Freescale Semiconductor
User's Guide

KIT33932EKEVBE Evaluation Board

Figure 1. KIT33932EKEVBE

Table of Contents

1 Kit Contents / Packing List

- KIT33932EKEVBE Evaluation Board (EVB)
- Hardware Document CD, CD33932EK
- Warranty Card, Freescale, 920-75133, Rev. A
- Technical Information Center Freescale Semiconductor, Inc. BR1530
- FCC Disclaimer, Freescale, 926-75760, Rev A

2   Important Notice

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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.

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1   Kit Introduction

The **KIT33932EKEVBE** Evaluation Board (EVB) is an easy-to-use circuit board that allows the user to exercise all the functions of the MC33932 H-Bridge circuit. The EVB parallel input can be easily controlled through a USB/SPI Dongle connected to a PC's USB port. The Freescale SPIGen program provides the User Interface to the USB/SPI Dongle and allows the user to send commands to the IC.

2 Kit Features

This EVB consists of a Dual H-Bridge, a parallel interface, power conditioning circuitry, and a set of 8 Input Select Jumpers. All +5 volt VDD power required by the EVB is obtained via the parallel interface.

3 Product Features

The 33932 is a monolithic H-Bridge Power IC in a robust thermally enhanced package. The 33932 has two independent monolithic H-Bridge Power ICs in the same package. They are designed primarily for automotive electronic throttle control, but are applicable to any low-voltage DC servo motor control application within the current and voltage limits stated in this specification.

Each H-bridge in the 33932 is able to control inductive loads with currents up to 5.0 A peak. RMS current capability is subject to the degree of heatsinking provided to the device package. Internal peak-current limiting (regulation) is activated at load currents above 6.5 A ±1.5 A. Output loads can be pulse width modulated (PWM-ed) at frequencies up to 11 kHz. A load current feedback feature provides a proportional (0.24% of the load current) current output suitable for monitoring by a microcontroller's A/D input. A Status Flag output reports under-voltage, over-current, and over-temperature fault conditions.

Two independent inputs provide polarity control of two half-bridge totem-pole outputs. Two independent disable inputs are provided to force the H-bridge outputs to tri-state (high-impedance off-state).

4 Hardware Description

4.1 Recommended Equipment

- PC Computer running Windows XP
- 5 V-40 V Power Supply
- USB Cable
- KITUSBSPIDGLEVME

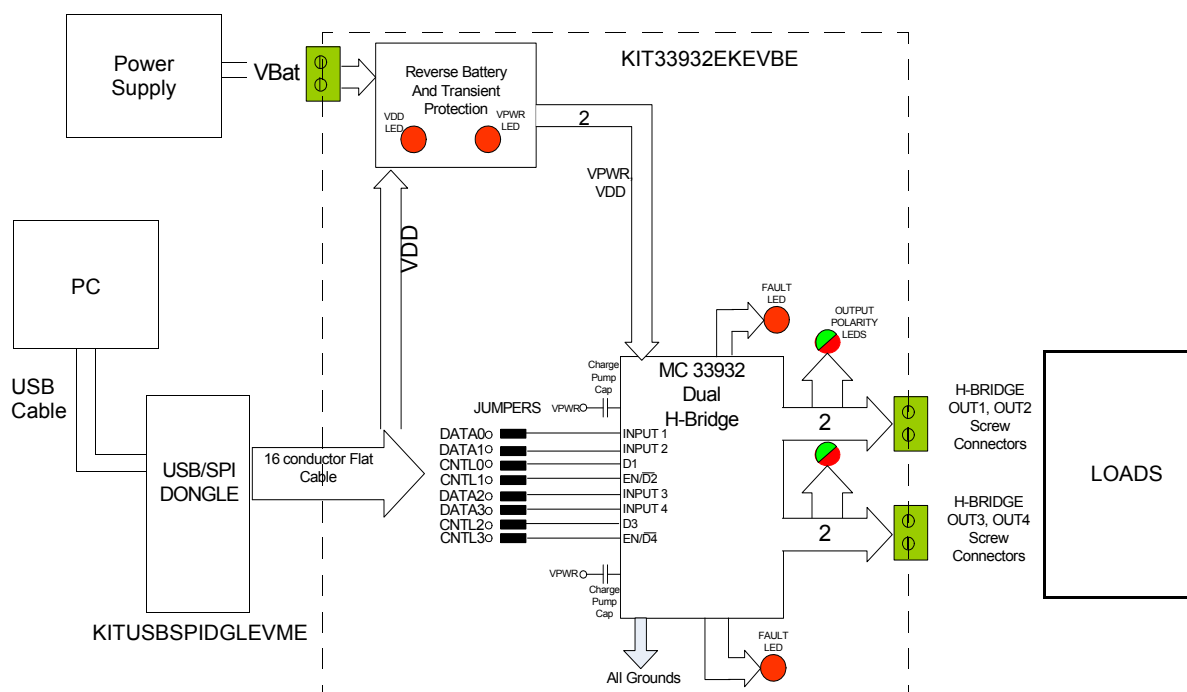The Hardware Block Diagram is shown below:

