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KIT22XS4200EKEVB Evaluation Board

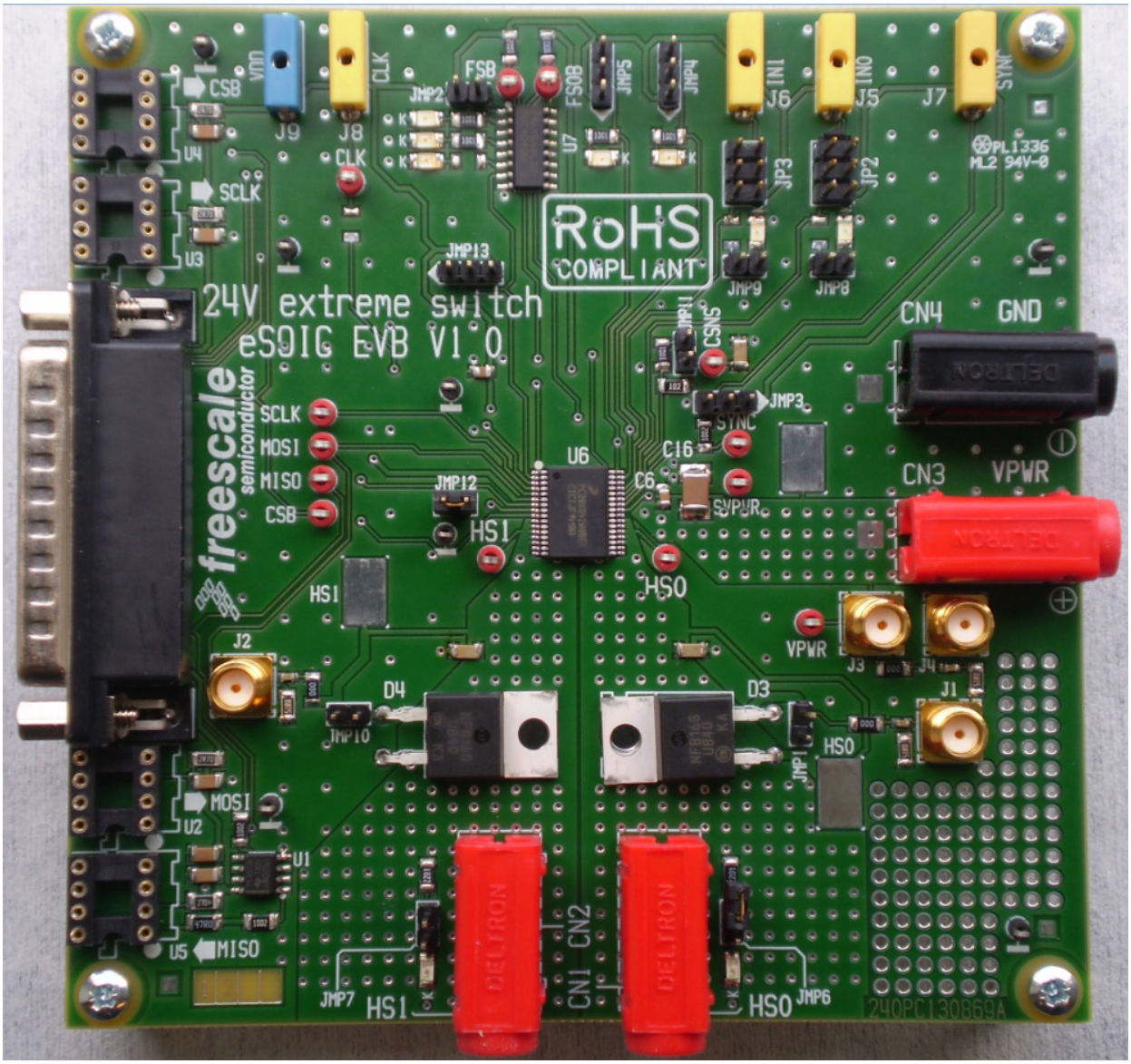

Figure 1. KIT22XS4200EKEVB

Contents

1 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 evaluation board 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 evaluation board 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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2 Getting Started

2.1 Kit Contents/Packing List

The **KIT22XS4200EKEVB** contents include:

- Assembled and tested evaluation board/module in anti-static bag.
- Quick Start Guide, Analog Tools
- Warranty card

2.2 Jump Start

Freescale's analog product development boards help to easily evaluate Freescale products. These tools support analog mixed signal and power solutions including monolithic ICs using proven high-volume SMARTMOS mixed signal technology, and system-in-package devices utilizing power, SMARTMOS and MCU dies. Freescale products enable longer battery life, smaller form factor, component count reduction, ease of design, lower system cost and improved performance in powering state of the art systems.

- Go to www.freescale.com/analogtools
- Locate your kit
- Review your Tool Summary Page
- Look for

- Download documents, software and other information

Once the files are downloaded, review the user guide in the bundle. The user guide includes setup instructions, BOM and schematics. Jump start bundles are available on each tool summary page with the most relevant and current information. The information includes everything needed for design.

2.3 Required Equipment and Software

To use this kit, you need:

- DC power supply capable of supplying up to 40 A at 6.0 to 58 V
- Electronic/resistive loads to load the various power channels
- 5.0 V Power supply, 1.0 A current capability
- KITUSBSPIEVME Interface Dongle
- USB cable with termination Type A and Type B
- DB25 cable (optional)

2.4 System Requirements

The kit requires the following to function properly with the software:

- USB enabled computer with Windows Vista, Windows 7
- CD Reader

3 Getting to Know the Hardware

3.1 Board Overview

The KIT22XS4200EKEVB demonstrates the capability of the MC22XS4200 as a 24 V dual high-side switch that provides integrated control with protective and diagnostic functions.

This product has been designed for truck, bus, and industrial applications. The low $R_{DS(on)}$ channels (< 22 mΩ) control different load types; bulb lamps, solenoids, or DC motors. Control, device configuration, and diagnostics are performed through a 16-bit SPI interface, allowing easy integration into existing applications.

Both channels can be controlled individually by external/internal clock signals or by direct inputs. Using the internal clock allows fully autonomous device operation. Programmable output voltage slew rates (individually programmable) helps improve EMC performance. To avoid shutting off the device upon inrush current, while still being able to closely track the load current, a dynamic overcurrent threshold profile is featured. Switching current of each channel can be sensed via a programmable sensing ratio. Whenever communication with the external microcontroller is lost, the device enters a fail-safe operation mode, but remains operational, controllable, and protected.

3.2 Board Features

The board features are as follows:

- Input voltage operation range from 6.0 to 58 V
- Dual high-side switch
- Programming, control, and diagnostics accomplished via the use of a 16-bit SPI interface
- Output with selectable slew-rate satisfy electromagnetic compatibility (EMC) requirements
- Each output can be controlled with direct inputs or internal PWM modulated clock signal

3.3 Device Features

This evaluation board features the following Freescale product:

Table 1. Device Features

Device	Description	Features
MC22XS4200	The 22XS4200 device is part of a 24 V dual high-side switch product family with integrated control, and a high number of protective and diagnostic functions.	• Two fully-protected 22 mΩ (at 25 °C) high-side switches • Up to 3.0 A steady-state current per channel • Separate bulb and DC motor latched overcurrent handling • Individually programmable internal/external PWM clock signals • Overcurrent, short-circuit, and overtemperature protection with programmable autoretry functions • Accurate temperature and current sensing

3.4 Board Description

Figure 2 describes the main blocks of the KIT22XS4200EKEVB.

