UM11313

FRDM-XS2410EVB evaluation board

Rev. 1 — 5 November 2019 User manual

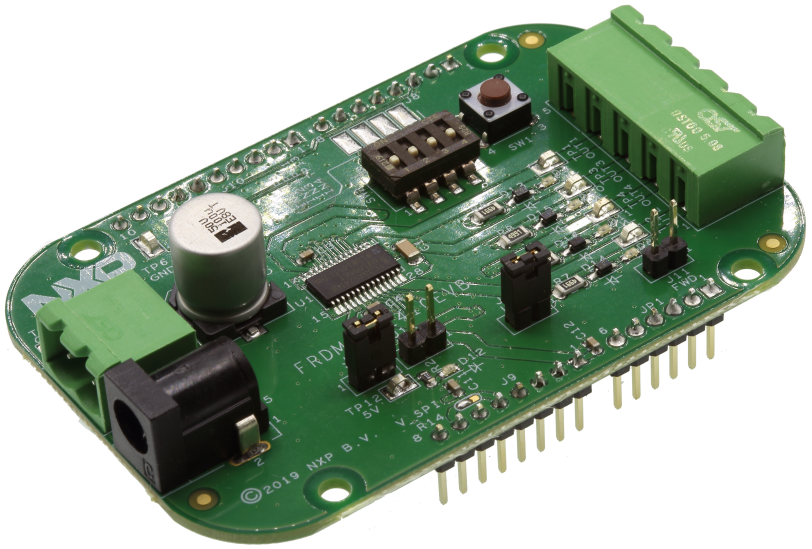

Figure 1. FRDM-XS2410EVB

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1 Introduction

This user manual for the FRDM-XS2410EVB evaluation board is intended for engineers involved in the evaluation, design, implementation, and validation of MC33XS2410EL[1] quad high side 100 mΩ smart device.

The document content provides the user with information to evaluate the MC33XS2410EL. This document addresses connecting the hardware, installing the software and tools, configuring the environment and using the kit.

The FRDM-XS2410EVB enables development on MC33XS2410 devices. The kit can be connected to the FlexGUI software which allows users to work with the output configuration, set different registers, monitor the different information from the analog-to-digital converter (ADC), and generate faults.

This board can also be used to start software development using software drivers provided for the S32K design studio IDE or MCUXpresso.

2 Finding kit resources and information on the NXP website

NXP Semiconductors provides online resources for this evaluation board and its supported device(s) on http://www.nxp.com.

The FRDM-XS2410EVB evaluation board information page is at http://www.nxp.com/FRDM-XS2410EVB. The information page provides tabs for overview information, specifications, ordering information (Buy), and documentation and software and a **Get started** button. If applicable, these tabs may also include tools and parametric information. The **Get started** button provides quick-reference information applicable to using the FRDM-XS2410EVB evaluation board, including the downloadable assets referenced in this document.

2.1 Collaborate in the NXP community

The NXP community is for sharing ideas and tips, ask and answer technical questions, and receive input on just about any embedded design topic.

The NXP community is at http://community.nxp.com.

3 Getting ready

Working with the FRDM-XS2410EVB requires the kit contents, additional hardware, and a Windows PC workstation with installed software. Meeting these minimum requirements enables users to produce successful results when working with this evaluation board.

3.1 Kit contents

- Assembled and tested evaluation board in an anti-static bag
- Power connector 2x1 for power supply
- Power connector 5x1 for outputs and ground
- Jumpers mounted on board

3.2 Additional hardware

In addition to the kit contents, the following hardware is necessary or beneficial when working with this kit.

- Power supply with a range of 0 V to 60 V and a DC current capability up to 10 A.

3.3 Windows PC workstation

This evaluation board requires a Windows PC workstation.

- USB-enabled computer with Windows 7 or Windows 10

3.4 Software

Software is necessary to work with this evaluation board. All listed software is available on the information page for the evaluation board at http://www.nxp.com/FRDM-XS2410EVB or from the provided link.

- FlexGUI latest version (for evaluation purpose)[2]
- Q100_eSwitch_SDK_SW.zip (for getting started with software drivers)
- Java Standard Edition (SE) Runtime Environment (JRE) installation available on the Oracle Corporation Technology Network[3]

4 Getting to know the hardware

The main purpose of this kit is to program the board and evaluate all the different features of the MC33XS2410 along with a power supply and real loads.

The FRDM-XS2410EVB provides flexibility to interact with all the features of the device and perform measurements on the main part of the application. With compatible pinouts, the FRDM-XS2410EVB can be interfaced to either KL25Z MCU or S32K144EVB Freedom boards. With the FlexGUI software loaded, the EVB allows access to the registers in read and write mode, device configuration, and monitoring key diagnostics parameters. Power outputs are accessible through connectors, and some of the signal can also be probed using test points. Some LEDs will witness the state of the outputs, such as Vdd supply or warning/IRQ faults on FAULTB pin.

4.1 Kit overview

The FRDM-XS2410EVB is a hardware tool to evaluate the features and functionality of the device and also assists the user in building code using the provided software drivers.

