

FRDM-CD1030EVM Evaluation Board

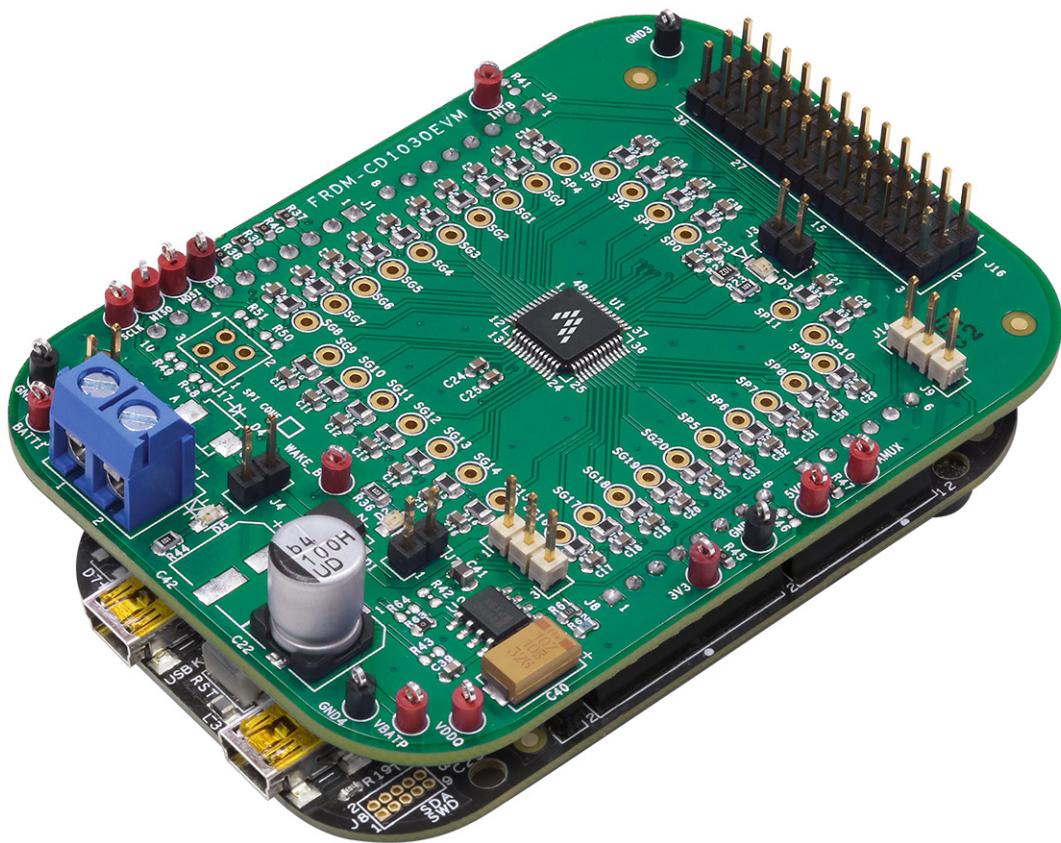


Figure 1. FRDM-CD1030EVM

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1 Important Notice

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2 Getting Started

2.1 Kit Contents/Packing List

The FRDM-CD1030EVM contents include:

- Assembled and tested FRDM-CD1030EVM customer evaluation board/module in anti-static bag
- Pre-programmed FRDM-KL25Z SPI Communication Board
- KIT-SW33-EVB Switch and Adapter boards
- 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.nxp.com/FRDM-CD1030EVM
- Review your Tool Summary Page
- Look for



Jump Start Your Design

- 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:

- Power supply 12 V with at least 1.0 A current capability
- KIT-SW33-EVB or any other type of ON-OFF switch to ground or switch to battery loads
- FRDM-KL25Z SPI communication board
- SPIGen Graphic User Interface

2.4 System Requirements

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

- Windows® XP, Windows 7, or Vista in 32- and 64-bit versions

3 Getting to Know the Hardware

3.1 Board Overview

The FRDM-CD1030EVM Evaluation Board (EVB) features the CD1030 - 33 Channel Switch Detection Interface with programmable wetting current. The kit is designed to detect the closing and opening of up to 33 switch contacts. The switch status, either open or closed, is transferred to the microprocessor unit (MCU) through a serial peripheral interface (SPI). The device also features a 35-to-1 analog multiplexer for reading the analog voltage at the inputs.

The analog input signal is buffered and provided on the AMUX output pin to be read by an external MCU. The CD1030 device has two modes of operation, Normal and Sleep. Normal mode allows programming of the device and supplies switch contacts with pull-up or pull-down current as it monitors switch change-of-state, while the sleep mode provides switch status detection with maximum power saving. The FRDM-CD1030EVM can be controlled through a USB/SPI communication board (FRDM-KL25Z) connected to the PC's USB port. The Freescale SPIGen (version 7.0 and above) program provides the user interface to the CD1030 SPI port and allows the user to program the configuration Registers, send commands to the IC and receive status from the IC.

3.2 Board Features

The board features are as follows:

- CD1030 device with 33 channels switch detection and status report capability
- Single row interface connectors for the Freescale FRDM-KL25Z pre-programmed communication board
- Status LEDs to report the status of the 1030 Interrupt (INT) and Wake-up lines
- Single load connector with 36 pin, 100 mils for easy interface with external switch loads
- Direct connection to battery power with optional 5.0 V/3.3 V LDO for VDDQ rail supply

3.3 Board Description

The FRDM-CD1030EVM provides access to the main features of the CD1030 device, as shown in [Figure 2](#).