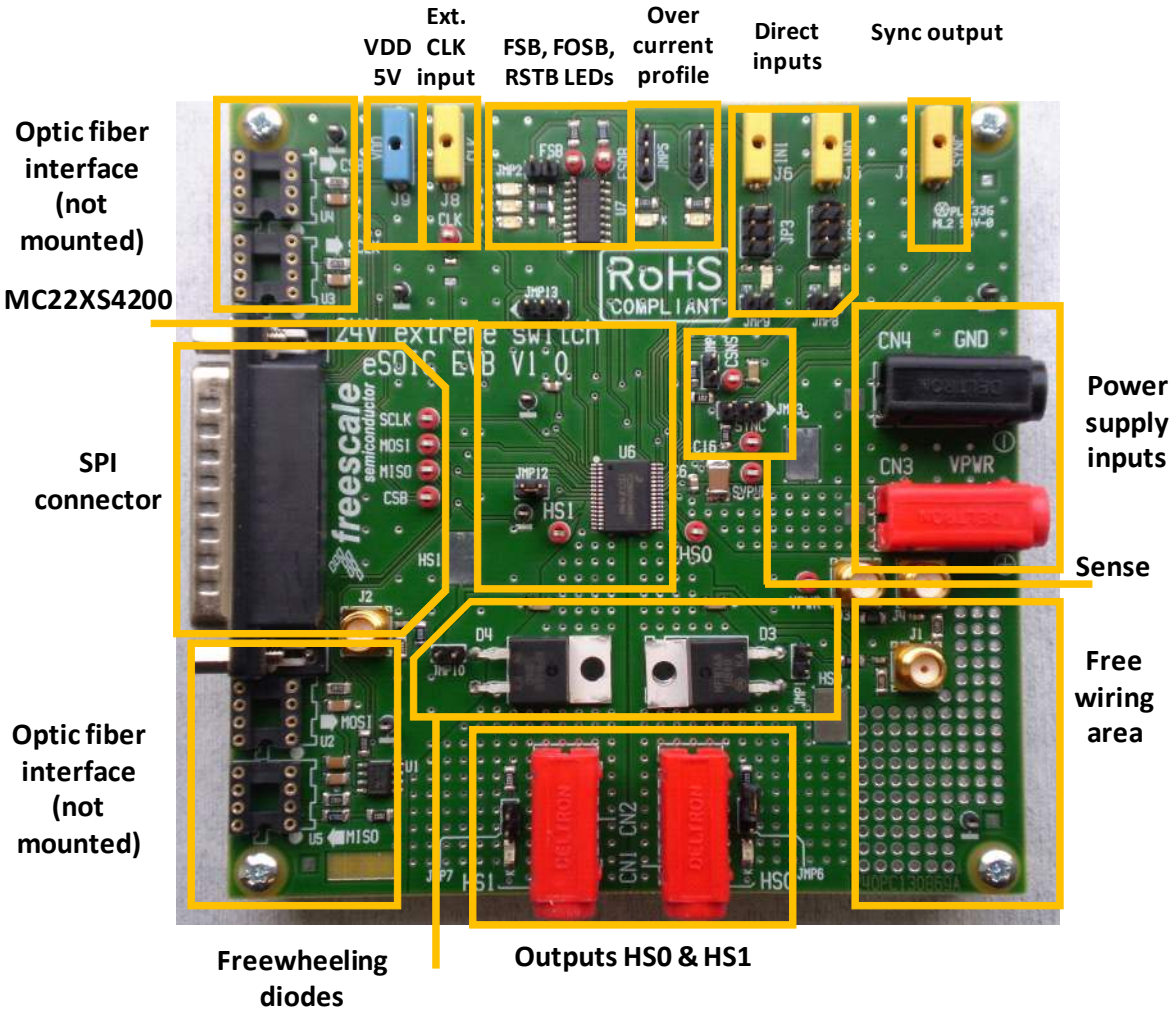


Figure 2. Board Description

Table 2. Board Description

Name	Description
VDD 5.0 V	Input connector for VDD supply 5.0 V
External Clock Input	Clock input connector for external PWM clock signal
FSB, FSOB, RSTB LEDs	LEDs for FSB, FSOB, RSTB states, LEDs are ON when three signals are active, (Example: when a fault is detected, FSB open drain is ON, LED will be ON). The LED feature is de-selectable
Over current profile	Jumpers to select either bulb or DC motor overcurrent handling
Direct Inputs	IN0 and IN1 direct inputs to control the outputs
Sync Output	Sync signal output to synchronize the ECU with sense current measurement
Power Supply Inputs	Connectors for VPWR from 6.0 V up to 58 V
Sense	CSNS output for current and temperature sensing
Free wiring area	Area for free wiring by user
Outputs HS0 & HS1	Outputs of the high-side switch
Optic Fibre Interface	Option to use fiber optic for SPI interface (not mounted)
SPI Interface	25 pin connector for SPI communication
MC22XS4200	Device high-side switch 22 mΩ output

3.5 LED Display

The following LEDs are provided as visual output devices for the KIT22XS4200EKEVB evaluation board:

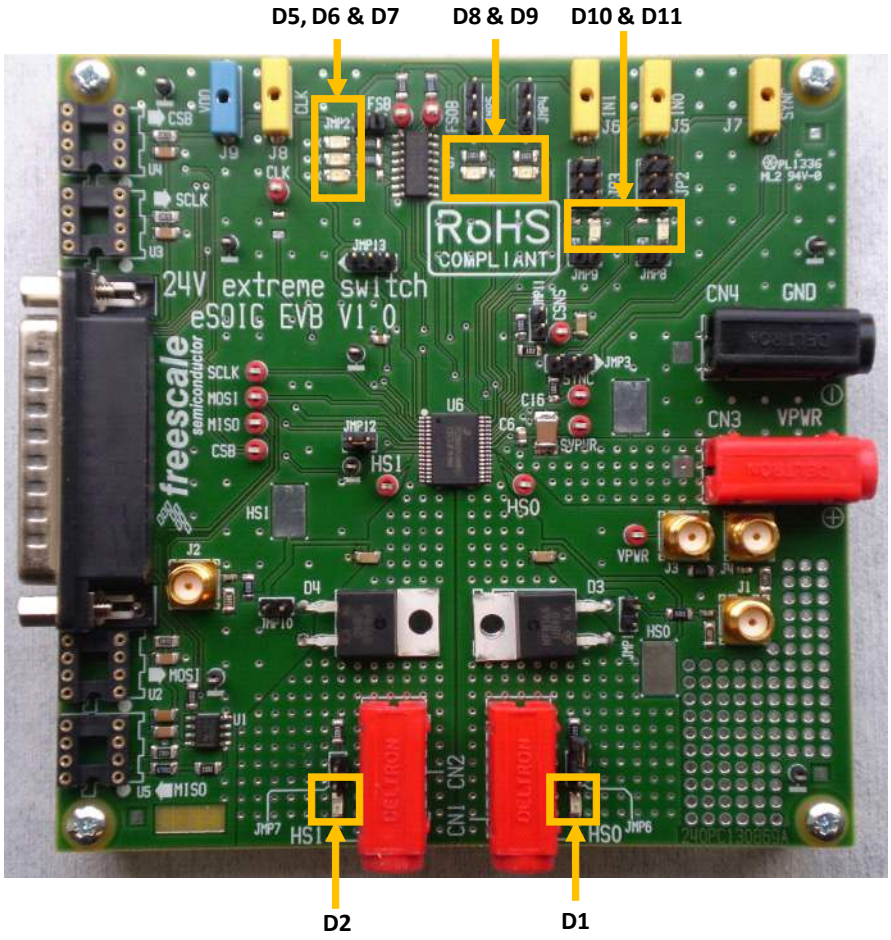


Figure 3. LED Display

Table 3. LED Display

LED ID	Description	Requires
D5	ON when FSB active i.e Fault detected (As FSB is open drain pin, FSB is close to GND when activated)	JMP2 connected
D6	ON when FS0B active i.e Fault detected on VDD or SPI (As FSOB is open drain pin, FS0B is close to GND when activated)	JMP2 connected
D7	ON when RSTB is low	JMP2 connected
D8	Reflects CONF0 state for channel 0 ON when CONF0 = 5.0 V ON when CONF0 = DC motor	JMP4 connected between position 1 & 2
D9	Reflects CONF1 state for channel 1 ON when CONF0 = 5.0 V ON when CONF0 = DC motor	JMP5 connected between position 1 & 2
D10	ON when IN0 = High	JMP8 connected
D11	ON when IN1 = High	JMP9 connected
D1	ON when HS0= High	JMP6 connected
D2	ON when HS1= High	JMP7 connected

3.6 Connectors

Connectors are intended to connect all external control signals and to connect outputs to loads. The GND reference for HS0 and HS1 is GND.