Figure 2. Block Diagram

4.2 LED Display

Several LED's are provided as visual output devices for the EVB. A list of the LED devices is shown below:

1. VDD LED - Indicates when +5 Volt supply is connected
2. VPWR LED - Indicates when +12 Volt supply is connected
3. Fault LEDs - Illuminates when one of the H-Bridges detects a fault
4. Output LEDs - Red/Green LED, for each H-Bridge, that indicates which direction the current is flowing in the legs of the H-Bridge.

4.3   I/O Jumper Definitions (J3)

The EVB contains seven jumpers that connect the inputs of the 33932 as follows (**Bold** = factory setting):

JUMPER NAME	JUMPER POSITION	CONNECTION
INPUT 1	1-2/**2-3**	GND/**DATA0**
INPUT 2	1-2/**2-3**	GND/**DATA1**
INPUT3	1-2/**2-3**	GND/**DATA2**
INPUT4	1-2/**2-3**	GND/**DATA3**
ENABLE/DISABLE 2	**1-2**/2-3	**PullUp**/CNTL1
ENABLE/DISABLE 4	**1-2**/2-3	**PullUp**/CNTL3
DISABLE 1	1-2/**2-3**	CNTL0/**GND**
DISABLE_2B	**1-2**/2-3	**GND**/CNTL2

The DATA0 -DATA3 and CNTL0 - CNTL3 signals are parallel outputs from the USB/SPI Dongle that can be controlled directly from the SPIGen program. An example config file called "MC33932_EVB_CONFIGURATION_FILE.spi" is provided on the CD which contains a batch file example.

If the user prefers to supply the various MC33932 input signals externally, other than from the USB-SPI Interface, the jumpers can be removed and connections can be made to the open pin number 2' s.

4.4   USB/SPI Dongle Connector

The USB/SPI dongle connector is a 16 pin, .1" center, dual-row connector that is designed to interface directly to the USB/SPI Dongle unit. The USB/SPI dongle connector consists of the following 16 pins –

Pin Number	Name	Description
1	CSB	SPI signal, Chip Select Bar
2	CNTL2	Parallel port signal CNTL2
3	SO	SPI signal, Serial Out
4	CNTL1	Parallel port signal CNTL1
5	SI	SPI signal, Serial In
6	CNTL0	Parallel port signal CNTL0
7	SCLK	SPI signal, Serial Clock
8	DATA4	Parallel port signal DATA4
9	CNTL3	Parallel port signal CNTL3
10	DATA3	Parallel port signal DATA3
11	VDD	+5 Volt VDD from USB
12	DATA2	Parallel port signal DATA2
13	NC	Unused
14	DATA1	Parallel port signal DATA1
15	GND	Signal Ground
16	DATA0	Parallel port signal DATA0

This connector mates with the 16 conductor flat cable that connects to the USB/SPI Dongle (KITUSBSPIDGLEVME).