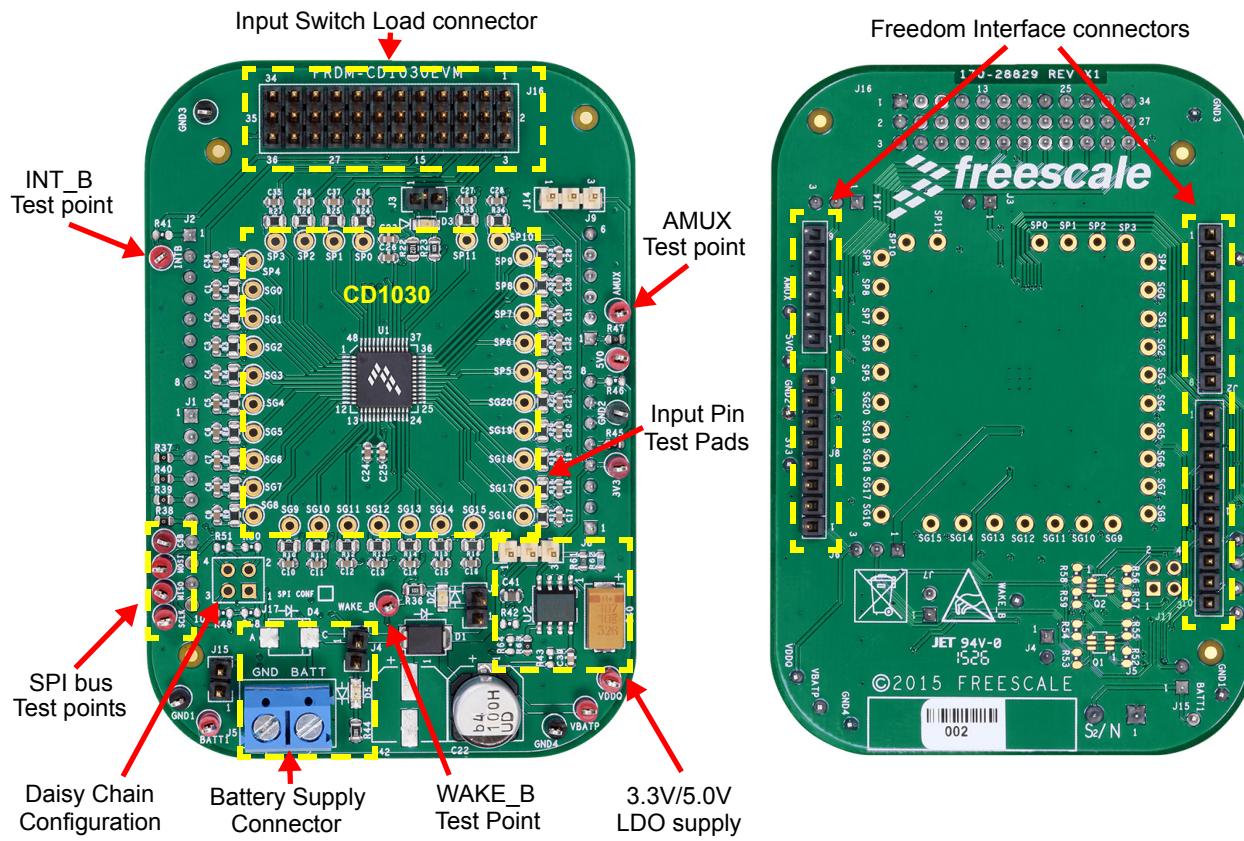


Figure 2. Board Description

Table 1. Board Description

Name	Description
Battery Supply Connector	Provides direct connection to battery voltage and serves as the source for VBATP pin on the CD1030, which is protected against reverse voltage by D1 Diode.
3.3 V/5.0 V LDO Supply	The FRDM-CD1030EVM provides an On-board LDO regulator to supply the VDDQ voltage during stand alone applications. This LDO is optional, and can be disabled through jumper resistors for application where 3.3 V/5.0 V is supplied from the FRDM-KL25Z Board.
Input Switch Load Connector	Provides access to the 33 SG/SP input pins as well as ground and battery voltage for direct interaction with the System loads.
Freedom Interface Connectors	J1, J2, J8, and J9 are single row connectors compatible with the Freedom/Arduino Pin configuration. These provide access to SPI communication pin, 3.3 V/5.0 V power supply from/to the Freedom board as well as access to I/Os to interface with the AMUX and INT_B on the CD1030.
SPI Bus Test Points	The FRDM-CD1030EVM provides easy access to the SPI signals in case external control is desired. SPI signals can be bypassed from the FRDM-KL25Z by changing the configuration of jumper resistors provided.
CD1030 Test points	The FRDM-CD1030EVM Provide access to all pins on the CD1030, including: VBATP, VDDQ, AMUX, WAKE_B, SPI pins, and all SG/SP input pins.

3.4 LED Display

The following LEDs are provided as visual indicators for the evaluation board:

1. D5 (BATTERY LED): When J4 is shorted, LED D5 indicates the presence of battery voltage on connector J5.
2. D2 (WAKE_B LED): When external pull-up is selected on J6, the LED lights when the device is in Normal mode.
3. D3 (INT_B LED): The LED lights up when an interrupt even has occurred. LED turns off when the INTflg is cleared.

3.5 Connectors

The FRDM-CD1030EVM provides various connectors to supply power, interface with programming logic or interface with the switch loads.

Table 2. Connectors

Name	Type	Description	
J5	Supply	Battery supply connector (Operating voltage range from 4.5 V to 36 V)	
J16	Input Switch Connector	3 x 12 pin header for direct access to the 33 input channels. See the connector pinout on Figure 4 .	
Freedom Interface J1, J2, J8, J9		<p>Interface connector to FRDM-KL25Z board. Female top mount connector allows to stack up to 3 FRDM-CD1030EVM evaluation boards for daisy chain configuration; long straight through male connector allows interfacing with the Freedom board on the bottom side.</p> <p>All NC pins are not used by the FRDM-CD1030EVM evaluation board, and may be used to interface other external signals on the System with the KL25Z MCU. Refer to the FRDM-KL25Z user guide for more information of the signal allocation for the unused pins.</p>	
J1	SPI Communication Interface to Freedom Board	PIN1 = NC PIN2 = NC PIN3 = CSB from MCU (bypass with R37) PIN4 = MOSI from MCU (bypass with R40) PIN5 = MISO to MCU (bypass with R39)	PIN6 = SCLK from MCU (bypass with R38) PIN7 = GND PIN8 = NC PIN9 = NC PIN10 = NC
J2	INT_B Interface	Pin 1 = INT_B to MCU Pin 2 = NC Pin 3 = NC Pin 4 = NC	Pin 5 = NC Pin 6 = NC Pin 7 = NC Pin 8 = NC
J8	Power Lines	Pin 1 = NC Pin 2 = NC Pin 3 = NC Pin 4 = 3.3V Supply from Freedom board	Pin 5 = 5V Supply from Freedom board Pin 6 = Ground Pin 7 = Ground Pin 8 = 5V supply to Freedom board
J9	AMUX Interface	Pin 1 = AMUX to MCU ADC Pin 2 = NC Pin 3 = NC	Pin 4 = NC Pin 5 = NC Pin 6 = NC
J17	Daisy Chain Configuration	<p>Provide an alternate configuration to stack up to three boards in daisy chain configuration. Depending on the number of boards set in daisy chain, each board must use a different configuration of J17 and the SPI shunt resistors provided. Use the SPI conf label to number each board configuration for easy identification.</p>	
		<p>Two Board Daisy Chain</p> <p>Board #1</p> <ul style="list-style-type: none"> •MOSI_M - R40 - POP •MISO_M - R39 - DNP •R48 - POP •R49 - DNP •R50 - DNP •R51 - DNP <p>Board #2</p> <ul style="list-style-type: none"> •MOSI_M - R40 - DNP •MISO_M - R39 - POP •R48 - DNP •R49 - DNP •R50 - POP •R51 - DNP <p>J17 - 1-2 shorted on top board.</p>	<p>Three Board Daisy Chain</p> <p>Board #1</p> <ul style="list-style-type: none"> •MOSI_M - R40 - POP •MISO_M - R39 - DNP •R48 - POP •R49 - DNP •R50 - DNP •R51 - DNP <p>Board #2</p> <ul style="list-style-type: none"> •MOSI_M - R40 - DNP •MISO_M - R39 - POP •R48 - DNP •R49 - POP •R50 - POP •R51 - DNP <p>Board #3</p> <ul style="list-style-type: none"> •MOSI_M - R40 - DNP •MISO_M - R39 - POP •R48 - DNP •R49 - DNP •R50 - DNP •R51 - POP <p>J17 - 1-2 and 3-4 Shorted on top board</p>

3.6 Test Point Definitions

The following test points provide access to signals on the evaluation board.

Table 3. Test Point Definitions

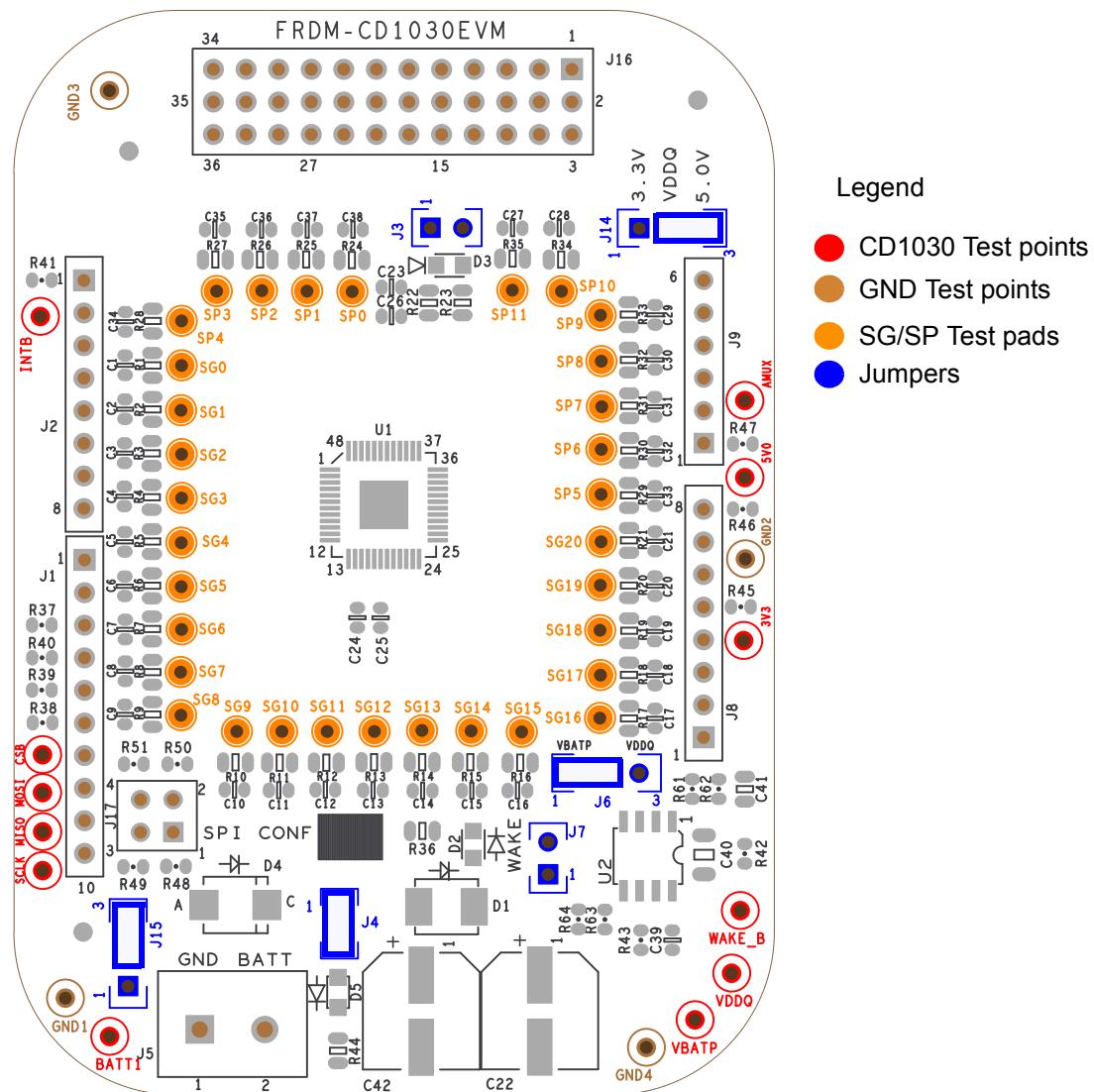
Schematic Label	Description
BATT1	Battery supply
VBATP	CD1030 input supply pin
VDDQ	Logic supply voltage
INTB	I/O interrupt pin
WAKE_B	I/O wake-up pin
AMUX	Analog multiplexer output pin
SCLK	SPI serial clock
MOSI	SPI Master out - Slave in
MISO	SPI Master In - Slave Out
CSB	SPI chip select
SGx	SG input pin test pad (connected directly to pin)
SPx	SP input pin test pad (connected directly to pin)
3V3	3.3 V supply from Freedom board
5V0	5.0 V supply from/to Freedom board
GNDx	4 x ground reference