4.1.1 FRDM-XS2410EVB features

- VBAT power supply connectors 0 V - 60 V (Jack and Phoenix)
- 4 high side outputs 100 mΩ up to 2.5 A per channel at room temperature
- 5 V supply regulator for VDD pin
- Manual switches for direct input control in safe mode
- Limp button to force safe mode externally
- LEDs to witness output state, VDD supply, or warning and fault in FAULTB IRQ pin
- 4 headers to connect on compatible hardware (KL25z, S32K144, or Arduino R3)

- Jumpers to enable LEDs, freewheeling diodes when driving inductive load, VDD connection, or MCU supply.

4.1.2 Hardware compatibility

The FRDM-XS2410EVB gets 4 single row header connectors with adjusted pinouts to fit both KL25z and S32K144 Freedom boards.

The header connector pinout also allows connection to different Arduino Rx boards. The VREF can be adjusted by solder point on the 3-pin jumper short R14.

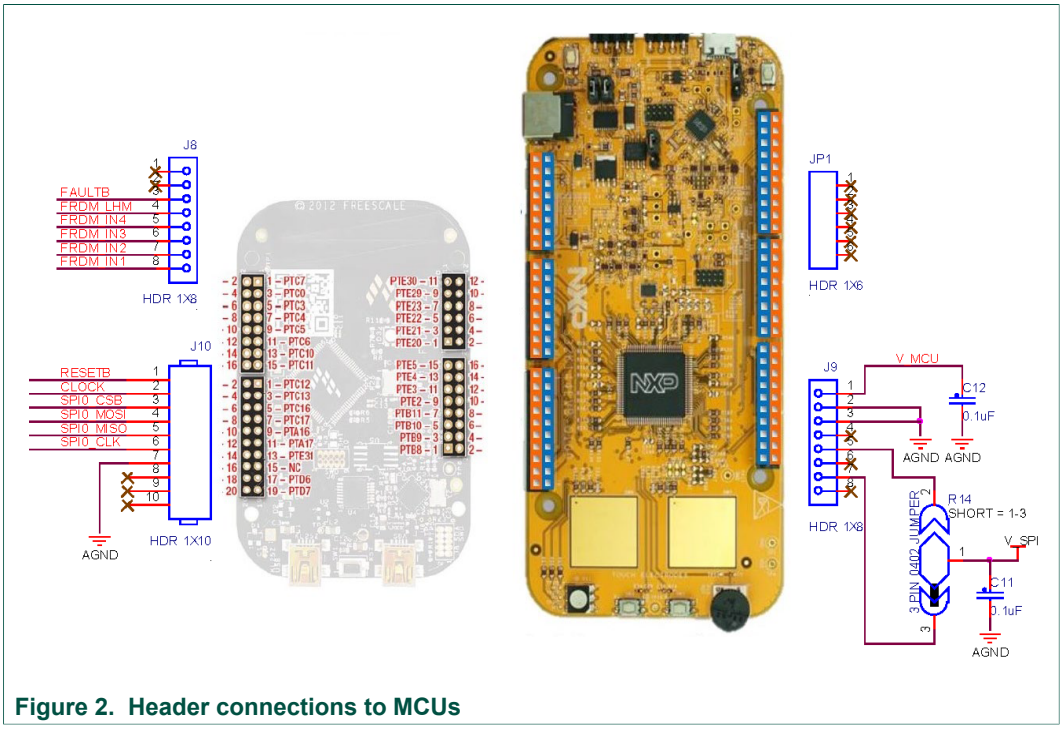

Figure 2. Header connections to MCUs

4.1.3 Jumper configuration for freewheeling path

If the user drives a highly inductive load, it is possible to connect independently freewheeling diodes for load demagnetization at turn off.

By default, jumper J11 and solder shorts SH1, SH2, SH3, and SH4 are open. In order to close the freewheeling path, J11, SH1, SH2, SH3, and SH4 should be closed.

The chosen diode can tolerate 15 A transient current peak.

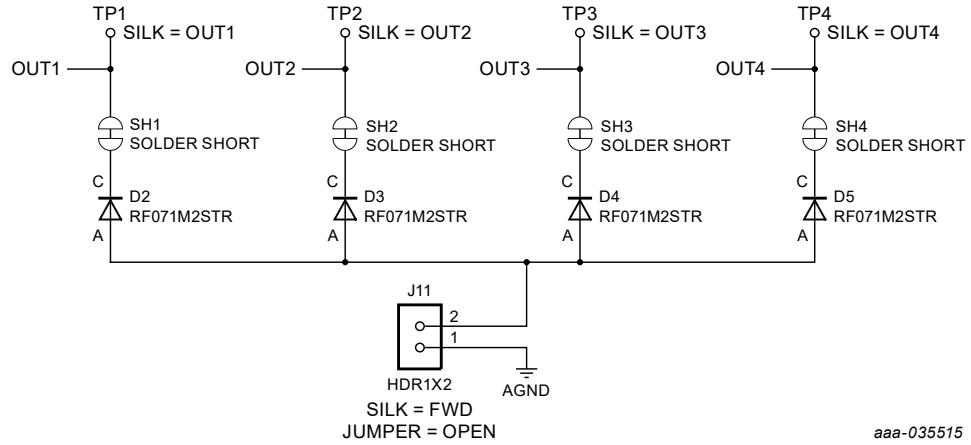

Figure 3. Optional Freewheeling power outputs path

4.1.4 SPI and IOs

In addition to various input/outputs, the SPI bus is connected to the header. The pinout is compatible with 'single row header version' of the kit in FlexGUI software for both KL25z and S32K144EVB

This kit uses a KL25Z MCU or S32K144EVB to communicate with FlexGUI. However, if the user wants to connect the SPI to another MCU, it is possible but not supported by FlexGUI.