4.5   Screw Terminal Connections

The EVB contains input and output screw terminal connections to allow easy access to the MC33932's drive circuits.

The diagram below shows the locations of the screw terminals and their functional definitions:
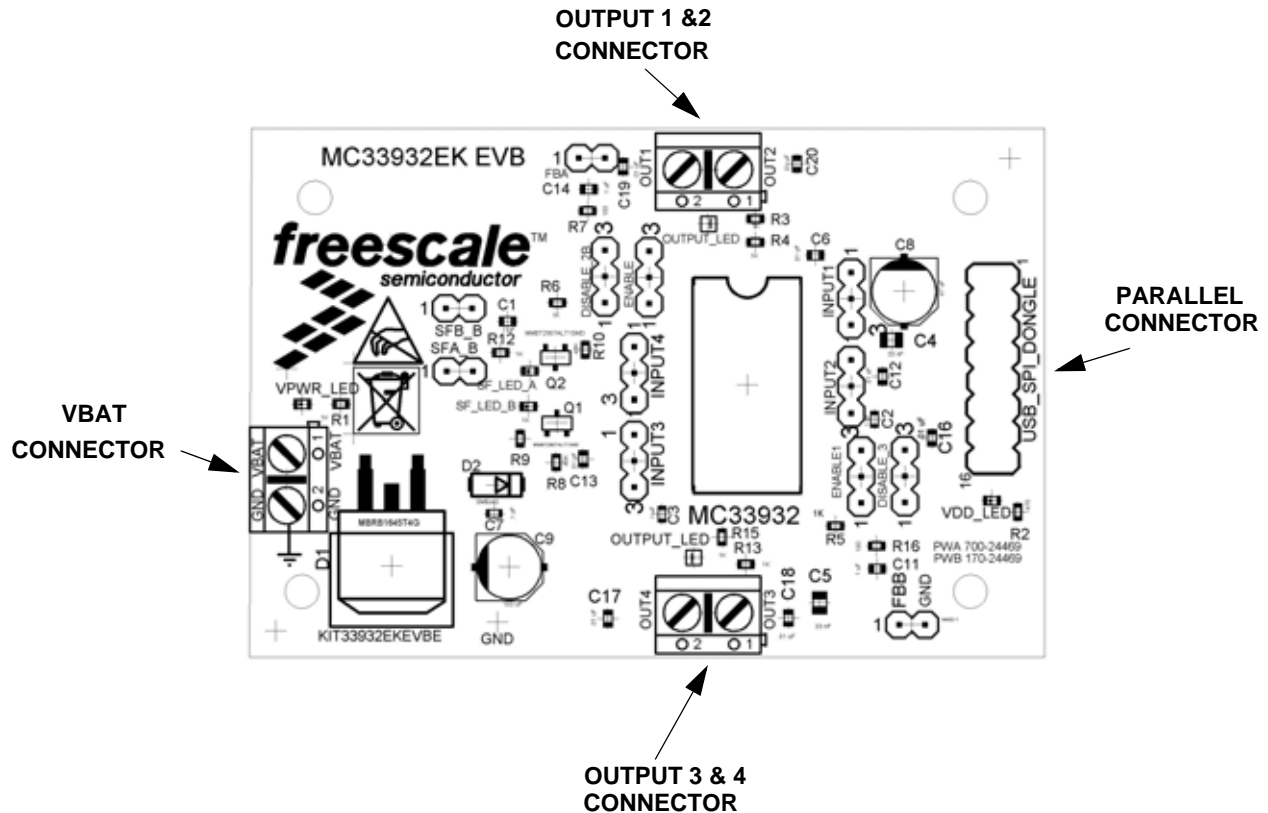

Figure 3. Screw Terminals with Definitions

4.6   VBAT Connector

The VBAT Connector is a 2 position screw terminal that provides +12 Volt and Ground Terminals. The Ground terminal is marked "**GND**" and the +12 Volt Terminal is marked "**VBAT**".