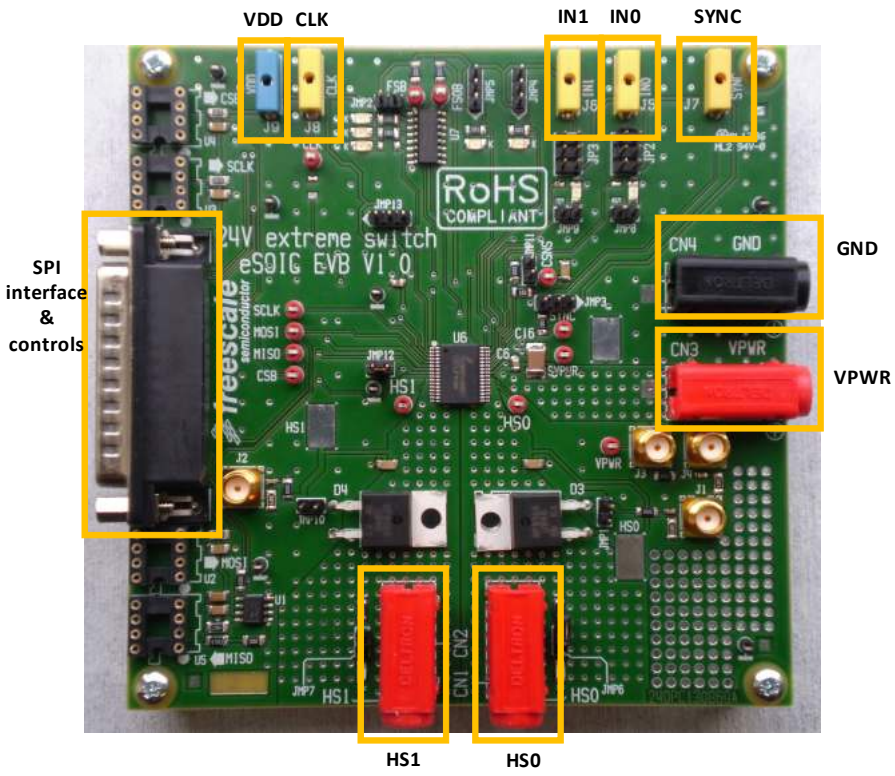


Figure 4. Connectors

Table 4. Connectors

Connector ID	Description
CN1	Output high-side switch channel 0
CN2	Output high-side switch channel 1
CN3	VPWR, 6.0 to 58 V
CN4	GND, ground reference
J5	Direct input for channel 0
J6	Direct input for channel 1

Table 4. Connectors (continued)

Connector ID	Description
J7	SYNC Output for current sense synchronization
JP1	SPI interface connector and controls **Note:** Control signal and fault signal from DB25 connector can be set through the USB to SPI interface 1. RSTB 2. CSB 3. MOSI 4. SCLK 5. IN0 6. IN1 7. SYNC 8. CONF0 9. CONF1 10. NC 11. NC 12. MISO 13. NC 14. NC 15. NC 16. FSOB 17. FSB 18. NC 19. NC 20. GND 21. NC 22. NC 23. NC 24. NC 25. NC

3.7 Test Point Definitions

The following test-point jumpers provide access to signals on the MC22XS4200 IC:

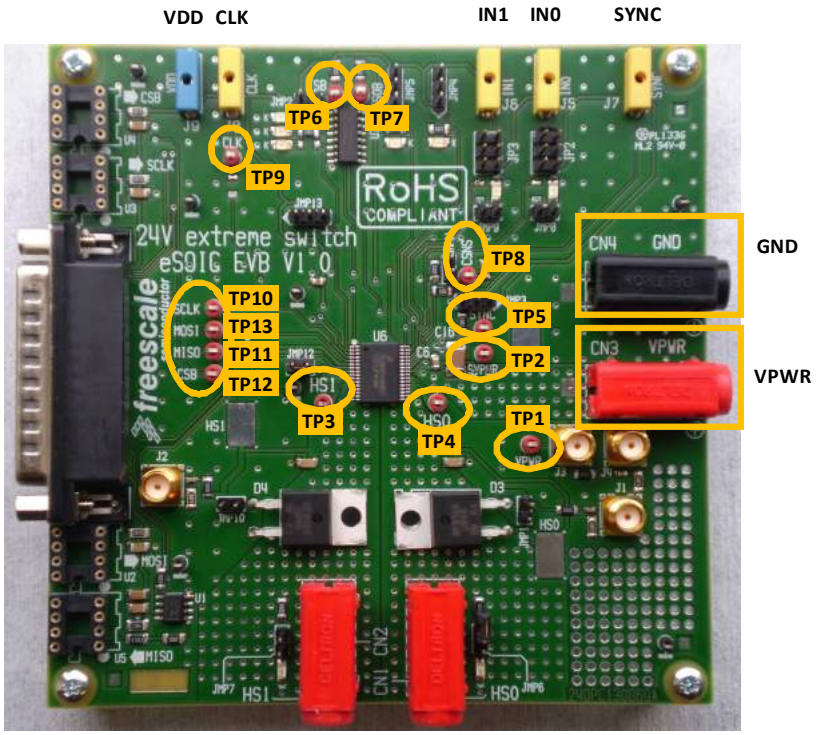


Figure 5. Test Point Definitions

Table 5. Test Point Definitions

Test Point	Name	Description
TP1	SV VPWR	Power supply sense
TP2	VP VPWR	Power supply
TP3	SHS1	High-side channel1 sense
TP4	SHS0	High-side channel0 sense
TP5	SYNC	Current sense synchronization
TP6	FSB	Fault status
TP7	FSOB	Fail-safe output
TP8	CSNS	Output current sense monitoring
TP9	CLK	PWM clock
TP10	SCLK	SPI serial clock
TP11	MISO	Serial Output (SO)
TP12	CSB	Chip select
TP13	MOSI	Serial Input (SI)

3.8 USB/SPI Dongle Connector

USB/SPI dongle connector mates with the 16 conductor flat cable connecting to the USB/SPI Dongle (KITUSBSPIDGLEVME).This is a 16 pin, 0.1” center, dual-row connector designed to interface directly to the USB/SPI Dongle unit. The USB/SPI dongle connector consists of the following 16 pins.

Table 6. USB/SPI Dongle Connector Description

Pin Number	Name	Description
1	CSB	SPI signal, Chip Select Bar
2	CNTL2	CNTL2 connected to MTX
3	SO	SPI signal, Serial Out
4	CNTL1	CNTL1 connected to RIN1
5	SI	SPI signal, Serial In
6	CNTL0	CNTL0 connected to RIN2
7	SCLK	SPI signal, Serial Clock
8	DATA4	DATA4 connected to O2HIN
9	CNTL3	CNTL3 connected to RESETB
10	DATA3	NC
11	VDD	+5.0 Volt VDD from USB
12	DATA2	DATA2 connected to IGNIN1
13	+3.3 V	+3.3 V from USB (Not Used)
14	DATA1	NC
15	GND	Signal Ground
16	DATA0	DATA0 connected to INJIN1

3.9 Jumper Definitions

The following table defines the evaluation board jumper positions and explains their functions.

Table 7. Jumper Definitions

Jumper	Description	Setting	Connection
JMP1	A diode is connected between ground and high-side output channel 0 (HS0)		Diode not connected
			Diode connected

Table 7. Jumper Definitions (continued)

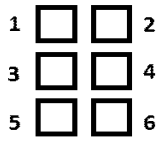
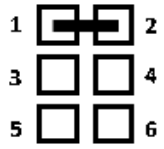
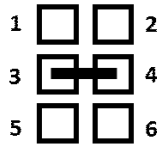
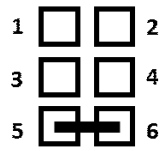
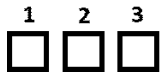
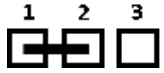
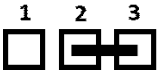
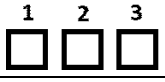
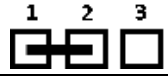
Jumper	Description	Setting	Connection
JP2	The direct input selection for channel 0 (IN0)		Direct input IN0 is internally tied to ground by internal pull-down resistor
			Direct input IN0 is connected to banana plug J5
			Direct input IN0 is connected to the USB/SPI dongle JP1
			Direct input IN0 is tied to VDD i.e HS0 is fully ON
JP3	The direct input selection for channel 1 (IN1)		Same description as for JP2
JMP2	The supply of MC74HC4049 (U7) is connected or disconnected to reduce consumption of D5, D6 & D7 on board		D5, D6, D7 are not supplied therefore state of FSB, FSOB, and RSTB is not reflected on LEDs
			D5, D6, D7 are supplied therefore state of FSB, FSOB, and RSTB is reflected on LEDs
JMP3	SYNC Signal		SYNC signal is open drain, without any jumper the SYNC signal is only available on the test point TP5. In that configuration, an external pull-up resistor is required outside the EVB.
			SYNC signal is open drain, SYNC is connected to on-board pull-up resistor to VDD **Note:** Recommended position for regular use of SYNC signal
			SYNC is directly connected to the 1 mm banana plug, the SYNC signal is not connected to pull-up resistor. In that configuration, an external pull-up resistor is required outside the EVB.