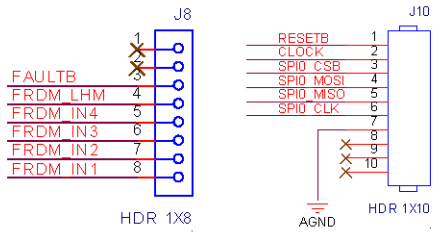

Figure 4. SPI connection to KL25Z

4.2 Kit featured components

Important board components are identified in Figure 5. Table 1 provides additional component details.

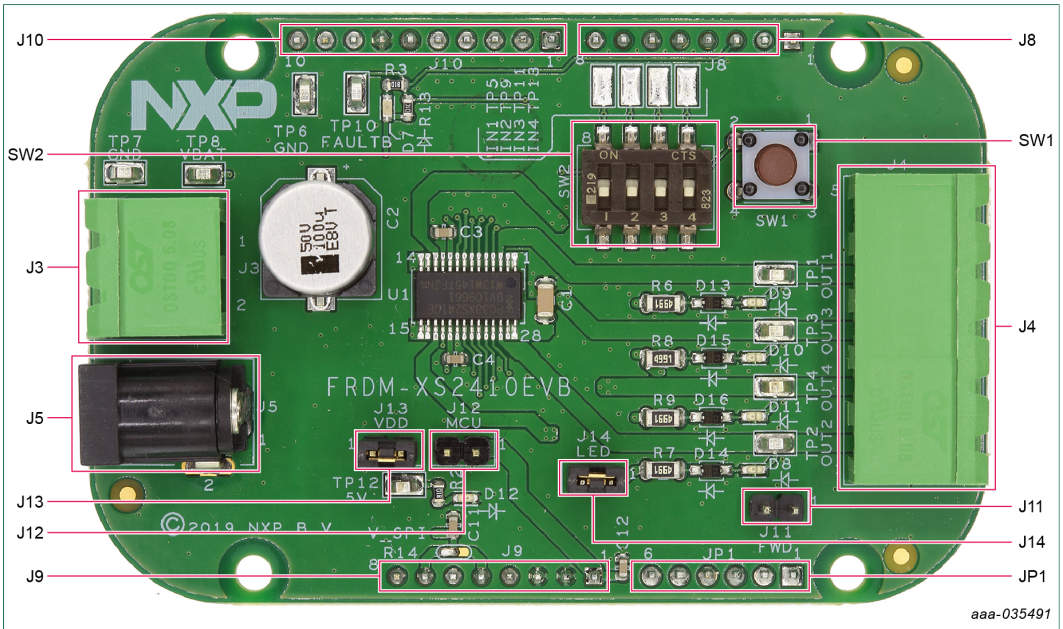

Figure 5. Evaluation board featured component locations

Table 1. Evaluation board component descriptions

Output name	Description	Default
J3	VBAT Power (and GND) connector	—
J4	Output 1, Output 2, Output 3, Output 4 (and AGND) connector	—
J5	VBAT Power (and AGND) DC Jack	—
J8	1x8 Freedom board header	—
J9	1x8 Freedom board header	—
J10	1x10 Freedom board header	—
J11	Output Freewheeling path jumper	open
J12	5 V VDD to MCU jumper	open
J13	5 V VDD to Q100 jumper	short
J14	Output LED Jumper	short
JP1	1x6 Freedom board header	—
SW1	Push button for LHM (safe mode)	—
SW2	4 ON/OFF switches for direct input 1, input 2, input 3, and input 4	Off

4.2.1 Indicators

Figure 6 identifies board LEDs, visual output devices on the evaluation board. Table 2 identifies connections and describes their color status.

