particular purpose, nor does Freescale assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation consequential or incidental damages. "Typical" parameters that may be provided in Freescale data sheets and/or specifications can and do vary in different applications, and actual performance may vary over time. All operating parameters, including "typicals," must be validated for each customer application by customer's technical experts. Freescale does not convey any license under its patent rights nor the rights of others. Freescale sells products pursuant to standard terms and conditions of sale, which can be found at the following address: <http://www.reg.net/v2/webservices/Freescale/Docs/TermsandConditions.htm>

Freescale, the Freescale logo, Altivec, C-5, CodeTest, CodeWarrior, ColdFire, C-Ware, Energy Efficient Solutions logo, mobileGT, PowerQUICC, QorIQ, Qorivva, StarCore, and Symphony are trademarks of Freescale Semiconductor, Inc., Reg. U.S. Pat. & Tm. Off. Airfast, BeeKit, BeeStack, ColdFire+, CoreNet, Flexis, MagniV, MXC, Platform in a Package, Processor expert, QorIQ Qonverge, QUICC Engine, Ready Play, SMARTMOS, TurboLink, Vybrid, and Xtrinsic are trademarks of Freescale Semiconductor, Inc. All other product or service names are the property of their respective owners.

© 2012 Freescale Semiconductor, Inc.

Document Number: KT06XS3517UG

Rev. 2.0

10/2012