4.7   H-Bridge Output Connectors

The H-Bridge Output Connectors are 2 position screw terminals that provides the following two connections:

1) Output 1/2 of the H-Bridge

2) Output 3/4 of the H-Bridge

For H-Bridge A the output 1 connector is labeled "**OUT1**"

For H-Bridge A the output 2 connector is labeled "**OUT2**"

For H-Bridge B the output 3 connector is labeled "**OUT3**"

For H-Bridge B the output 4 connector is labeled "**OUT4**"

5   Setup and Example Demonstrations

To perform the examples included in the CD the following connections and setup must be performed:

1. Make sure the SPIGen 5.0X program is installed on the PC and it can communicate with the USB/SPI Dongle as described in that kit's documentation.
2. Connect the USB/SPI Dongle to the EVB via a 16 pin ribbon cable. Make sure to orient the cable so that pin1 on both the USB/SPI Dongle and the EVB are connected correctly, pin 1 to pin 1.
3. Connect the USB/SPI Dongle to a PC, LED 2 on the USB/SPI Dongle and the VDD LED on the board should both be illuminated.
4. Attach a +12 VDC supply (do not turn on power yet) to the power connector on the EVB, making sure to observe the GND and +12V terminals. The current capability of the +12V supply should exceed the maximum total current that the number of simultaneously ON loads will require.
5. Attach loads to the OUT1/2 and OUT3/4 terminals. One possible demo load is a 10w halogen G4 Base T3 bulb (used in landscape lighting applications). This load will draw approximately 850 mA and fits nicely into the screw terminals.
6. Launch SPIGen and from the "**File**" menu, select "**Open**" and browse to the CD containing the "MC33932_EVB_CONFIGURATION_FILE.spi" file. The title on the SPIGen screen should change from "Generic SPI Generator" to "MC33932 SPI Generator".
7. Turn on the +12 Volt Supply. Verify that all is working correctly by clicking on the "Extra Pins" button in the SPIGen main screen and then click on the following buttons to set the up the proper conditions:
   A. Control 0 "**Low**"
   B. Control 1 "**High**"
   C. Control 2 "**Low**"
   D. Control 3 "**High**"
8. Next, click on the Data 0 "**High**" button. The OUT1/2 load or bulb should turn on. The OUT 1/2 LED should be glowing green. Clicking on the DATA 0 "**Low**" button should turn off the load or bulb and the OUT 1/2 LED.

   Next, click on the Data 1 "**High**" button. The OUT1/2 load or bulb should turn on. The OUT 1/2 LED should be glowing red. Clicking on the DATA 1 "**Low**" button should turn off the load or bulb and the OUT 1/2 LED.
9. Next, click on the Data 2 "**High**" button. The OUT3/4 load or bulb should turn on. The OUT 3/4 LED should be glowing green. Clicking on the DATA 2 "**Low**" button should turn off the load or bulb and the OUT 3/4 LED.
10. Next, click on the Data 3 "**High**" button. The OUT3/4 load or bulb should turn on. The OUT 3/4 LED should be glowing red. Clicking on the DATA 3 "**Low**" button should turn off the load or bulb and the OUT 3/4 LED. If everything described so far occurs then you are ready to proceed with the remaining examples.

EXAMPLE 1. RUNNING THE TEST BOTH H-BRIDGES BATCH FILE

1. Click on the "Send a Batch of Commands" Tab in the SPIGen main screen.
2. In the box below the "Commands to Send:" column is a pull-down menu box containing several batch file names. One of these example batch files is labeled "**Test Both H-Bridges**".
3. Click on this label to load it. You should see a list of commands in the "Command to Send" box.
4. Click on the "**Continuous**" button and observe that the loads or bulbs you have attached to the EVB board are blinking twice and then going out in succession.