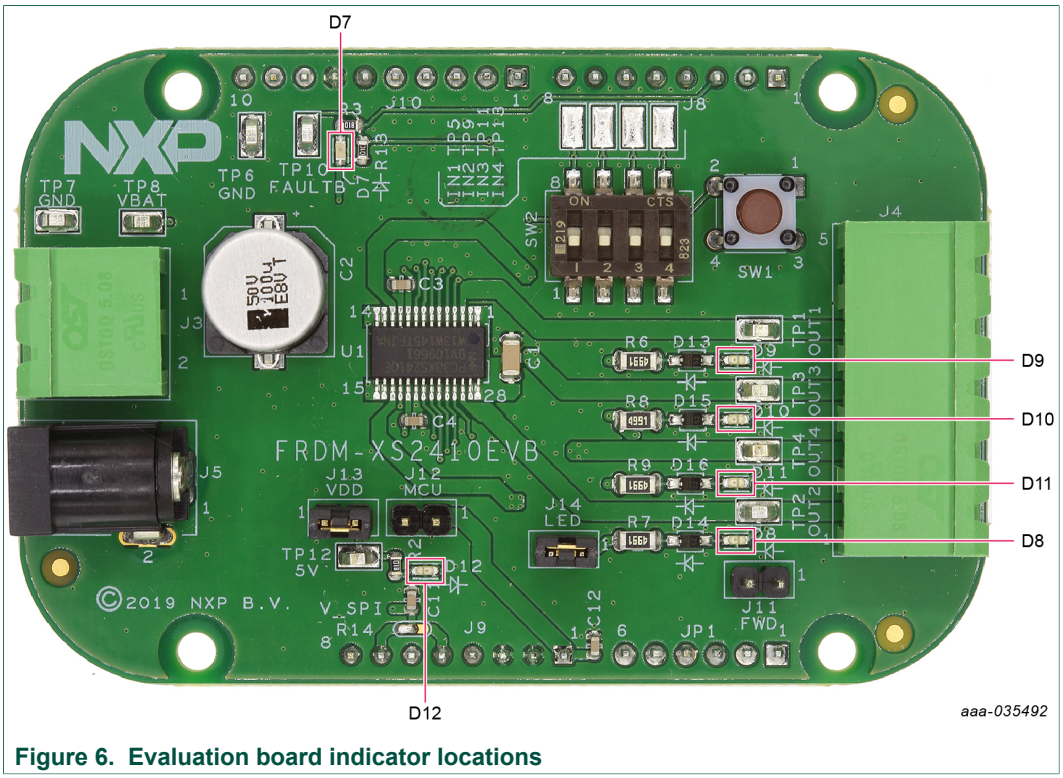

Figure 6. Evaluation board indicator locations

Table 2. Evaluation board indicator descriptions

Label	Name	Color	Description
D9	OUT1	Green	OUT1 On
D8	OUT2	Green	OUT2 On
D10	OUT3	Green	OUT3 On
D11	OUT4	Green	OUT4 On
D12	Vdd	Red	Vdd On
D7	FAULTB	Red	Fault status reporting

4.2.2 Connectors

Figure 7 identifies connector locations on the board. Table 3 provides additional details for the connectors.

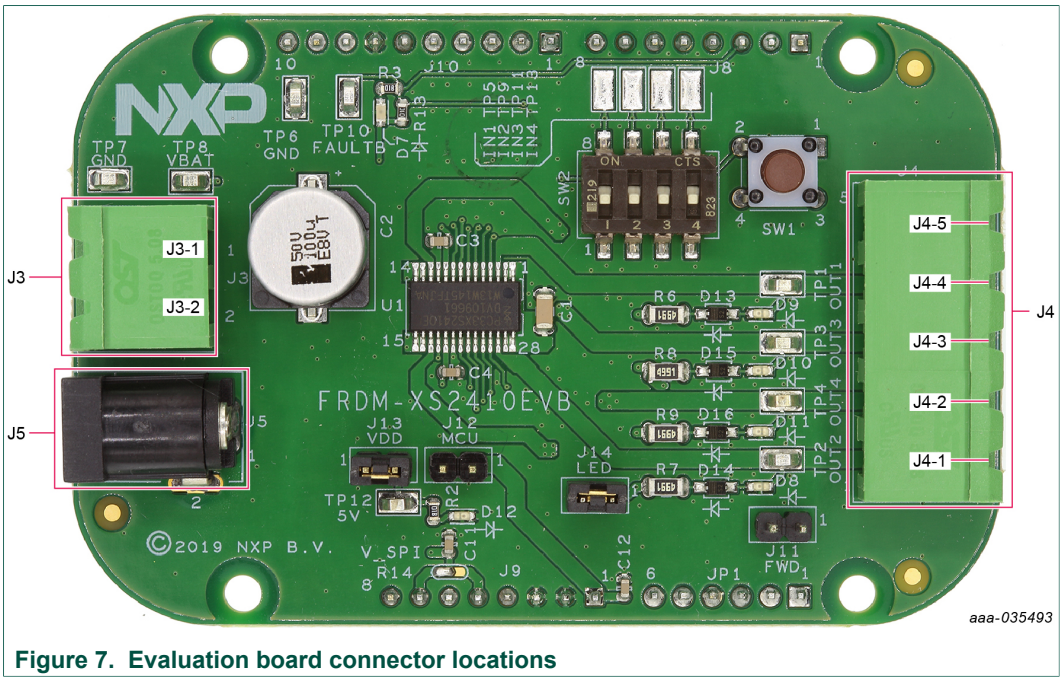

Figure 7. Evaluation board connector locations

VBAT connects to the board through Phoenix connector (J3) or with J5 Cliff electronic connector with desktop power supply. J4 is the output power connector with 5 positions: OUT1, OUT2, OUT3, OUT4, and ground.