3.7 Jumper Definitions

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

Table 4. Jumper Definition

Name	Default	Description
J3	Open	INT_B LED bypass jumper (short to bypass LED D5)
J4	Close	Battery voltage LED. Short to enable LED indicator when battery is connected on J5
J7	Open	WAKE_B LED bypass jumper. (short to bypass the LED D2)
J6	1-2	WAKE_B pull-up selector Short position 1-2 to select VBATP as pull-up voltage Short position 2-3 to select VDDQ as pull-up voltage
J14	2-3	VDDQ supply selector from FRDM-KL25Z communication board Short position 1-2 for 3.3 V VDDQ supply Short position 2-3 for 5.0 V VDDQ supply
J15	2-3	SG5 input selector. Short position 1-2 to connect SG5 to battery voltage Short position 2-3 to allow SG5 input from connector J16



Legend

- CD1030 Test points
- GND Test points
- SG/SP Test pads
- Jumpers

3.8 Evaluation Board Schematic

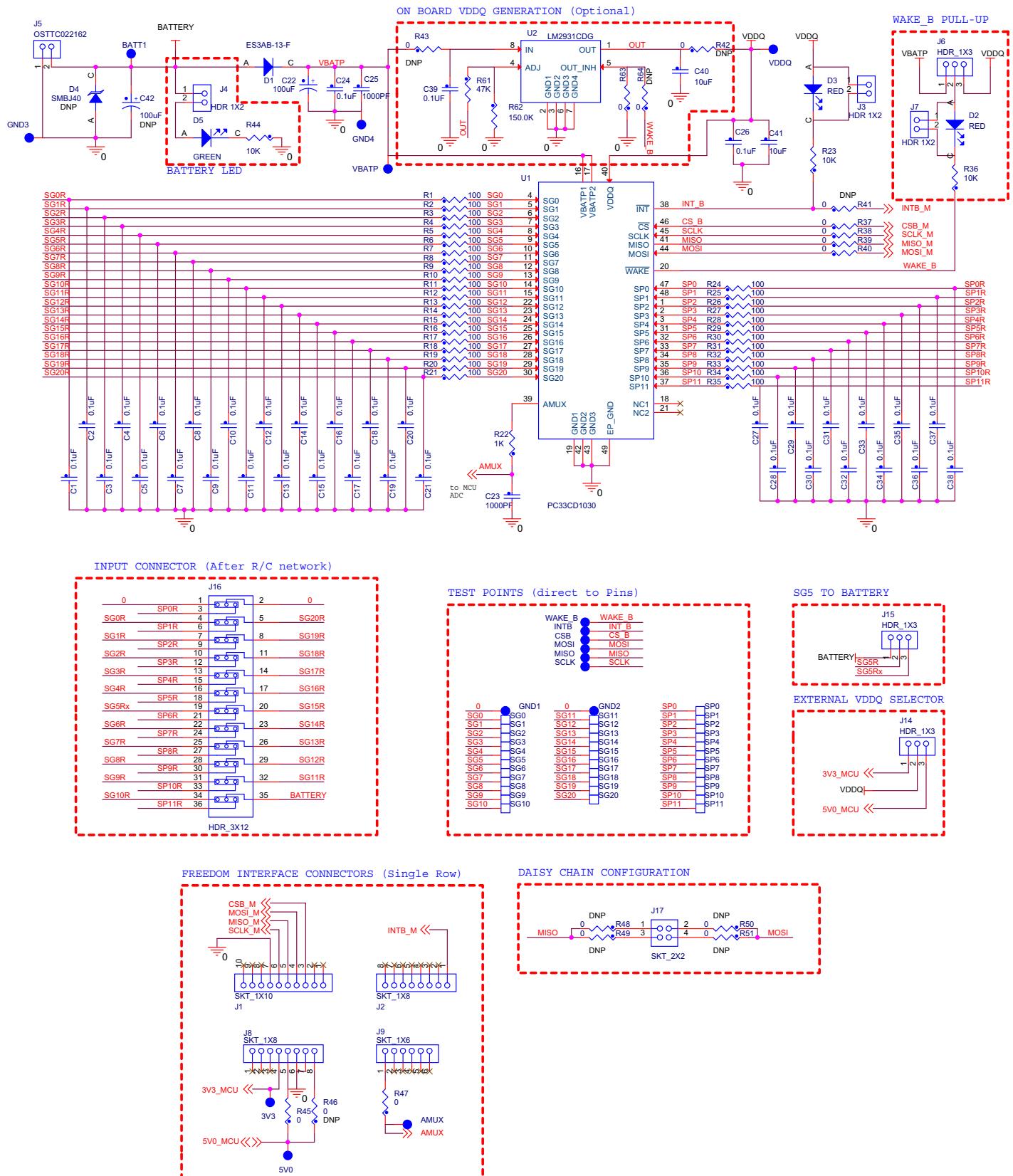


Figure 4. Schematic

3.9 Board Layout

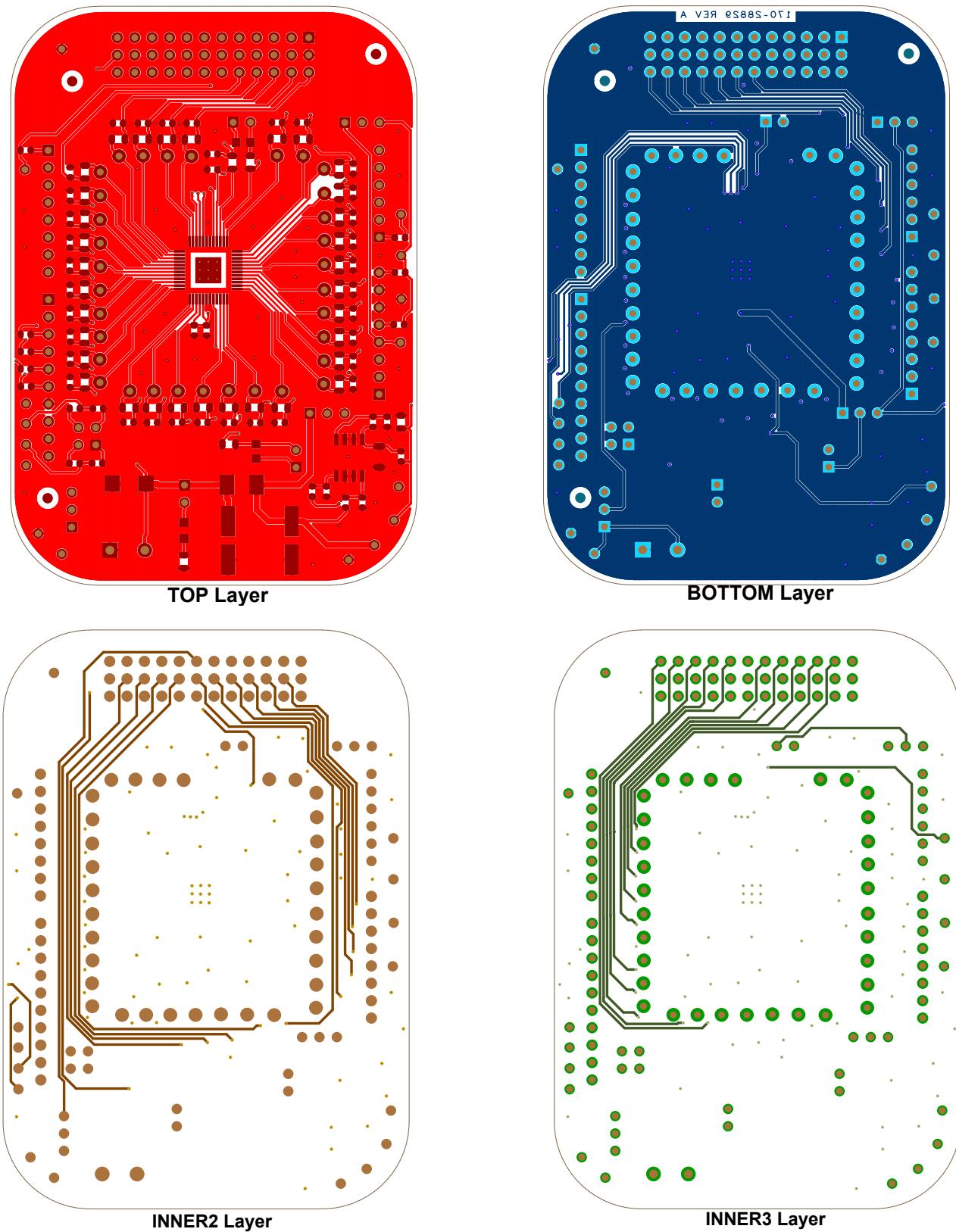


Figure 5. Layout

3.10 Bill of Materials

Table 5. Bill of Materials ⁽¹⁾

Item	Qty	Schematic Label	Value	Description	Part Number	Assy Opt
Active Components						
1	1	U1		IC 33-CHANNEL MULTIPLE SW DETECTION INTERFACE 3.3V LQFP48	MC33CD1030AE	
2	1	U2		IC VREG LDO ADJ 2.7-29.5V 0.1A SOIC8	LM2931CDG	⁽¹⁾
Diodes						
3	1	D1	ES3AB-13-F	DIODE RECT 3A 50V AEC-Q101 SMB	ES3AB-13-F	⁽¹⁾
4	1	D4	SMBJ40	DIODE TVS 9.3A 40V SMB SMT	SMBJ40A	^{(1), (3)}
5	2	D2, D3	RED	LED RED SGL 2MA 0805 SMT	SML-211UTT86J	⁽¹⁾
6	1	D5	GREEN	LED GRN SGL 25MA 0805	598-8170-107F	⁽¹⁾
Capacitors						
7	35	C1, C2, C3, C4, C5, C6, C7, C8, C9, C10, C11, C12, C13, C14, C15, C16, C17, C18, C19, C20, C21, C24, C26, C27, C28, C29, C30, C31, C32, C33, C34, C35, C36, C37, C38	0.1 uF	CAP CER 0.1uF 100V X7R 10% 0603		
8	1	C22	100 uF	CAP AEL 100uF 50V 20% -- SMD		
9	2	C23, C25	1000 PF	CAP CER 1000PF 100V 10% X7R 0603		
10	1	C39	0.1 uF	CAP CER 0.1UF 50V 10% X7R 0603		
11	1	C40	10 uF	CAP CER 10uF 25V 10% X7R 1206		
12	1	C41	10 uF	CAP CER 10UF 16V +80/-20% Y5V 0805		
13	1	C42	100 uF	CAP AEL 100uF 50V 20% -- SMD		⁽³⁾
Resistors						
14	33	R1, R2, R3, R4, R5, R6, R7, R8, R9, R10, R11, R12, R13, R14, R15, R16, R17, R18, R19, R20, R21, R24, R25, R26, R27, R28, R29, R30, R31, R32, R33, R34, R35	100	RES MF 100 OHM 1/2W 1% AEC-Q200 0805		