There are other demo batch examples that can be run and examined for learning how to use the EVB.
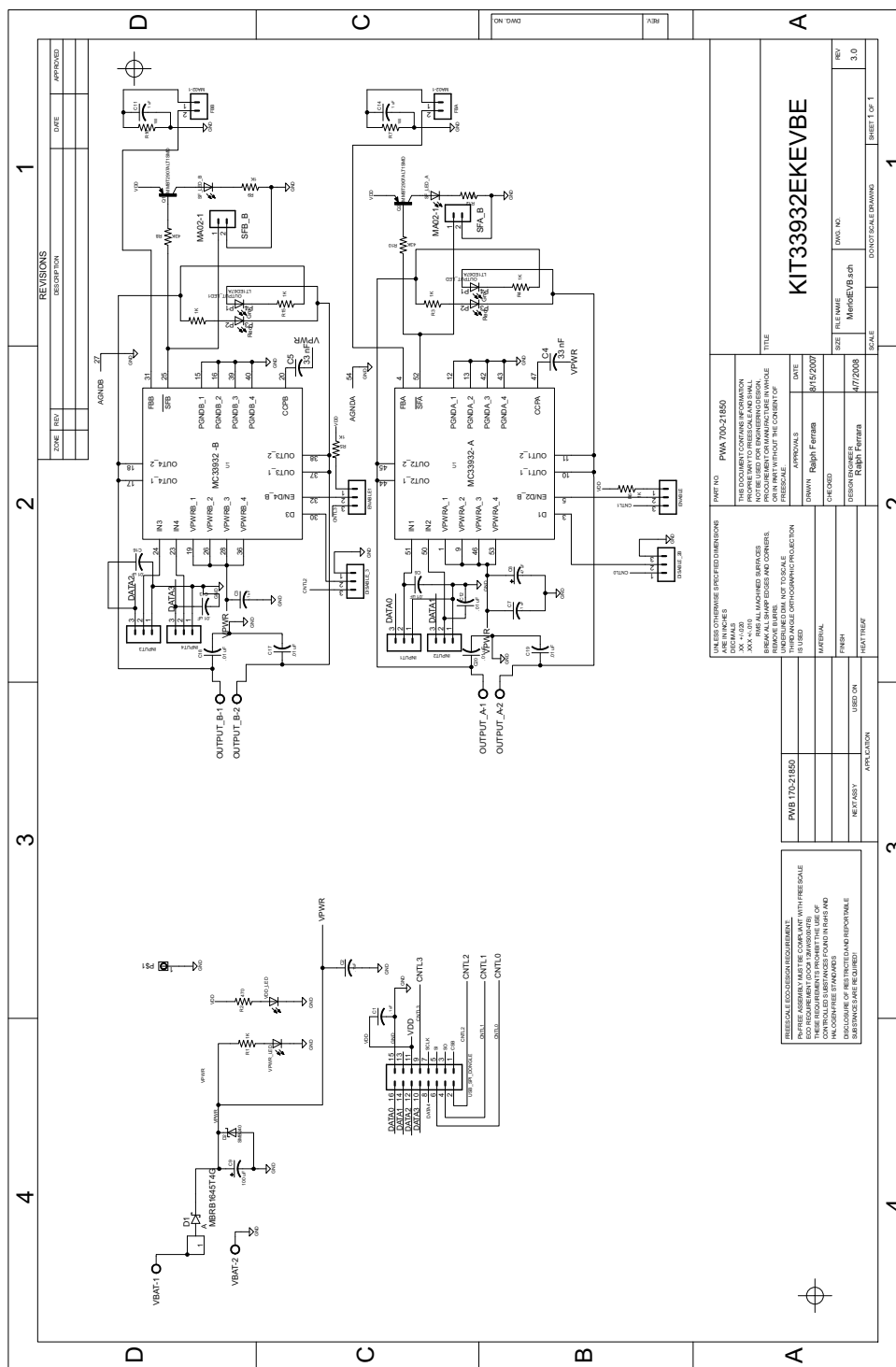
6   EVB Schematic