Table 3. Power connectors

Schematic label	Signal name	Description
J3-1	VBAT	Battery voltage supply input
J3-2	GND	Ground
J5	VBAT /GND	DC power jack
J4-1	OUT2	Output 2
J4-2	OUT4	Output 4
J4-3	OUT3	Output 3
J4-4	OUT1	Output 1
J4-5	GND	Ground

4.2.3 Test points

Figure 8 identifies board test points that provide signal access to and from the board. Table 4 provides additional test point details.

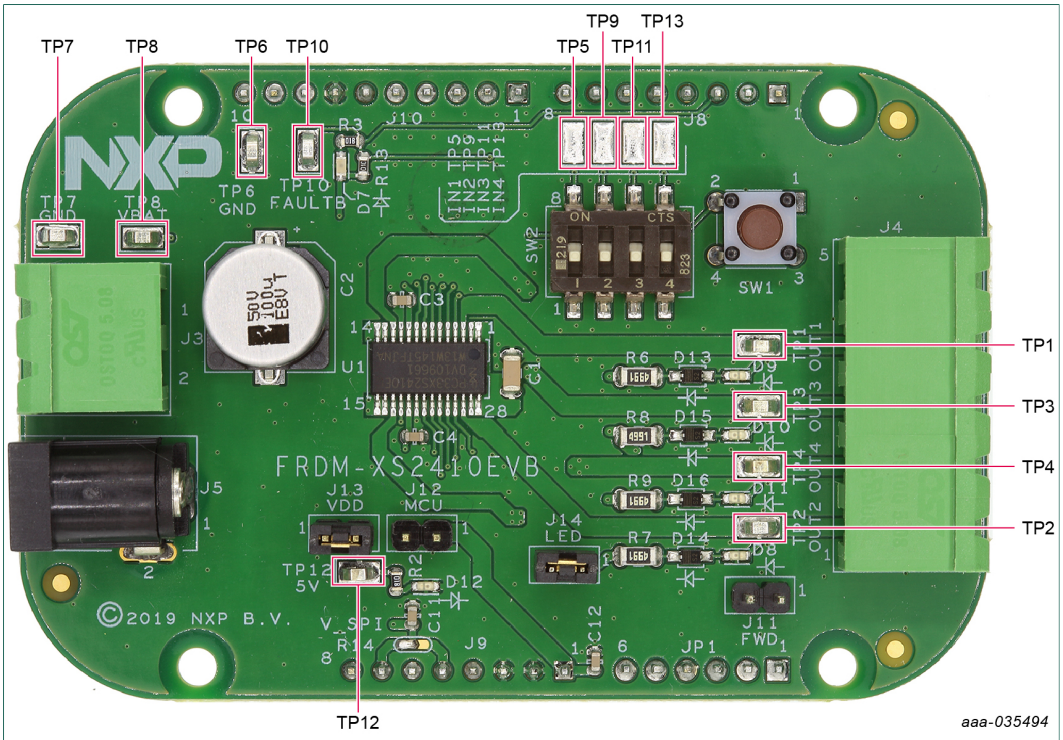

Figure 8. Evaluation board test points

Table 4. Evaluation board test point descriptions

Test point name	Signal name	Description
TP1	OUT1	Output 1
TP2	OUT2	Output 2
TP3	OUT3	Output 3
TP4	OUT4	Output 4
TP5	IN1	Input 1
TP6	GND	Ground
TP7	GND	Ground
TP8	VBAT	Power supply
TP9	IN2	Input 2
TP10	FaultB	Fault status signal
TP11	IN3	Input 3
TP12	VDD	5 V signal
TP13	IN4	Input 4

4.2.4 Jumpers

Figure 9 identifies the jumper locations on the evaluation board. Table 5 provides additional jumper details.