15	1	R22	1.0 K	RES MF 1K 1/8W 5% 0805		
16	3	R23, R36, R44	10 K	RES MF 10K 1/10W 5% 0805		
17	7	R37, R38, R39, R40, R45, R47, R63	0	RES MF ZERO OHM 1/10W -- 0603		
18	9	R41, R42, R43, R46, R48, R49, R50, R51, R64	0	RES MF ZERO OHM 1/10W -- 0603		⁽³⁾
19	1	R61	47 K	RES MF 47K 1/16W 5% 0603		
20	1	R62	150.0 K	RES MF 150.0K 1/10W 1% 0603		
Switches, Connectors, Jumpers, and Test Points						
21	12	BATT1, 3V3, 5V0, WAKE_B, VDDQ, VBATP, SCLK, M _{OS} I, MISO, INTB, CSB, AMUX	TEST POINT RED	TEST POINT RED 40 MIL DRILL 180 MIL TH 109L	5000	⁽¹⁾
22	4	GND1, GND2, GND3, GND4	TEST POINT BLACK	TEST POINT BLACK 40 MIL DRILL 180 MIL TH 109L	5001	⁽¹⁾
23	1	J1	SKT_1X10	CON 1X10 SKT TH 100MIL SP 340H SN 394L	SSQ-110-23-T-S	⁽¹⁾
24	2	J2, J8	SKT_1X8	CON 1X8 SKT TH 100MIL SP 340H SN 394L	SSQ-108-23-T-S	⁽¹⁾
25	3	J3, J4, J7	HDR 1X2	HDR 1X2 TH 100MIL SP 338H AU 100L	TSW-102-07-F-S	⁽¹⁾

Table 5. Bill of Materials (1) (continued)

Item	Qty	Schematic Label	Value	Description	Part Number	Assy Opt
26	1	J5	OSTTC022162	CON 1X2 TB 5.08MM SP 406H SN 138L	OSTTC022162	(1)
27	3	J6, J14, J15	HDR_1X3	HDR 1X3 TH 100MIL SP 330H AU 98L	HTSW-103-07-S-S	(1)
28	1	J9	SKT_1X6	CON 1X6 SKT TH 100MIL SP 340H SN 394L	SSQ-106-23-T-S	(1)
29	1	J16	HDR_3X12	HDR 3X12 TH 100MIL CTR 338H AU 100L	TSW-112-07-S-T	(1)
30	1	J17	SKT_2X2	CON 2X2 SKT TH 100MIL CTR 340H TIN 394L	SSQ-102-23-T-D	(1)
31	33	SP1, SG1, SP2, SG2, SP3, SG3, SP4, SG4, SP5, SG5, SP6, SG6, SP7, SG7, SP8, SG8, SP9, SG9, SP10, SG10, SP11, SG11, SG12, SG13, SG14, SG15, SG16, SG17, SG18, SG19, SG20, SP0, SG0	Test point	TEST POINT PAD 080-040MIL TH		(3)

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.
3. Do not populate

4 Accessory Boards

4.1 FRDM-KL25Z Communication Interface Board

The FRDM-CD1030EVM is designed to be used with the FRDM-KL25Z Freedom Board, which is pre-programmed to provide an USB-to-SPI communication interface. The main function of the FRDM-KL25Z provides Serial communication from a PC environment (SPIGEN) to control all features on the FRDM-CD1030EVM Evaluation Board. However, the FRDM-KL25Z can also be used as system Processor to create stand alone applications interacting with the FRDM-CD1030EVM.