Figure 4. KIT33932EKEVBE Schematic

7 Board Layout

7.1 Assembly Layer Top
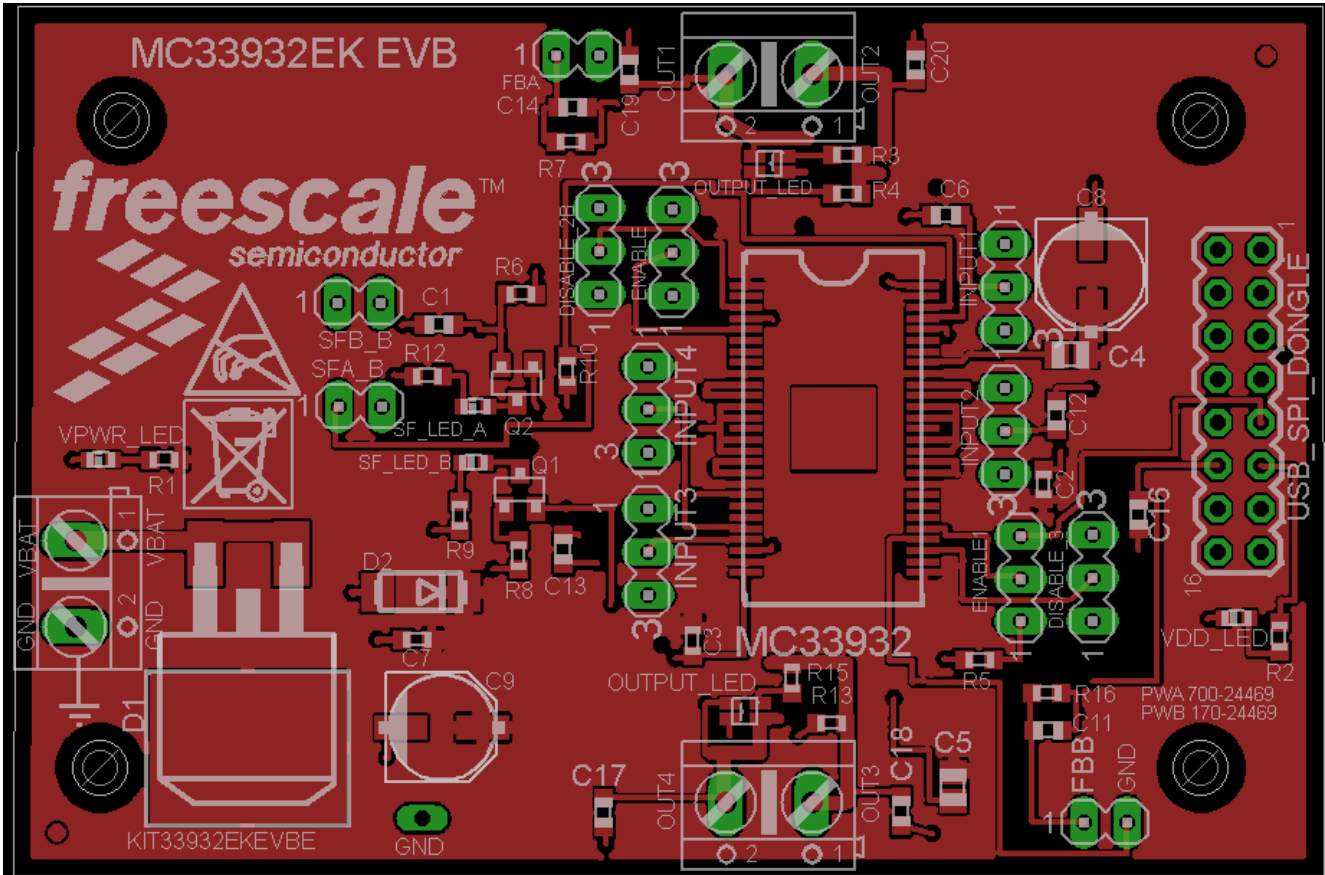
Figure 5. Assembly Layer Top

7.2   Assembly Layer Bottom
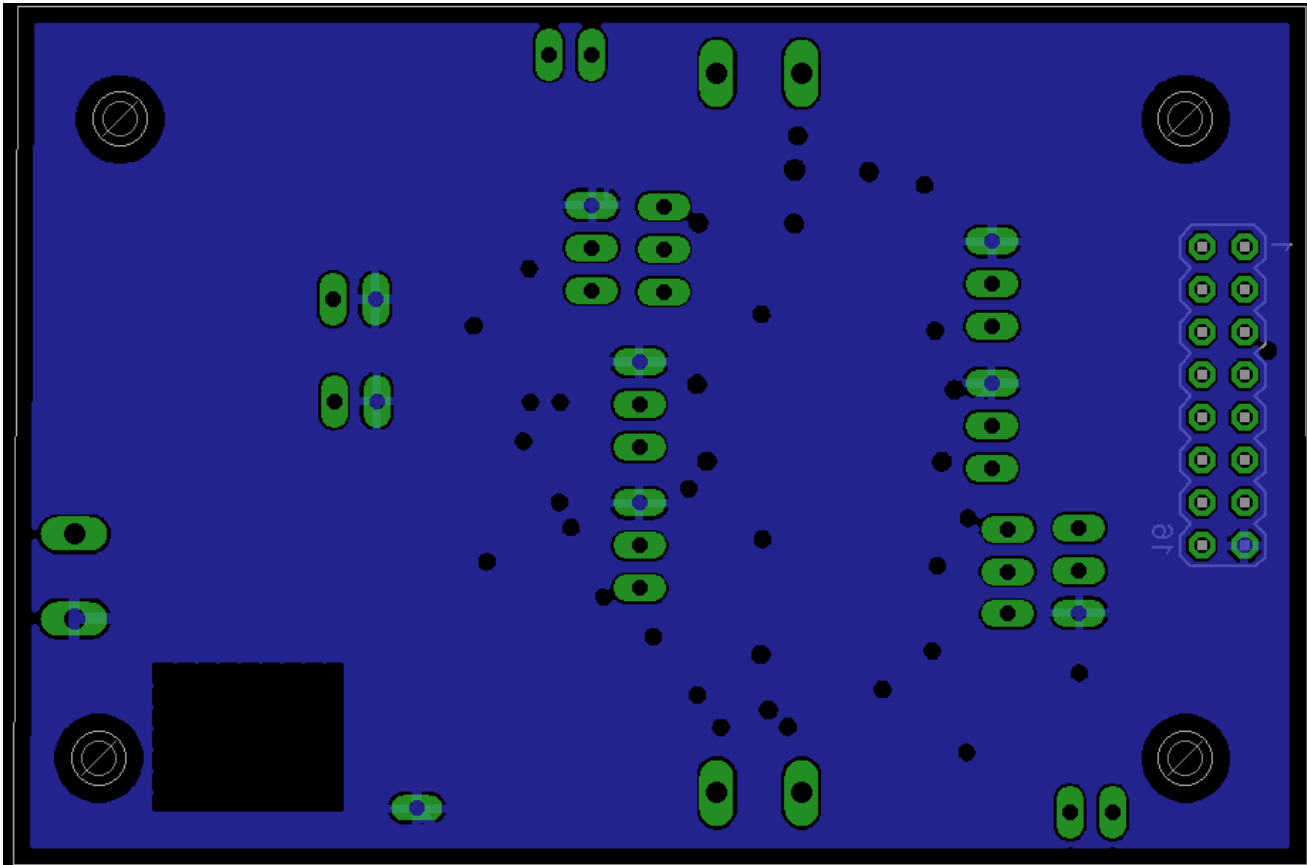
Figure 6. Assembly Layer Bottom

8　Bill of Material

Freescale MC33932					
Item	Qty	Ref Des	Value	Description	Package
1	4	C1, C2, C3, C7	0.1µF	CAP CER 0.1UF 25V 10% X7R 0603	0603 (1608 Metric)
2	2	C11, C14	1.0µF	CAP CER 1UF 35V 10% X5R 0603	0603 (1608 Metric)
3	2	C4,C5	0.033µF	CAP CER 0.033UF 50V 10% X7R 0805	0805 (2012 Metric)
4	8	C6, C12, C13, C16, C17, C18, C19, C20	10000pF	CAP CER 10000PF 50V 10% X7R 0603	0603 (1608 Metric)
5	1	C8	47µF	CAP ALUM 47UF 35V 20% SMD	Radial, Can - SMD
6	1	C9	100µF	CAP ALUM 100UF 35V 20% SMD	Radial, Can - SMD
7	1	D1	SCHOTTKY	DIODE SCHOTTKY 45V 16A D2PAK	D2PAK, TO-263
8	1	D2	40V	DIODE TVS 40V 600W UNIDIR 5% SMB	DO-214AA, SMB