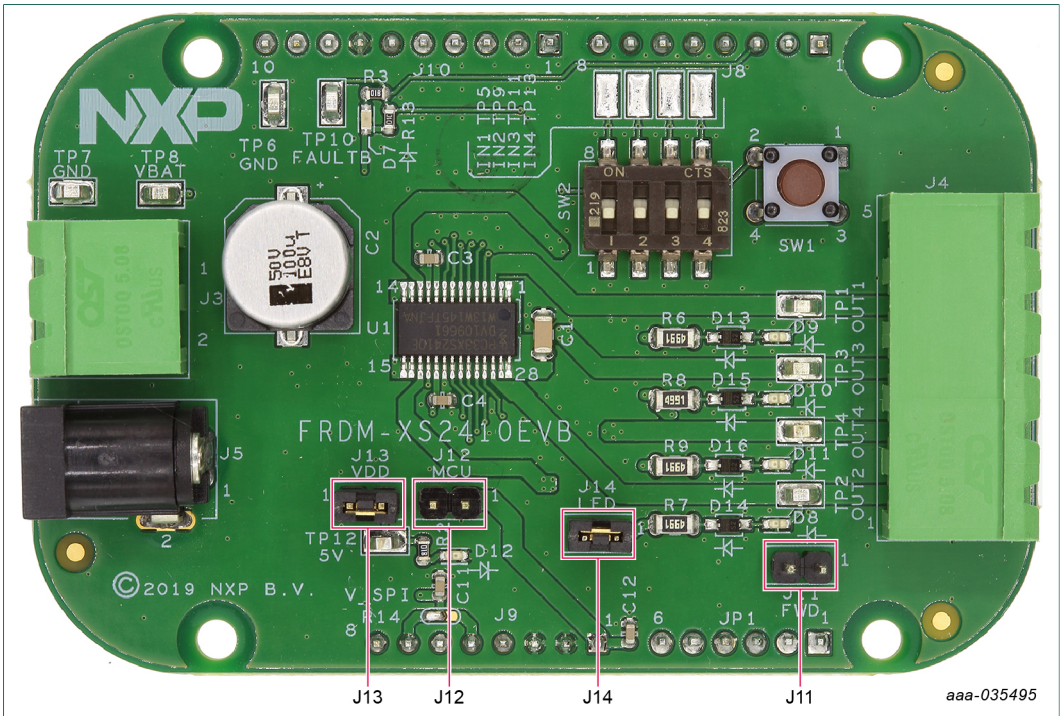

Figure 9. Evaluation board jumper locations

Table 5. Evaluation board jumper descriptions

Name	Function	Pin number	Jumper/pin function
J11	FWD	1−2	Freewheeling diode connections in case of inductive loads
J12	MCU	1-2	Connect 5 V regulator to MCU if not supplied by USB
J13	VDD	1-2	Connect Vpwr to VDD regulator (5 V)
J14	LED	1-2	Connect each output to their respective LED

4.2.5 Switches

Figure 10 identifies two switch locations on the evaluation board. Table 6 provides additional switch-related information.

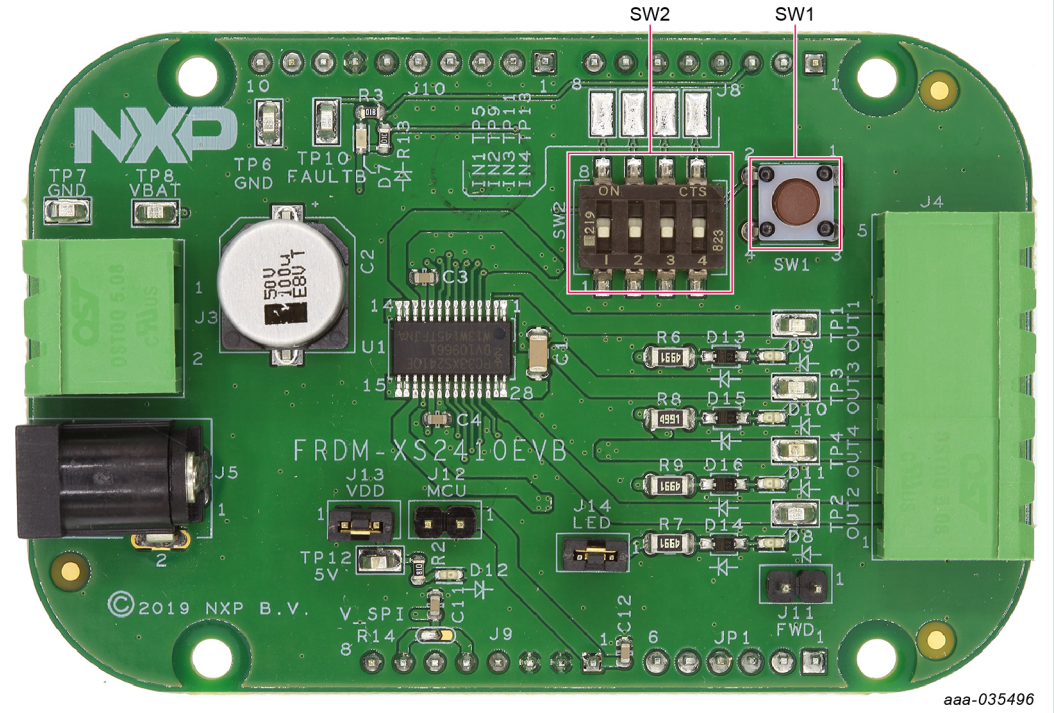

Figure 10. Switch locations

Table 6. Switch functions

Position	Function	Description
SW1	LHM	Force safe mode (direct input control)
SW2	INx	Set IN1, IN2, IN3, and IN4 to a high (5 V) or a low state (0 V) to control the output in safe mode

4.3 Schematic, board layout, and bill of materials

The schematic, board layout, and bill of materials for the FRDM-XS2410EVB evaluation board are available at http://www.nxp.com/FRDM-XS2410EVB.

5 Installing and configuring software and tools

This development kit uses FlexGUI software. FlexGUI software is based on Java Standard Edition (SE) Runtime Environment (JRE). Preparing the Windows PC workstation consists of two steps.

1. Install the appropriate Java SE Runtime Environment (JRE).
2. Install FlexGUI software package.

5.1 Installing the Java JRE

1. Download the JRE, version 8u162 or newer, available on the Oracle Corporation Technology Network[3].
2. Open the installer and follow the installation instructions.
3. After a successful installation, restart the computer.

5.2 Installing FlexGUI software package

The FlexGUI software is installed by extracting the contents of a zip file to a desired location.