Figure 6. KITUSBSPIDGLEVME Interface Dongle

4.1.1 Connecting the FRDM-KL25Z communication Interface Board

A typical connection of FRDM-KL25Z Communication Interface Board to the FRDM-CD1030EVM evaluation board is done by directly stacking the FRDM-CD1030EVM on the Freedom/Arduino Interface connectors as shown in [Figure 7](#).

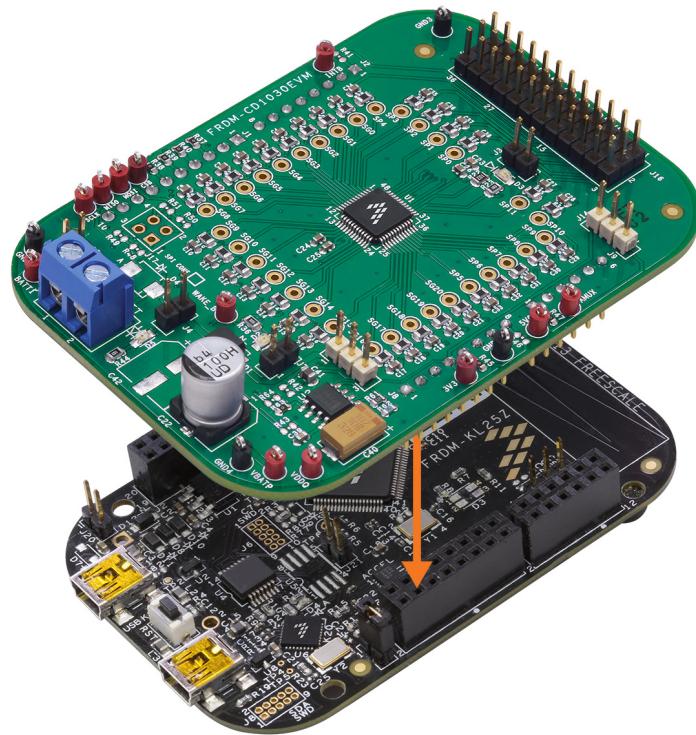


Figure 7. FRDM-CD1030EVM Connection to the FRDM-KL25Z

4.2 KIT-SW33-EVB Switch and Adapter Boards

The FRDM-CD1030EVM Evaluation Kit includes the KIT-SW33-EVB Switch board comprised of a fully populated Switch board with 33 Dip switches to allow closure to GND or Battery voltage on the input channels. The KIT-SW33-EVB also provides an adapter board with a 36 pin interface connector to provide easy access to all 33 input channels, including the input protection R/C network provided on the FRDM-CD1030EVM evaluation board.

Both Switch and Adapter boards connect to J16 on the FRDM-CD1030EVM, as shown in Figure 8.

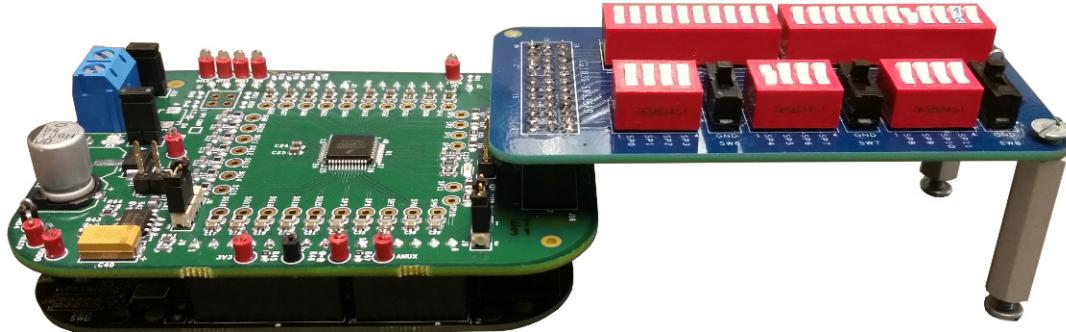


Figure 8. KIT-SW33-EVB Interface with the FRDM-CD1030EVM

Use switches SW1 and SW2 to connect or disconnect the SG pins to the FRDM-CD1030EVM ground, or an external voltage level set on the SW_SG test point.

Switches SW3, SW4, and SW5, allow connection to FRDM-CD1030EVM ground/battery and/or external voltage level applied to BATT_IN test point, as selected by J2. Ground or battery level selection on the SP channels is done in three independent banks of four channels each, controlled by SW6, SW7, and SW8 SPDT switches respectively.

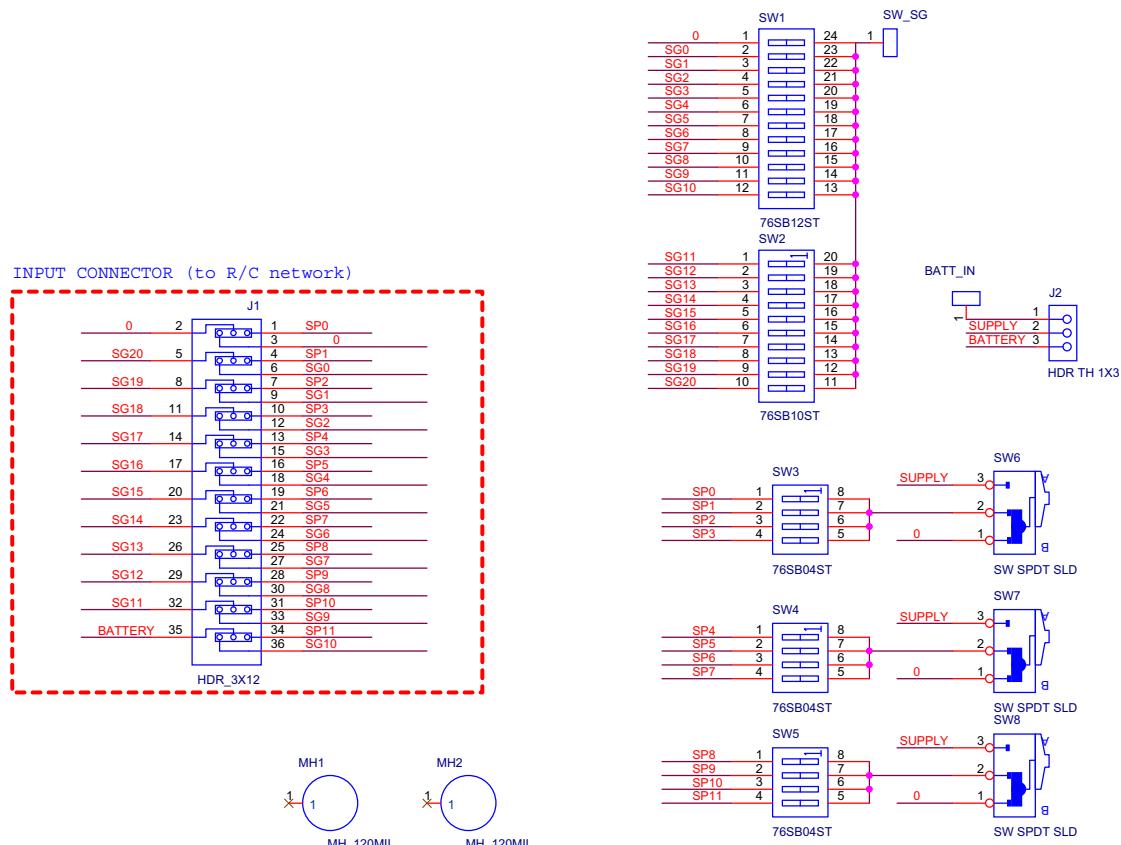


Figure 9. KIT-SW33-EVB Switch Board Schematic

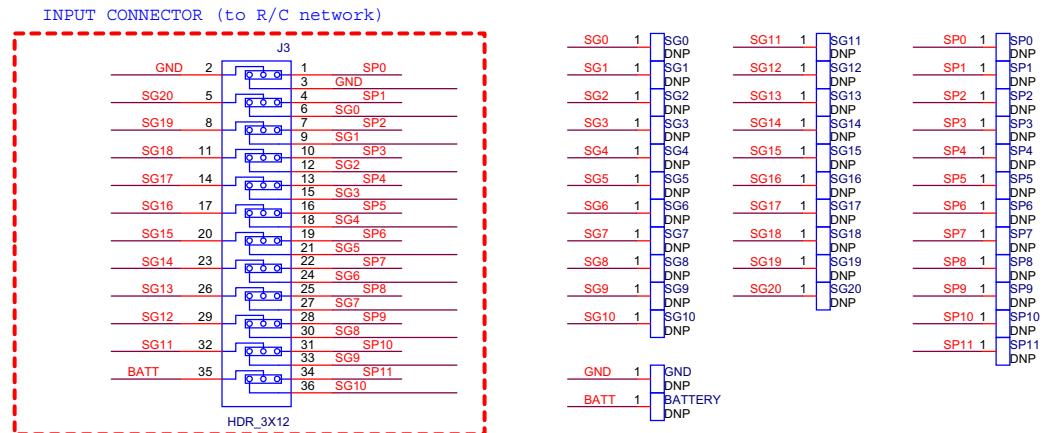


Figure 10. KIT-SW33-EVB Adapter Board Schematic

5 Configuring the Hardware

Figure 11 shows the configuration diagram for the FRDM-CD1030EVM.