Table 7. Jumper Definitions (continued)

Jumper	Description	Setting	Connection
JMP4	CONF0 configuration pin for channel 0		CONF0 input pin is internally connected to a voltage regulator (3.3 V) CONF0 = 1, DC motor overcurrent protection profile selected
			CONF0 input pin is connected to VDD (5.0 V) CONF0 = 1, DC motor overcurrent protection profile selected This position enables LED emitting
			CONF0 input pin is connected to GND CONF0 = 0, bulb overcurrent protection profile selected
JMP5	CONF1 configuration pin for channel		Same description as for JMP4
JMP6	LED on HS0		LED on HS0 is disconnected
			LED on HS0 is connected
JMP7	LED on HS1		Same description as for JMP6
JMP8	LED on IN0		LED on IN0 is disconnected
			LED on IN0 is connected
JMP9	LED on IN1		Same description as for JMP8
JMP10	A diode is connected between ground and high-side output channel 1 (HS1)		Same description as for JMP1
JMP11	CSNS output		Test point TP8 is not connected to CSNS
			CSNS is connected to TP8
JMP12	Device GND		The device ground is not connected Intent of that position is to simulate ground disconnection
			Device connected to GND
JMP13	RSTB state		RSTB is internally tied to GND
			RSTB is connected to connector DB25 (JP1)
			RSTB is connected to VDD (5.0 V), device cannot be reseted

4 Accessory Interface Board

The KIT22XS4200EKEVB kit may be used with the KITUSBSPIEVME interface dongle (shown below), which provides a USB-to-SPI interface. This small board makes use of the USB, SPI, and parallel ports built into Freescale's MC68HC908JW32 microcontroller. The main function provided by this dongle is to allow Freescale evaluation kits having a parallel port to communicate via a USB port to a PC.

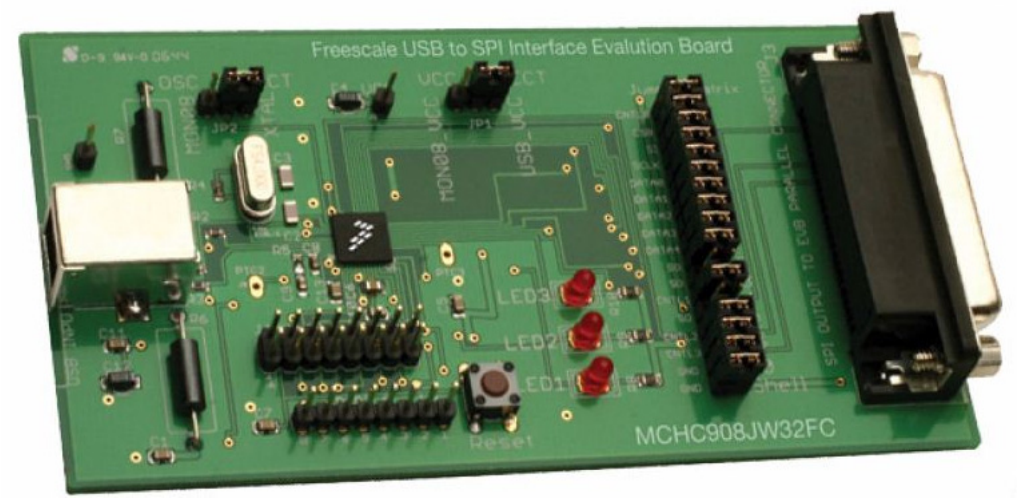


Figure 6. KITUSBSPIEVME Interface Dongle

4.1 Connecting KITUSBSPIEVME to the Board with DB25 Cable

The KITUSBSPIEVME is connected to a computer through USB cable and a DB25 parallel cable as shown in Figure 7.

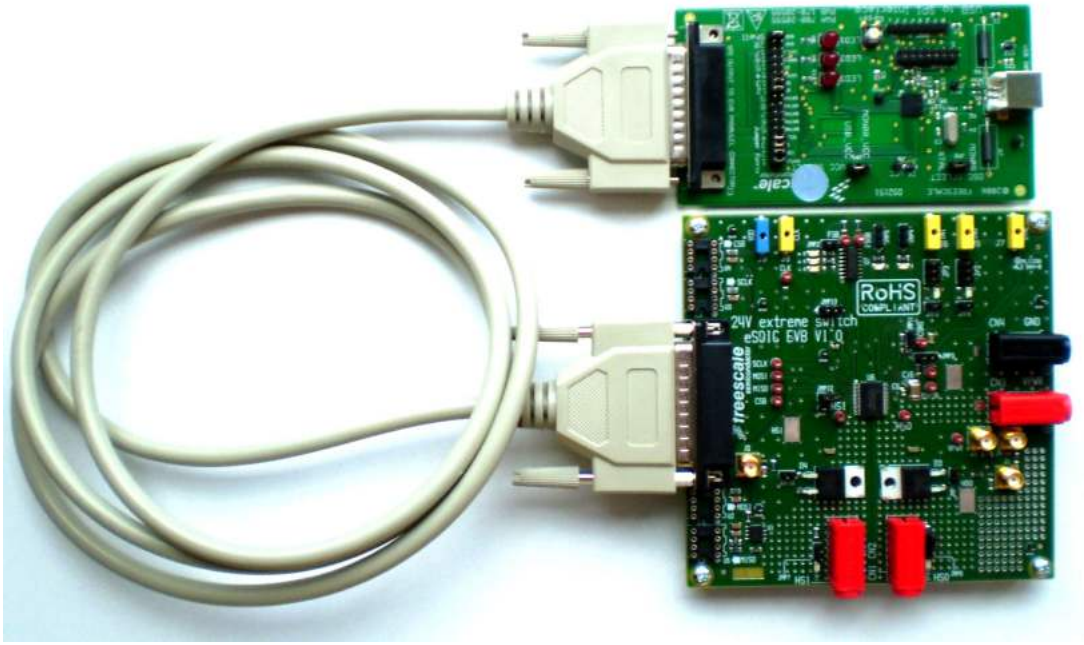


Figure 7. Connecting KITUSBSPIEVME to the Board with DB25 Cable

4.2 Connecting KITUSBSPIEVME to the Board without DB25 Cable

The KITUSBSPIEVME can be directly connected to the KIT22XS4200EKEVB as shown in Figure 8.

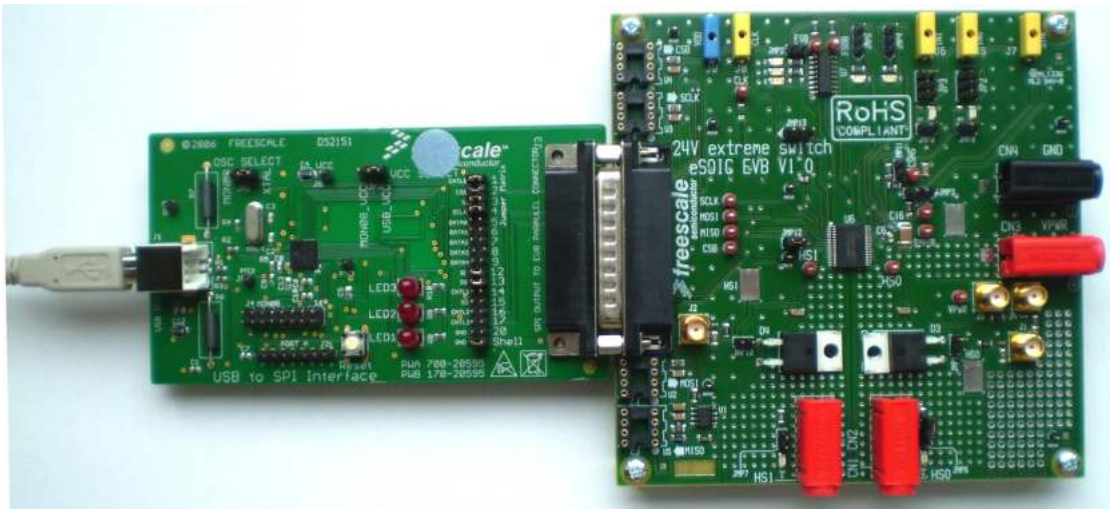


Figure 8. Connecting KITUSBSPIEVME to the Board without DB25 Cable

5 Installing the Software and Setting up the Hardware

5.1 Installing SPIGen Freeware on your Computer

The latest version of SPIGen is designed to run on any Windows 8, Windows 7, Vista, or XP-based operating system. To install the software, go to www.freescale.com/analogtools and select your kit. Click on the link to open the corresponding Tool Summary Page. Look for “Jump Start Your Design”. Download to your computer desktop the SPIGen software as well as the associated configuration file.