1. Download the latest FlexGUI version, available at https://www.nxp.com/design/:FLEXGUI-SW.
2. Extract all the files to the desired location on your PC.
3. Start the setup file located under the GUI folder: *flexgui-app-des-q100*.

For details on FlexGUI installation procedure, review the documentation at https://www.nxp.com/design/:FLEXGUI-SW.

6 Configuring the hardware for startup

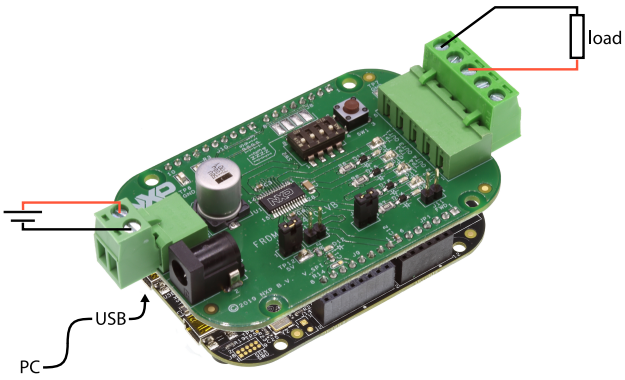

Figure 11. Typical initial configuration

Figure 11 shows a typical hardware configuration incorporating the evaluation board, power supply, and MCU

This board can be used either with FlexGUI software for evaluation or with software drivers for development.

- For FlexGUI software usage, refer to the dedicated user guide for FRDM-XS2410EVB at https://www.nxp.com/design/:FLEXGUI-SW.
- For MC33XS2410 related software drivers, software examples and documentation, refer to https://www.nxp.com/XS2410-SWUG including UM11182 [4].

7 FRDM-XS2410EVB evaluation using FlexGUI

All installation details and software flashing on MCU are described in UM11301[5], the dedicated FlexGUI user guide for FRDM-XS2410EVB. This following chapter shows a high-level overview of the GUI and some of the key features of the application.

7.1 Starting the FlexGUI application

After the FlexGUI application is started with *flexgui-app-des-q100*, the FlexGUI launcher displays the supported MCU and communication protocols. After the boards are selected, the GUI starts.

7.2 FlexGUI workspace and features

7.2.1 General settings

At first launch, the FlexGUI starts in user mode. Figure 12 displays the general settings that can be configured or monitored.

The bottom left area of the GUI shows three tabs:

- **Q100**: The user can decide to switch to Watchdog Off mode using the Switch Mode drop-down list followed by clicking **Apply**. The SPI frequency may also be changed.
- **Pins**: The Pins tab allows direct control of the various device inputs (IN and LHM) and reading the device output (FAULT_B)
- **CHx status**: The CHx tab allows reading or polling the different warnings and faults from the 4 channels.

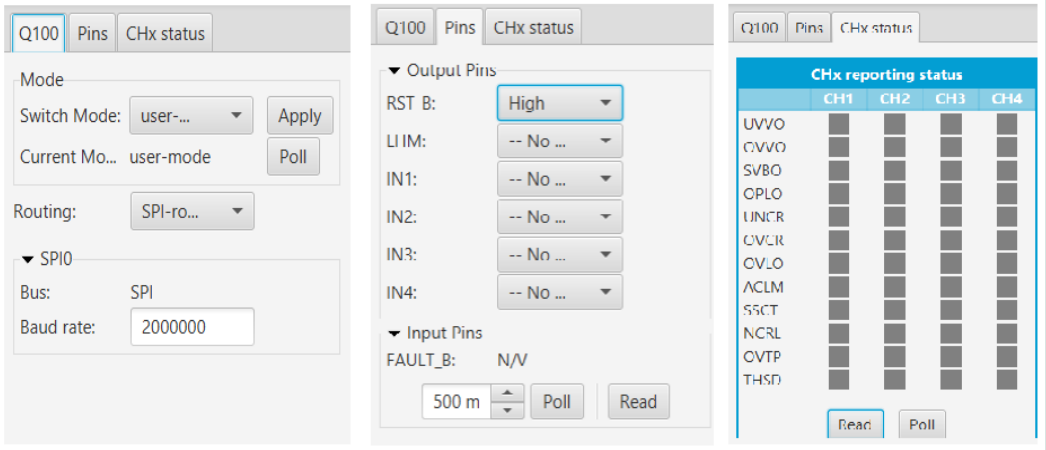

Figure 12. General settings

7.2.2 Main panel

The FRDM-XS2410EVB workspace consists of several tabs, each dedicated to a specific aspect of device functionality or configuration. Figure 13 shows the main panel, composed of the following tabs:

- **Register map**: Using this tab, all SPI registers can be accessed in write and read mode.
- **Interrupts and warning**: The user can set different voltage/current/temperature thresholds and have a 1 screen overview of faults reporting.
- **Output drive**: The output drive tab configures the way outputs are driven and their state.
- **Miscellaneous settings**: This tab provides access to additional configuration settings such as current limitation, open load thresholds, output short to Vpwr or PI regulation close loop.
- **ADC monitor**: The ADC monitor tab displays a timed view of the voltage, current, and temperature monitoring.