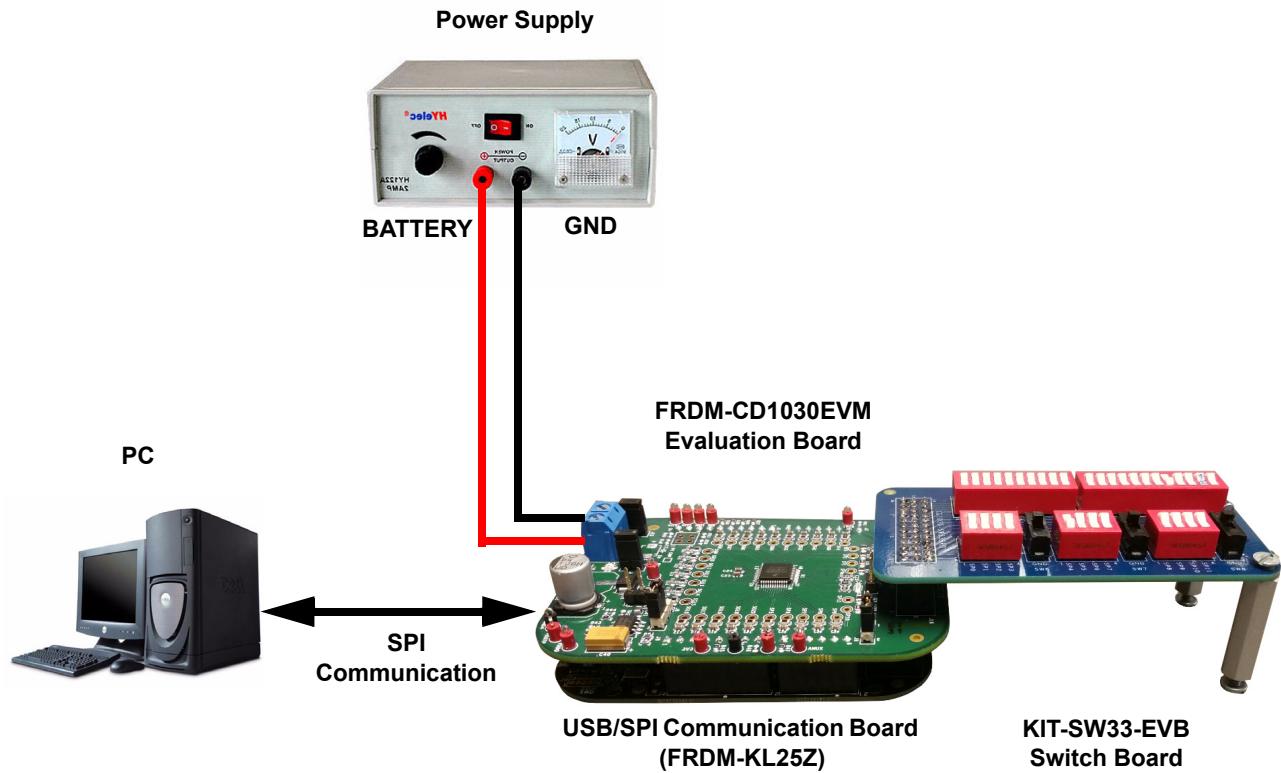


Figure 11. Evaluation Kit Setup

5.1 Step-by-step Instructions for the Hardware Setup Using SPIGen

To start working with the FRDM-CD1030EVM, the following connections and setup must be performed:

1. Install the SPIGen.
2. Plug the FRDM-CD1030EVM on top of the FRDM-KL25Z communication board.
3. Connect FRDM-KL25Z to the computer using the KL25Z mini USB connector.
4. Attach DC power supply (without turning on the power) to FRDM-CD1030EVM.
5. Attach loads to the FRDM-CD1030EVM board output terminals as desired.
6. Launch SPIGen and select the CD1030 command page.
7. Turn on the power supply. LED D5 lights up.

6 Software Installation and Setup

6.1 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 the appropriate kit. Click on the link to open the corresponding Tool Summary Page. Look for “Jump Start Your Design”. Download the SPIGen software to the computer desktop. Run the install program from the desktop. The Installation Wizard guides the user 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. The GUI provides embedded support for some Freescale devices, eliminating the need of loading a configuration file to talk to a specific device. The CD1030 is already supported by the latest SPIGen software. Locate the CD1030 folder from the “Device View” window and click on it to expand and get access to all the configuration registers for the CD1030 device.

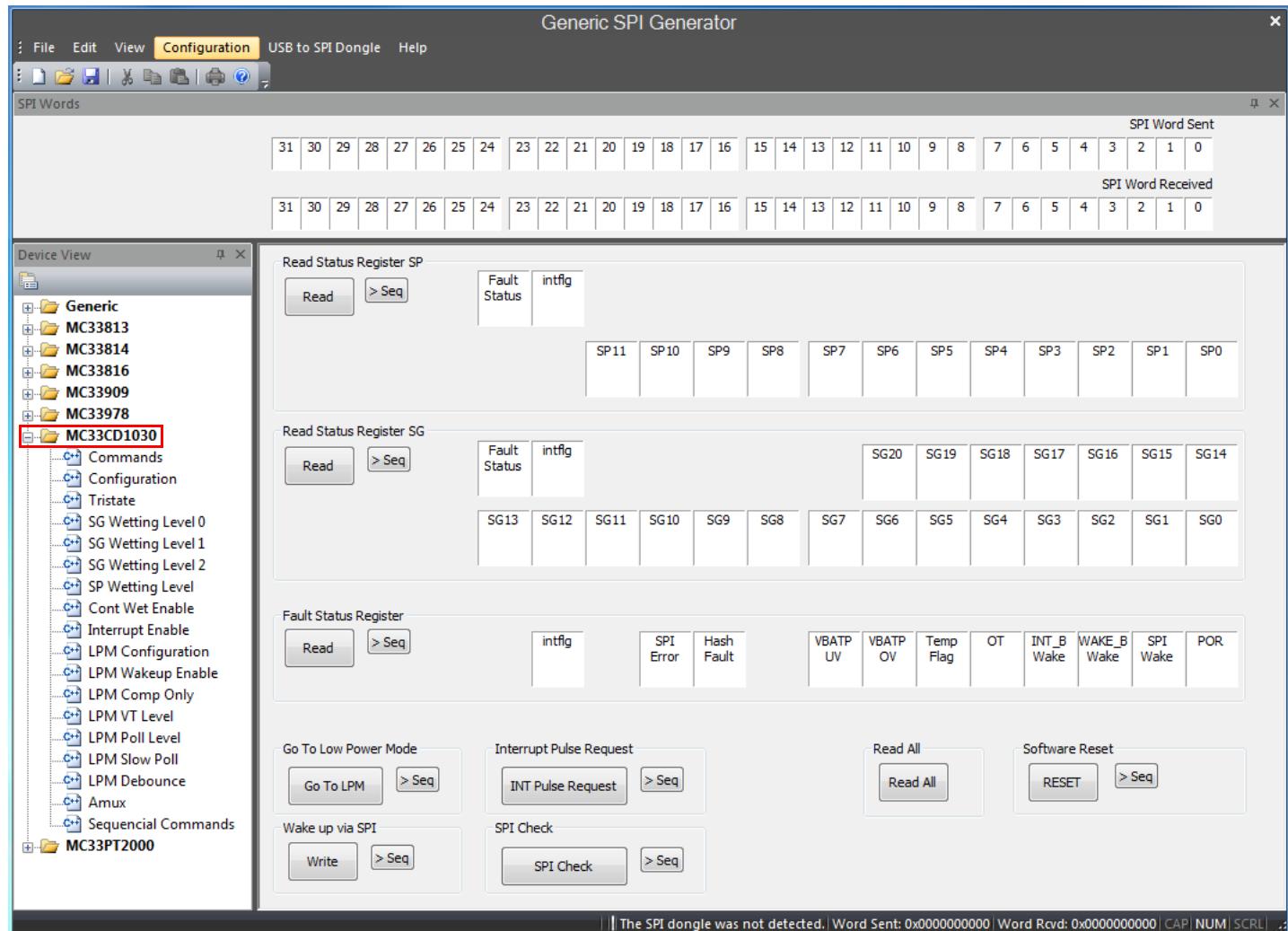


Figure 12. SPIGen GUI

6.2 Describing the GUI Interface

The SPIGen GUI is divided into three major sections:

1. Device View provides a list of supported devices embedded into the SPIGen software.
2. Command window provides access to all the functions and commands contained in each one of the command pages for the CD1030
3. SPI Words window provides the latest SPI word sent and received in RAW format (32-bit).