Run the install program from the desktop. The Installation Wizard guides 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 Graphic User Interface (GUI) appears. Go to the file menu in the upper left hand corner of the GUI, and select “Open”. In the file selection window appearing, set the “Files of type:” drop-down menu to “SPIGen Files (*.spi)”. (As an exceptional case, the file name may have a .txt extension, in which case you should set the menu to “All Files (*.*)”.) Next, browse for the configuration file you saved on your desktop earlier and select it. Click “Open”, and SPIGen creates a specially configured SPI command generator for your evaluation board.

The GUI is shown in Figure 9. The text at the top is the name of the configuration file loaded. The left side panel displays folders that group user interfaces. The process of loading the configuration file has assigned a list of “Extra Pins” as well as a list of “Quick Commands”, all of which are board-specific.

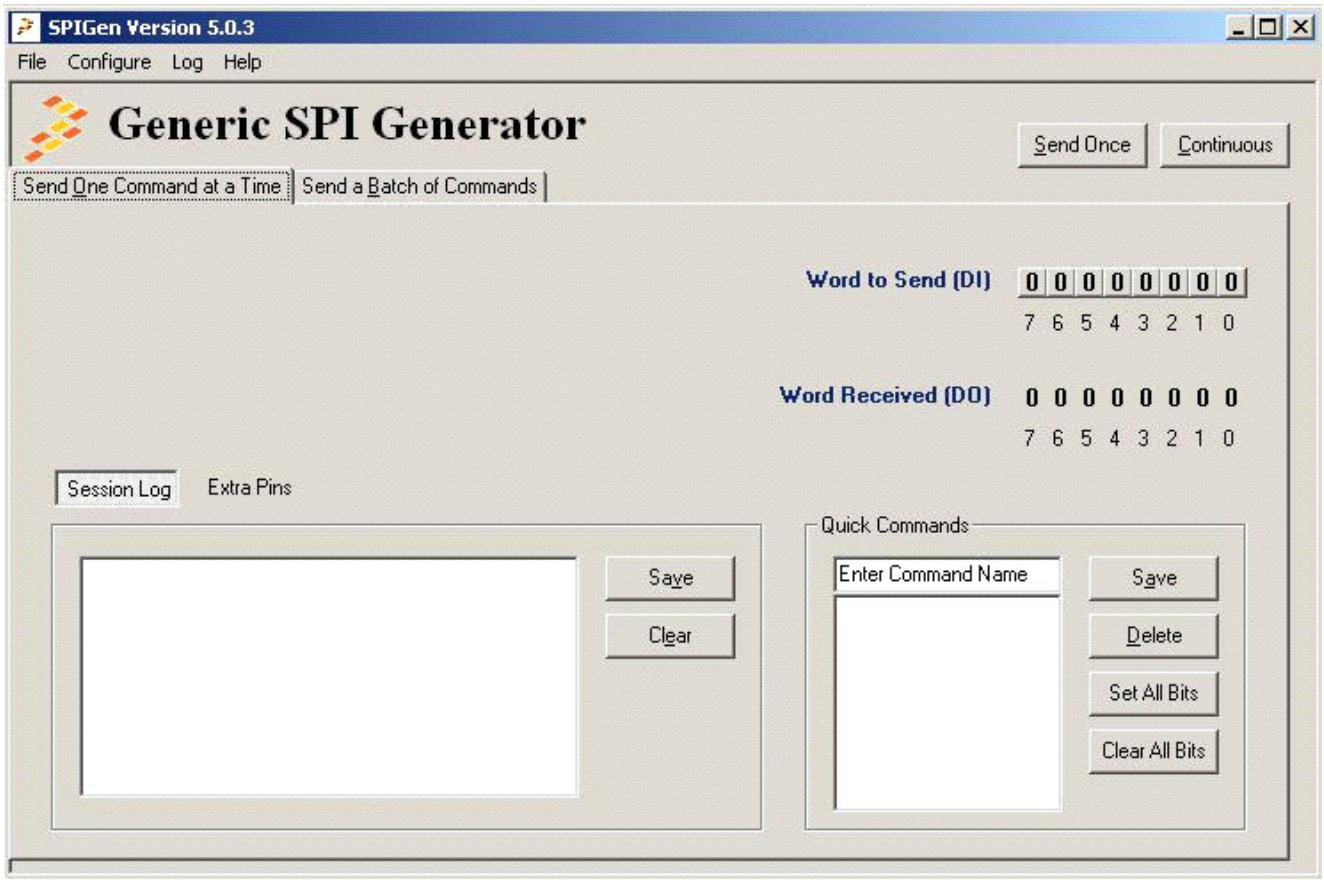


Figure 9. SPIGen GUI

5.2 Configuring the Hardware

The KIT22XS4200EKEVB operates with a single DC power supply from 6.0 to 58 V, and is fully controlled via the SPI with the help of an USB-SPI KITUSBSPIEVME EVB kit, requiring a 5.0 V DC power supply.

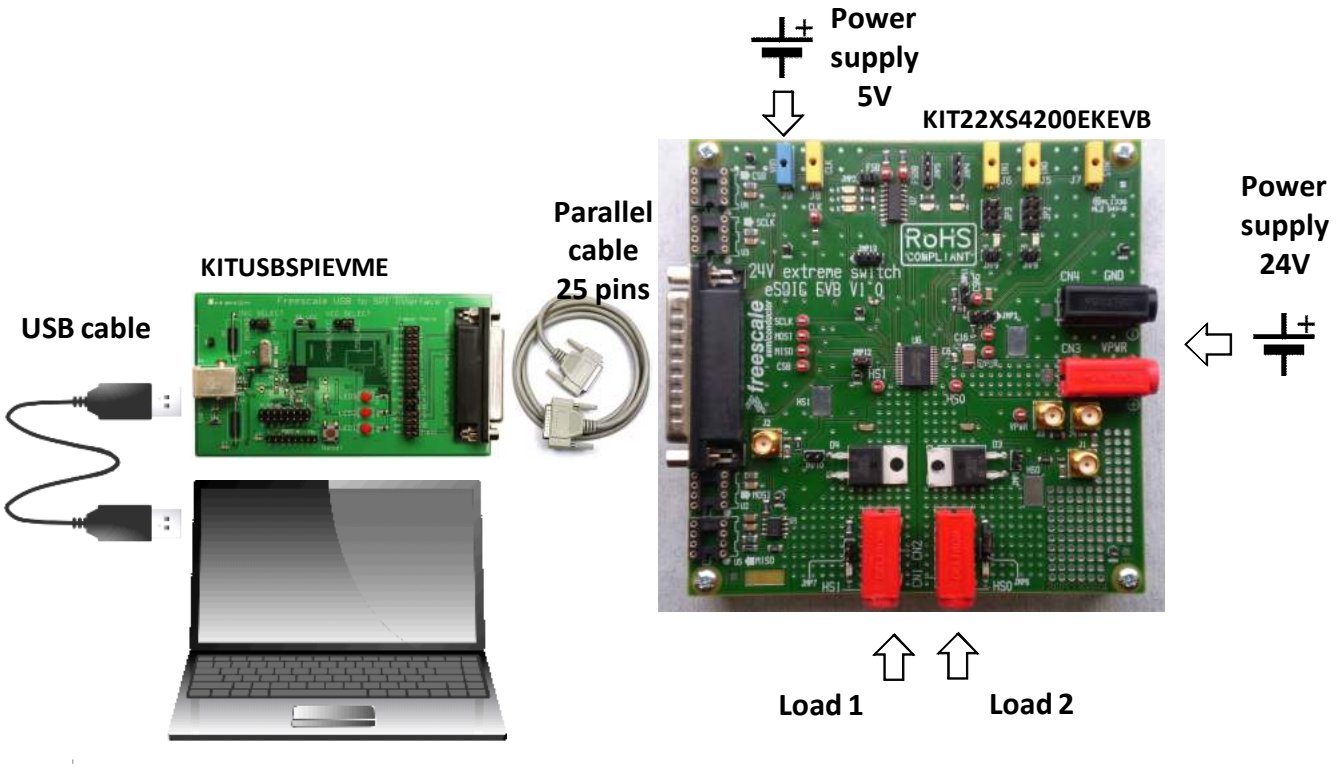


Figure 10. KIT22XS4200EKEVB Board Setup

5.2.1 Step-by-step Instructions for Setting up the Hardware using SPIGen

To perform the demonstration examples, the following connections and setup must be performed:

