

# FRDM-17510EJ-EVB Evaluation Board

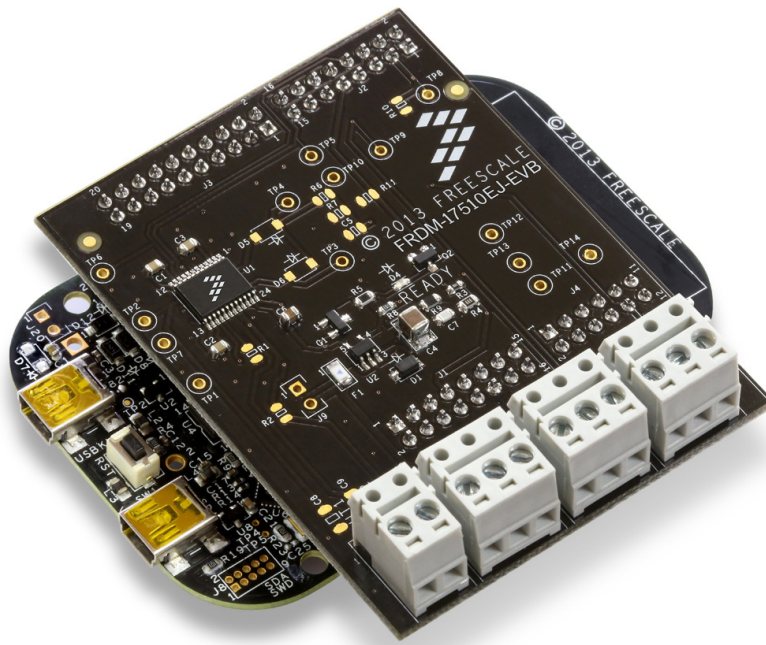


Figure 1. FRDM-17510EJ-EVB Evaluation Board

# Contents

1 Important Notice .....	3
2 Getting Started .....	4
3 Getting to Know the Hardware .....	5
4 FRDM-KL25Z Freedom Development Platform .....	9
5 Installing the Software and Setting up the Hardware .....	12
6 Schematic .....	15
7 Silkscreen .....	16
8 Board Bill of Materials .....	17
9 References .....	18
10 Revision History .....	19

# 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 **FRDM-17510EJ-EVB** contents include:

- Assembled and tested evaluation board/module in anti-static bag.
- Warranty card

### 2.2 Jump Start

Freescle's analog product development boards help to easily evaluate Freescle 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. Freescle 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](http://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

To use this kit, you need:

- DC Power supply (2.0 V to 15 V, 0.1 V to 1.2 A, depending on brushed DC motor requirements)
- USB A to mini-B cable
- FRDM-KL25Z Freedom Development Platform
- Typical loads (brushed DC motor or power resistors)
- 3/16" blade screwdriver
- Oscilloscope (preferably 4-channel) with current probe
- Digital multi-meter
- One 12-pin (PPTC062LFBN-RC), two 16-pin (PPTC082LFBN-RC), and one 20-pin (PPTC102LFBN-RC) female connector, by Sullins Connector Solutions, or equivalent soldered to FRDM-KL25Z

### 2.4 System Requirements

To use this kit, you need:

- USB-enabled PC with Windows XP or higher

## 3 Getting to Know the Hardware

### 3.1 Board Overview

The FRDM-17510EJ-EVB evaluation board features the MPC17510EJ H-Bridge IC, which features the ability to drive brushed DC motors in both directions. The MPC17510EJ incorporates internal control logic, a charge pump, gate drive, and high current, low  $R_{DS(on)}$  MOSFET output circuitry. An auxiliary gate drive for an external MOSFET circuit is also available.

### 3.2 Board Features

The FRDM-17510EJ-EVB evaluation board is designed to be able to easily evaluate and test the main component, the MPC17510EJ. The board's main features are as follows:

- Compatible with Freedom series evaluation boards such as FRDM-KL25Z
- Built in fuse for both part and load protection
- Screw terminals to provide easy connection of power and loads
- Test points to allow probing of signals
- Built in voltage regulator to supply logic level circuitry
- LED to indicate status of the on board voltage regulator

### 3.3 FRDM-KL25Z Features

The features of the FRDM-KL25Z are as follows:

- MKL25Z128VLK4 in an 80 LQFP package
- Capacitive touch slider
- MMA8451Q accelerometer
- Tri-color (RGB) LED
- Flexible power supply options – USB, coin cell battery, external source
- Battery-ready, power-measurement access points
- Easy access to MCU I/O via Arduino™ R3 compatible I/O connectors

### 3.4 Device Features

This evaluation board features the following Freescale product:

**Table 1. Device Features**

Device	Description	Features
MPC17510EJ	The MPC17510EJ is an H-Bridge motor driver IC intended for operating brushed DC motors.	<ul style="list-style-type: none"> <li>• Wide voltage range of operation from 2.0 V to 15 V</li> <li>• Output Current of 1.2 A (DC) continuous, 3.8 A peak</li> <li>• 450 mΩ <math>R_{DS(on)}</math> H-Bridge MOSFET outputs</li> <li>• 5.0 V TTL/CMOS compatible inputs</li> <li>• PWM frequencies up to 200 kHz</li> <li>• Undervoltage shutdown</li> <li>• Cross conduction (shoot through) suppression</li> </ul>

### 3.5 Board Description

This evaluation board consists mainly of an MPC17510EJ. The following sections describe the additional hardware used to support the H-Bridge driver.