6.3 Using the GUI Interface

Before starting the communication with the FRDM-CD1030EVM, it is important to understand the Full Duplex nature of the SPI communication protocol.

During each SPI clock cycle, a full duplex data transmission occurs:

- the master sends a bit on the MOSI line; the slave reads it from that same line
- the slave sends a bit on the MISO line; the master reads it from that same line

Not all transmissions require all four of these operations to be meaningful, but they do happen.

This means when the master sends a configuration command [A] through the MOSI pin, the actual data received on the MISO pin is the value for the transaction made in the previous SPI request, which in turns means the user sees the result to the command [A] on the MISO response of the next SPI transaction [B], as depicted in [Figure 13](#).

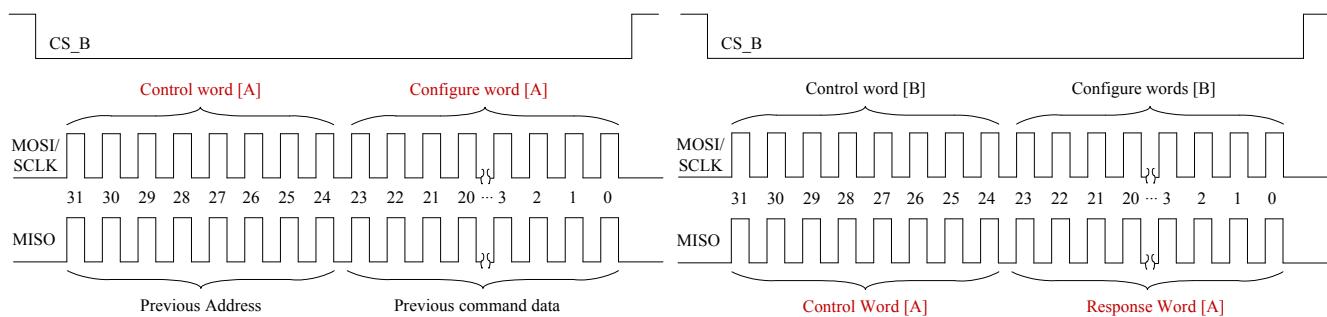


Figure 13. Full Duplex SPI Transaction Example.

Due to the Full Duplex nature of the protocol, when using the SPIGen GUI, the user should send the command twice in order to see the actual response to the request sent.

6.3.1 Reading/Writing a SPI Register

The CD1030 SPI register map is conformed by 33 Functional registers which can be Read only, Write only, or Read and Write. For more detail on the organization and register definition, refer to the CD1030 Data Sheet. The SPIGen GUI provides a friendly way to configure and read each one of the registers.

To write a configuration register / command:

- Click on the corresponding command page
- Highlight the Register bits to set the register to 1 or clear to set to 0 or select the pre-defined configuration options if available.
- Click the “Write” button to send the SPI command

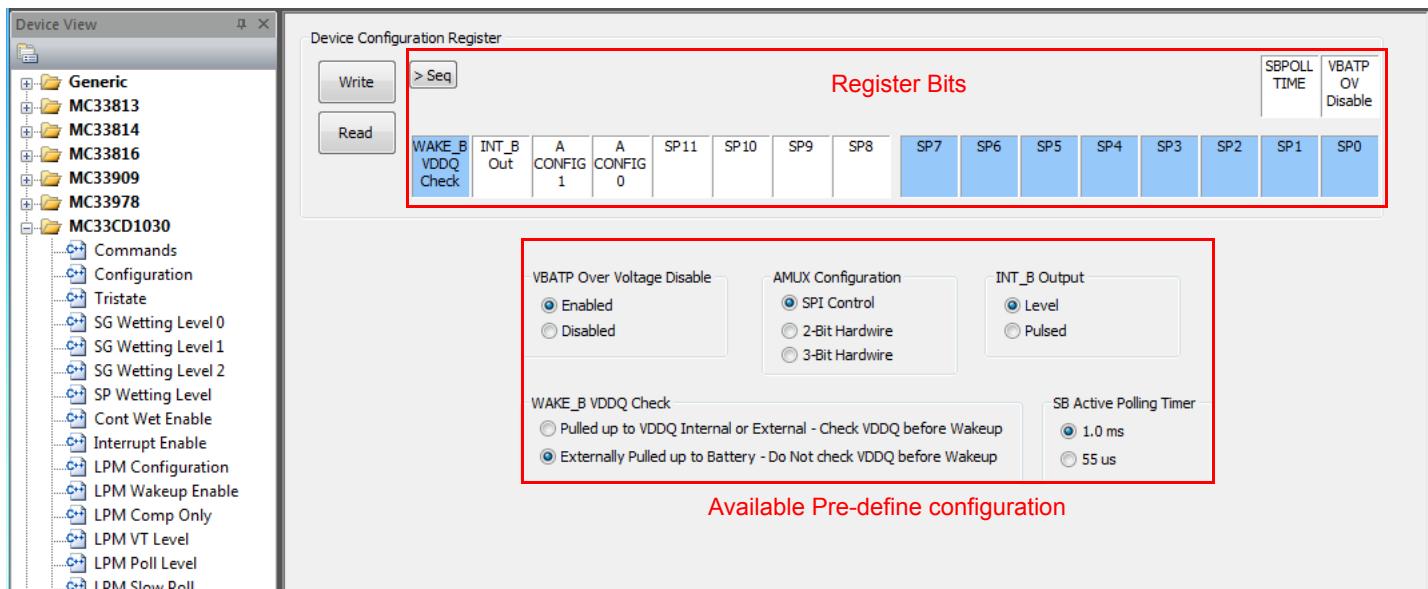


Figure 14. Register SPI Write

To read the value of a specific register, click the “Read” button twice. The current value is populated on the Raw Register bits.

The SPIGen GUI writes or reads registers according to its proper function. Therefore, if a register is Read only, SPIGen does not provide a predefined way to write into that register. [Figure 15](#) shows the Read Status register, which is an example of a read only register on the CD1030, and so SPIGen provides only the “Read” button.

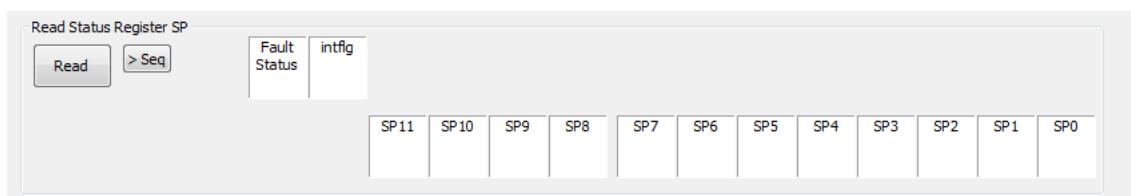


Figure 15. Read only Register Example

6.3.2 Creating Sequential Scripts

The SPIGen GUI provides a way to create, save, and load scripts with a sequence of commands for quick configuration. To add commands to the “sequential command” page, set the configuration bits as desired and click on the “>Seq” button. The corresponding configuration is added to the “Sequential commands” in the order they are entered, as shown in [Figure 16](#).