1. Ready the computer and install the SPIGen.
2. To start working with KIT22XS4200EKEVB, provide 24 V input voltage between 6.0 to 58 V, by connecting the (+) probe to the VPWR pin, and the (-) probe to the GND pin, on the input power terminal block.
3. Apply a 5.0 V input voltage between VDD and the GND terminal.
4. Connect the load between the HS0 (or HS1) pin and the (-) terminal with the 24 V power supply.
5. Start SPIGen.

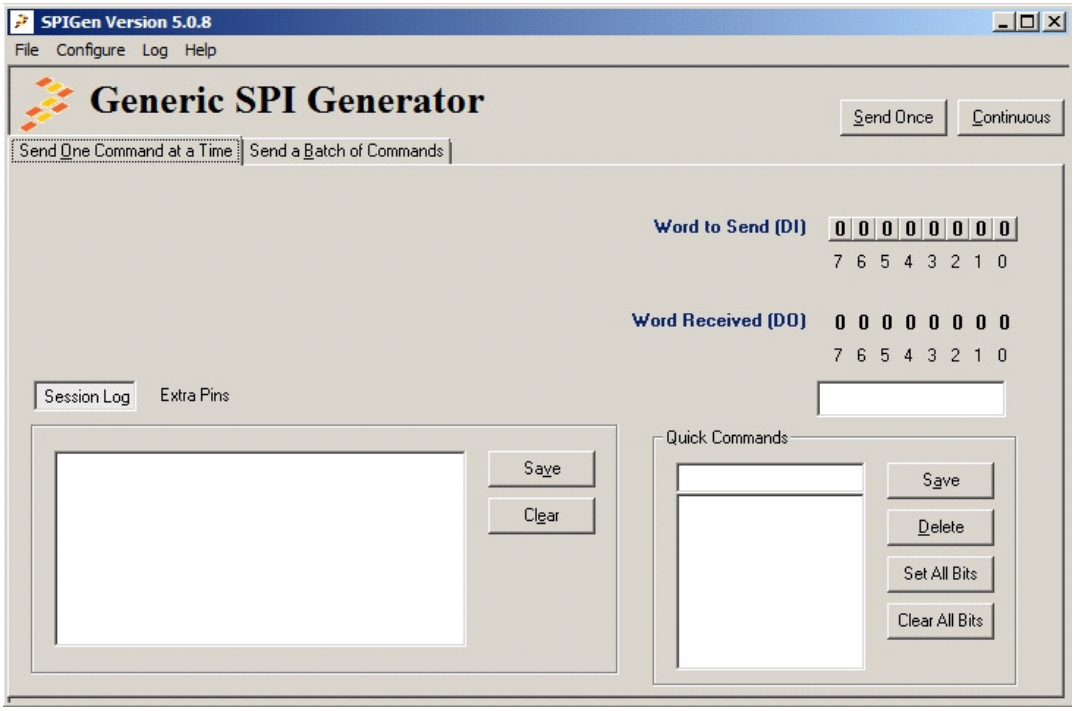


Figure 11. SPIGen GUI

6. To configure SPD22, download the Config SPI file. Select File and open SPD22_config.file

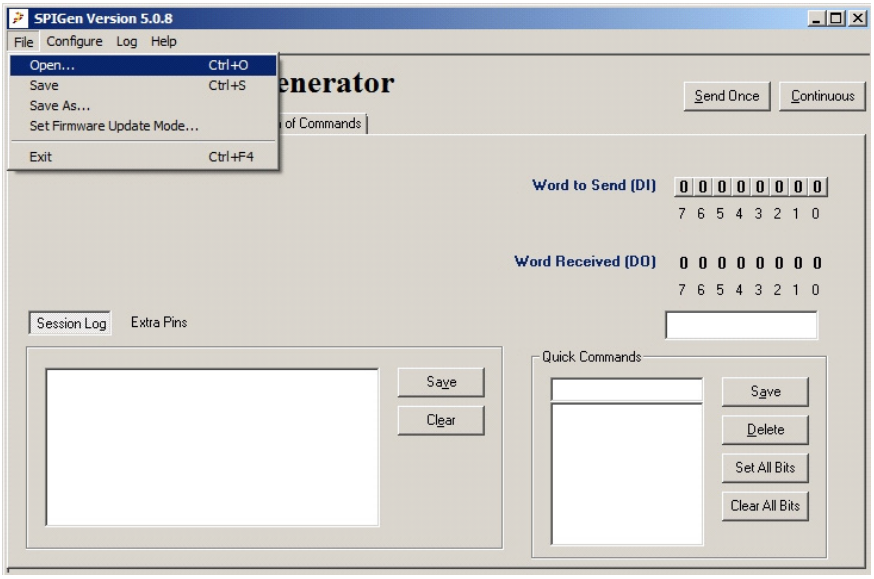


Figure 12. Loading Config File

7. To initialize SPD22, perform the following steps:
   - Set RSTB to level high by entering Extra Pins in the Session Log text box
   - Set Control0 = High
   - Set Bit 6 of SO to 1
   - Click **Send Once**

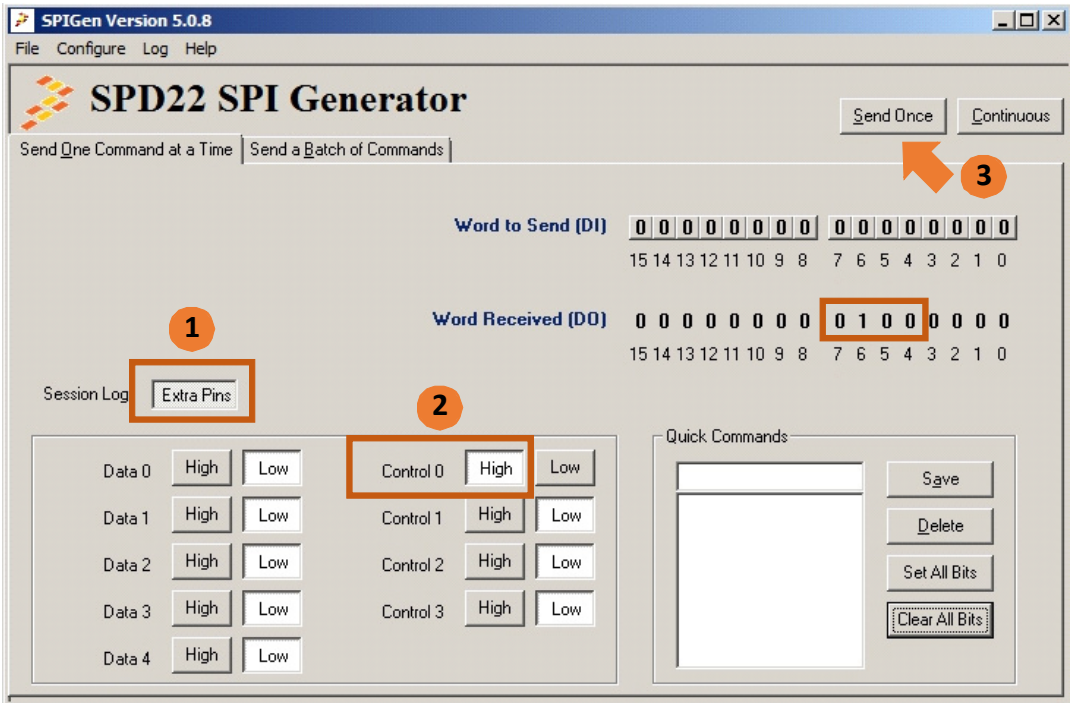


Figure 13. SPD22 Initialization

8. For faster initialization, perform the following steps:
    - Click **Send One Command at a Time**
    - Select **Init** for the setup
    - Click **Send Once**
    - **Session Log** displays log of send and receive commands