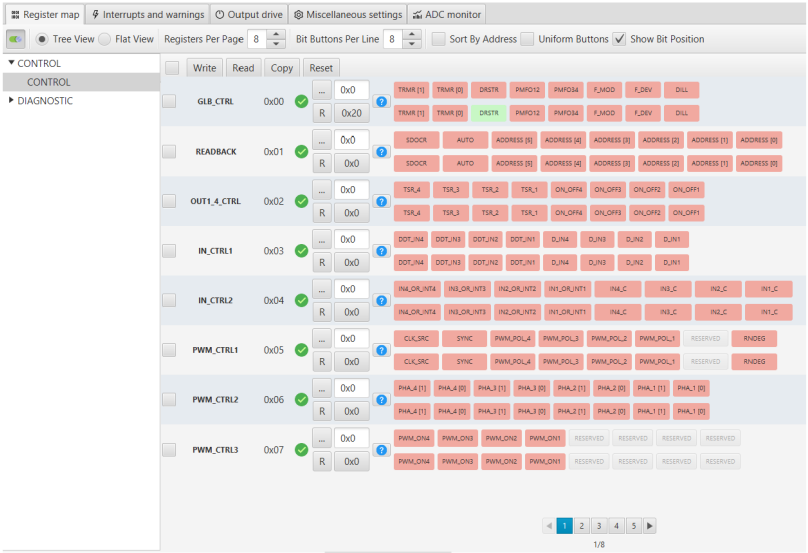

Figure 13. Main panel

7.2.3 Working with the Script editor

Configure registers and device inputs using the script editor. The script editor is useful for trying specific test sequences or to configure your own initialization procedure.

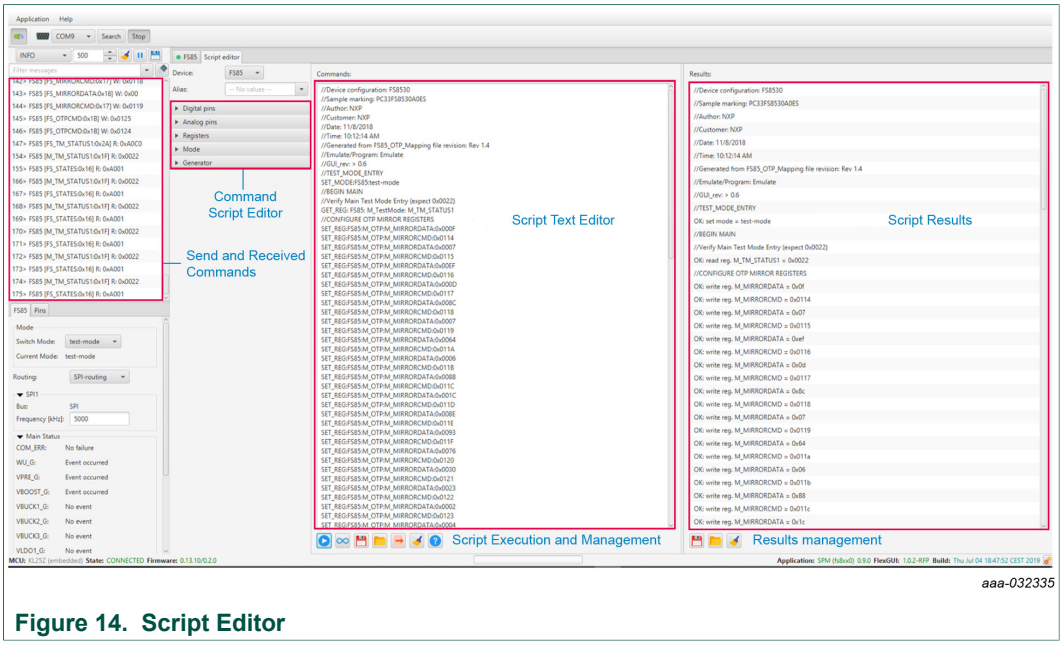

Figure 14. Script Editor

The main areas of the script editor are:

- **Send and receive command**: displays a summary of commands sent and received from the device
- **Command script editor**: builds commands to be sent to the device (access to read and write registers and device inputs
- **Script text editor**: sends a sequence of register configurations from a text file or from command edited directly in this area
- **Script results**: displays result status of each command sent to the device

8 References

[1] **MC33XS2410** — *Quad 100 mΩ / dual 50 mΩ, 3.0 V to 60 V high-side switch* data sheet, Contact your NXP sales representative.

[2] **FlexGUI webpage** — detailed information on FlexGUI software including documentation, downloads, software, and tools https://www.nxp.com/support/:FLEXGUI-SW

[3] **Java SE Runtime Environment** — Oracle Corporation Technology Network, https://www.oracle.com/technetwork/java/javase/downloads/jre8-downloads-2133155.html

[4] **UM11182**, *Q100 (MC33XS2410) Extreme switch software driver user guide*

[5] **UM11301**, *FlexGUI for Q100 v1.0.0 user guide*

9 Revision history

Table 7. Revision history

Rev	Date	Description
v.1	20191105	Initial version

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