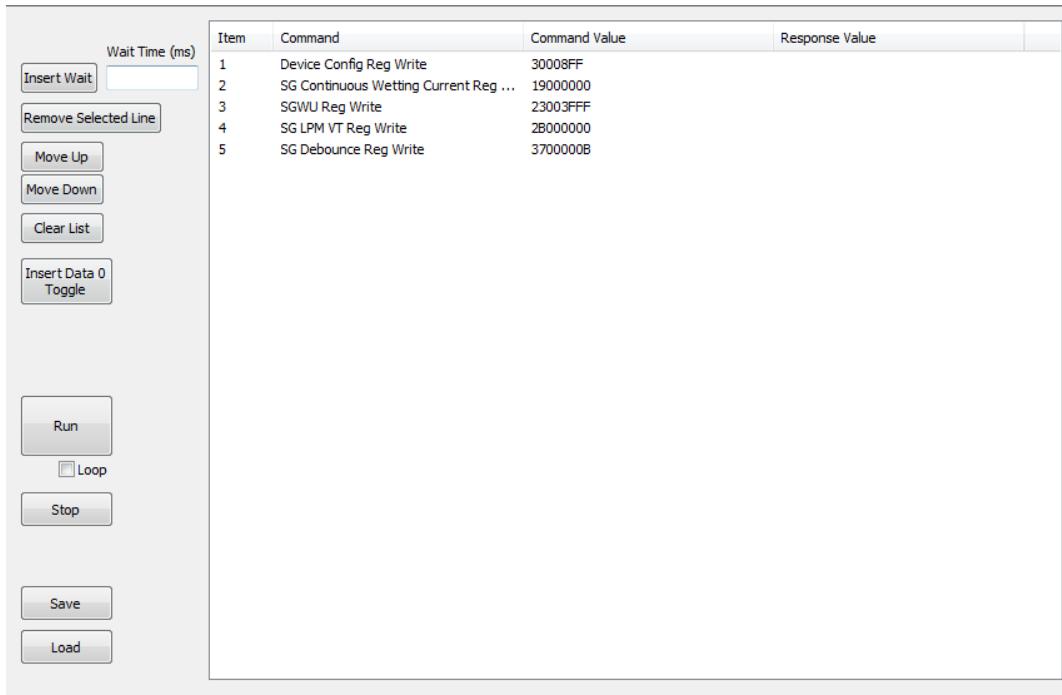


Figure 16. Sequential Command Page

The sequential script page organizes and creates various functions within the script by using the following buttons.

- Insert Wait: Inserts a defined delay before the next command
- Remove Selected line: Deletes the selected line from the script
- Move Up/Down: Shift the selected command one place up or down
- Clear List: Deletes all lines from the script window
- Insert Data 0 Toggle: Not Used on FRDM-CD1030EVM
- Run: Starts the script as a single or loop sequence
- Loop: Enables the looping sequence mode to repeat the script indefinitely
- Stop: Ends the script before it is over
- Save: Saves the current configuration into a .txt file
- Load: Loads a previous configuration from a file

6.3.3 Sending Customize SPI Commands

The SPIGen GUI sends customized 32-bit SPI words for debugging or any other special use with the CD1030.

- From Generic folder in the device view, select the Single command page.
- Choose the 32-bit length and the format preference (binary or Hex).
- Set the bits high or low as desired.
- Click the “Send Once” or “Send Continuously” button to send the selected word through SPI.

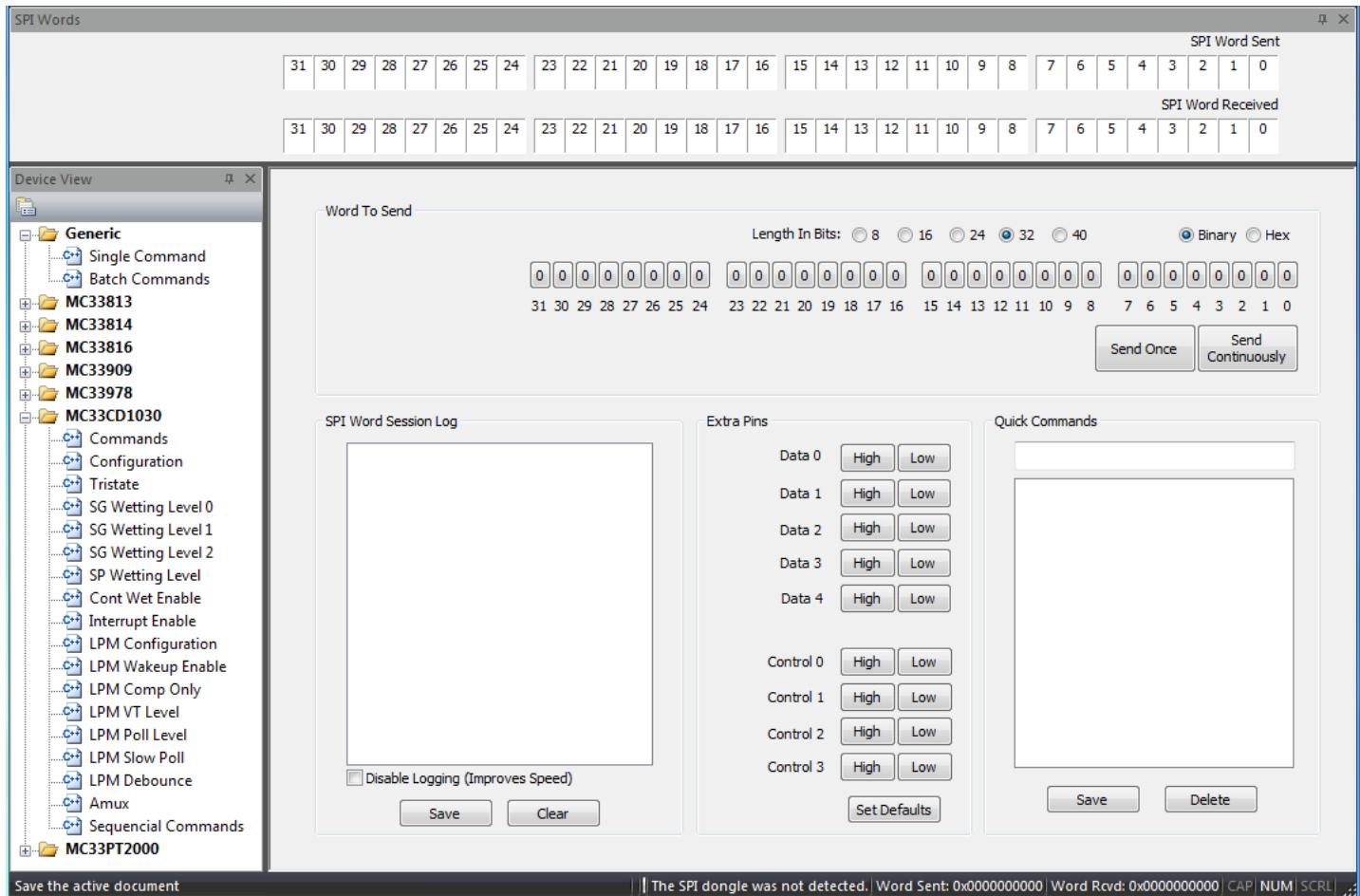


Figure 17. Generic Single Command Page

- The “SPI word Session Log” frame, shows the history of commands sent.
- The “Extra pins” section sets the extra control/data I/Os high or low, as provided in the IO Port of the FRDM-KL25Z. Note that not all signals may be usable as input or output with the FRDM-CD1030EVM. Make sure you understand each pin function on the CD1030 before applying a high or low to these pins.
- The “Quick Commands” section allows the user to create customized commands. The commands are saved for further quick access during the current session. To save a quick command, set the 32-bit word to be saved, write a name on the header frame, and then click the “Save” button. The new commands added are listed below the header frame.

7 References

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

NXP.com Support Pages	Description	URL
FRDM-CD1030EVM	Tool Summary Page	www.nxp.com/FRDM-CD1030EVM
CD1030	Product Summary Page	www.nxp.com/CD1030
FRDM-KL25Z	Tool Summary Page	www.nxp.com/FRDM-KL25Z
SPIGen	Software	www.nxp.com/SPIGEN

7.1 Support

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

7.2 Warranty

Visit www.nxp.com/warranty to submit a request for tool warranty.

8 Revision History

Revision	Date	Description
1.0	10/2015	<ul style="list-style-type: none">Initial release
	1/2016	<ul style="list-style-type: none">Updated back page and logo

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