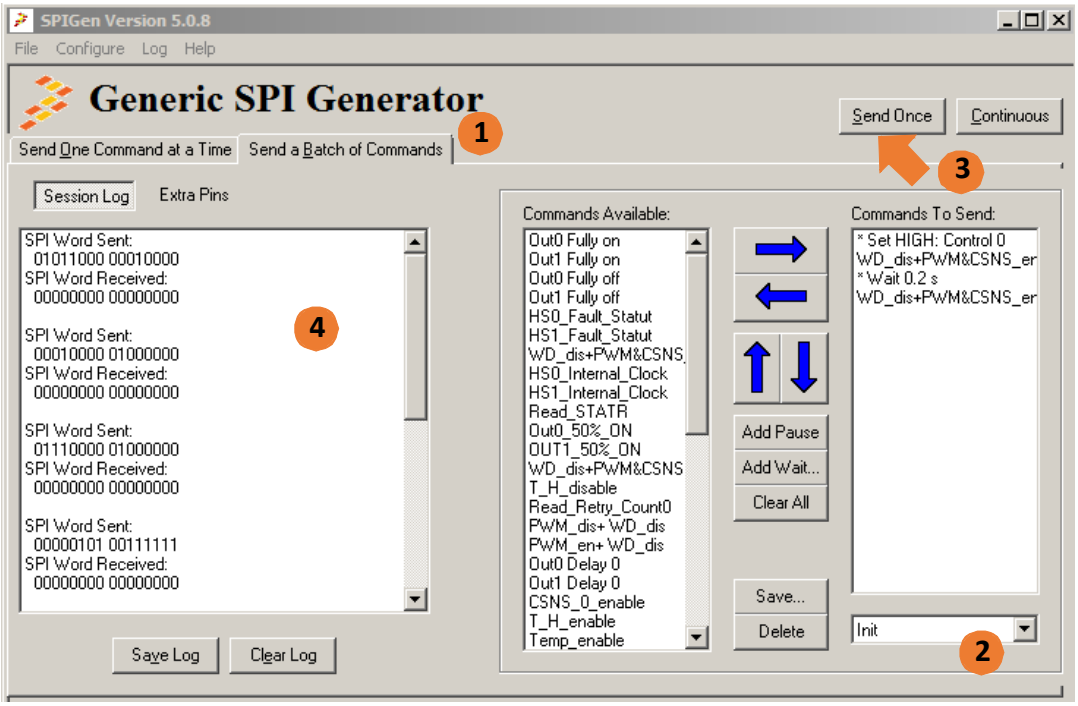


Figure 14. Alternate Initialization Sequence with Batch Commands

9. After initialization, perform the following steps:
    - Click **Send One Command at a Time**
    - Select **Out0 Fully On** from the list
    - Click **Send Once**
    - **Session Log** displays log of send and receive commands

Result : The bulb connected to HS0 is turned on.