9	8	DISABLE_2B, DISABLE_3, ENABLE, ENABLE1, INPUT1, INPUT2, INPUT3, INPUT4	MA03-2	CONN HEADER VERT .100 3POS 15AU	
10	4	FBA, FBB, SFA_B, SFB_B	MA02-1	CONN HEADER VERT .100 2POS 15AU	
11	1	GND TP	MA01-1	CONN HEADER VERT .100 1POS 15AU	
12	3	OUTPUT_A, OUTPUT_B, VBAT	2POS	CONN TERM BLOCK 2POS 5.08MM PCB	Term Block
13	2	OUTPUT_LED, OUTPUT_LED1		LED YELGRN/RED 565/635 DIFF 1616	0606 (1616 Metric)
14	2	Q1, Q2	PNP	TRANSISTOR SWITCHING PNP SOT-23	TO-236-3, SC-59, SOT
15	9	R1, R3, R4, R5, R6, R9, R12, R13, R15	1K	RES 1.0K OHM 1/10W 5% 0603 SMD	0603 (1608 Metric)
16	1	R2	470	RES 470 OHM 1/10W 5% 0603 SMD	0603 (1608 Metric)
17	2	R7, R16	100	RES 100 OHM 1/10W 5% 0603 SMD	0603 (1608 Metric)
18	2	R8, R10	43K	RES 43K OHM 1/10W 5% 0603 SMD	0603 (1608 Metric)
19	2	SF_LED_A, SF_LED_B	RED	LED RED HI BRT SS TYPE LO CUR SM	0603 (1608 Metric)
20	2	VDD_LED, VPWR_LED	GREEN	LED GREEN USS TYPE 0603	0603 (1608 Metric)
21	1	USB_SPI_DONGLE	MA08-2	CONN HDR BRKWAY .100 08POS VERT	
22	1	U1	MC33932EK	DUAL 5A H-BRIDGE	54LD SOIC-EP

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

9 References

The following table provides Web links where you can obtain information on additional Freescale products and application solutions:

Document Number	Type	Description/URL
MC33932	Data Sheet	freescale.com/files/analog/doc/data_sheet/MC33932.pdf
AN2409	Application Note	Small Outline Integrated Circuit Fine Pitch Package (SOIC): freescale.com/files/analog/doc/app_note/AN2409.pdf
	Freescale Website	freescale.com
	Freescale Analog Web page	freescale.com/analog

10 Revision History

REVISION	DATE	DESCRIPTION OF CHANGES
1.0	6/2012	• Initial Release

KIT33932EKEVBE, Rev. 1.0

How to Reach Us:

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Document Number: KT33932EKUG
Rev. 1.0
6/2012