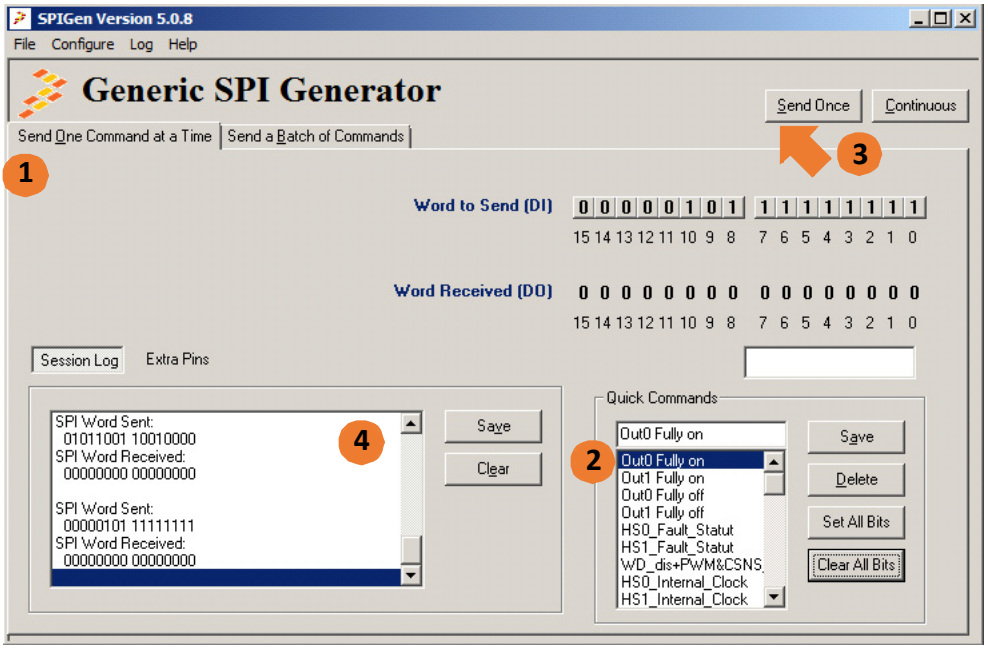


Figure 15. Single Command Sequence

6 Schematic

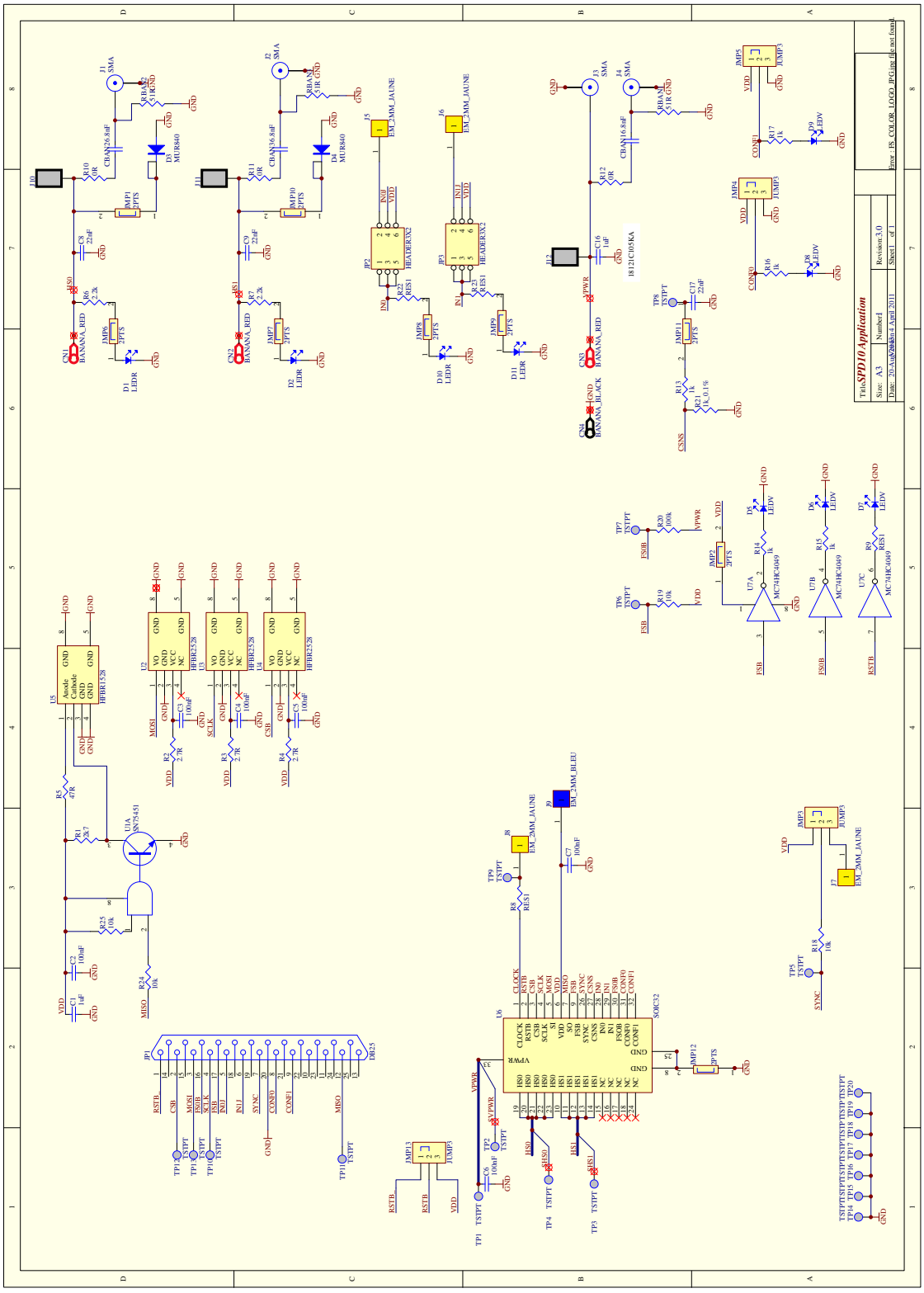
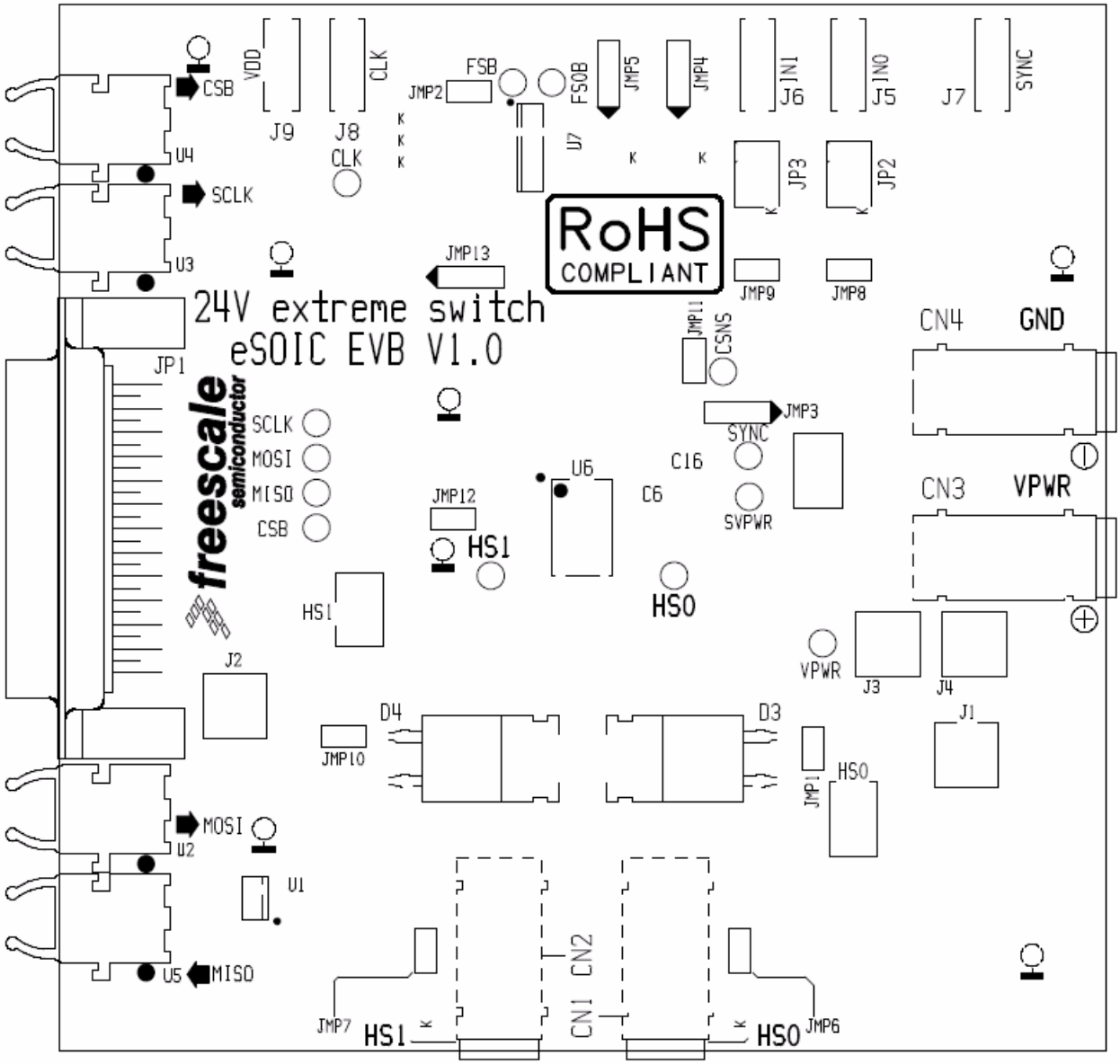


Figure 16. Evaluation Board Schematic

7 Board Layout

7.1 Silkscreen



8 Board Bill of Materials

Table 8. Bill of Materials (1)

Item	Qty	Schematic Label	Value	Description	Part Number	Assy Opt
Active Components						
1	1	U7		Buffer/Converter Hex Inv CMOS	MC74HC4049	(2)
2	1	U1		Dual peripheral driver	SN75451	(2)
3	1	U6		Freescale device	MC22XS4200BEK	(2)
4	1	U2	HFBR-2528	Fiber Optic Receiver		
5	1	U3	HFBR-2528	Fiber Optic Receiver		
6	1	U4	HFBR-2528	Fiber Optic Receiver		
7	1	U5	HFBR-1528	Fiber Optic Transmitter		
Resistors						
8	3	R10,R12,R11	0 Ω	Resistor 1%, SMD		
9	5	R13,R17,R16,R14,R15	1.0 K	Resistor 1%, SMD		
10	1	R21	1.0 K	Resistor 0,1%, SMD		
11	2	R7,R6	2.2 K	Resistor 1%, SMD		
12	4	R2,R3,R4,R1	2.7 Ω	Resistor 1%, SMD		
13	4	R18,R19,R25,R24	10 K	Resistor 1%, SMD		
14	1	R5	47 Ω	Resistor 1%, SMD		
15	1	R20	100 K	Resistor 1%, SMD		
Capacitors						
16	2	C1, C16	1.0 μF	Capacitor Ceramic 50 V		
17	6	C2, C3, C4, C5, C6, C7	100 nF	Capacitor Ceramic 50 V		
18	3	C8, C9, C17	22 nF	Capacitor Ceramic 50 V		
19	3	CBAN1, CBAN2, CBAN3	6.8 nF	Capacitor Ceramic 50 V		
Diodes						
20	4	D1, D2, D10, D11	LEDR	Diode LED red		
21	2	D3, D4	MUR840	Rectified diode 7.0 A, 400 V		
22	5	D5, D6, D7, D8, D9	LEDV	Diode LED green		

Notes
1. Freescale does not assume liability, endorse, or warrant components from external manufacturers 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.
2. **Critical components.** For critical components, it is vital to use the manufacturer listed.

9 References

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

Freescale.com Support Pages	Description	URL
KIT22XS4200EKEVB	Tool Summary Page	http://www.freescale.com/webapp/sps/site/prod_summary.jsp?code=KIT22XS4200EKEVB
MC22XS4200	Product Summary Page	http://www.freescale.com/webapp/sps/site/prod_summary.jsp?code=MC24XS4
KITUSBSPIEVME	Tool Summary Page	http://www.freescale.com/webapp/sps/site/prod_summary.jsp?code=KITUSBSPIEVME
SPIGen Reference	Product Summary Page	http://www.freescale.com/webapp/sps/site/prod_summary.jsp?&code=SPIGEN

9.1 Support

Visit www.freescale.com/support for a list of phone numbers within your region.

9.2 Warranty

Visit www.freescale.com/warranty for a list of phone numbers within your region.

10 Revision History

Revision	Date	Description of Changes
1.0	9/2014	• Initial Release

How to Reach Us:

Home Page:
freescale.com

Web Support:
freescale.com/support

Document Number: KT22XS4200UG
Rev. 1.0
9/2014