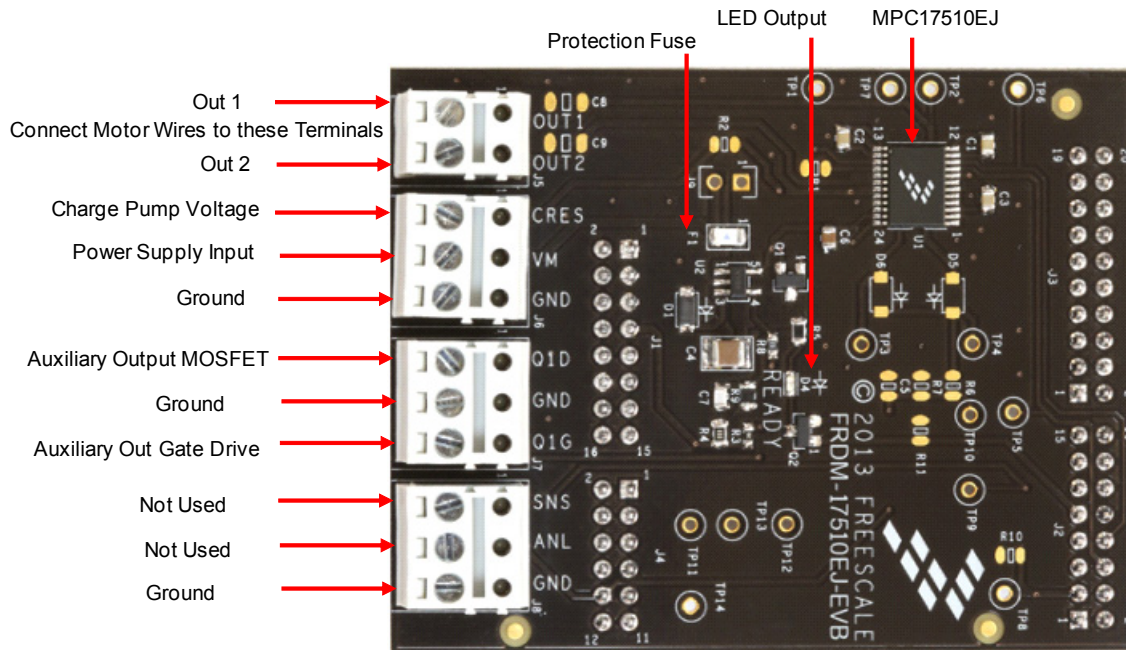


Figure 2. Board Description

Table 2. Board Description

Name	Description
U1	MPC17510EJ H-Bridge motor driver IC
F1	Overcurrent protection fuse
D4	User defined LED output
OUT1	Output 1 Connect motor lead to this terminal
OUT2	Output 2 Connect motor lead to this terminal
CRES	Charge pump voltage
VM	Power supply input
GND	Ground terminal
Q1D	Auxiliary output of on board MOSFET (drain)
GND	Ground terminal
GOUT	Boosted gate drive auxiliary output
SNS	Not used – connection to FRDM-KL25Z input
ANL	Not used – connection to FRDM-KL25Z input
GND	Ground terminal

## 3.6 LED Indicator

An LED is provided as a visual output device for the FRDM-17510EJ-EVB evaluation board:

**Table 3. LED Display**

LED ID	Description
LED1	LED1 (D4 board designator) is illuminated with an output from the FRDM-KL25Z. The on board voltage regulator must be operating for the LED to operate.

## 3.7 Test Point Definitions

The following test-points provide access to signals on the FRDM-17510EJ-EVB.

**Table 4. Test Point Definitions**

TP #	Signal Name	Description
TP1	GOUT	General Purpose Output (MOSFET output)
TP2	OUT1	This is output 1 of the MPC17510EJ H-Bridge
TP3	OUT2	This is output 2 of the MPC17510EJ H-Bridge
TP4	OUT1 + OUT2	This test point is not used
TP5	IN1	Analog Multiplexer output pin
TP6	IN2	SPI serial Clock
TP7	EN	SPI Master out - Slave in
TP8	GIN	SPI Master In - Slave Out
TP9	SNSIN	Not Used
TP10	ANLIN	Not Used
TP11	VDDPWRGOOD	Signal to microcontroller indicating the voltage regulator is operating (5.0 V)
TP12	READY	Logic signal from microcontroller. This signal causes the green LED to operate.
TP13	VDD	Logic Power Supply from the voltage regulator on the board
TP14	GND	Ground Connection

## 3.8 Input Signal Definitions

The MPC17510EJ IC has four input signals that are used to control certain outputs or functions inside the circuit. These signals are:

**Table 5. Input Signal Definitions**

Name	Description
GIN	This signal is the input that controls the Auxiliary Output
IN1	This signal controls Output 1
IN2	This signal controls Output 2
EN	This signal enables Output 1 and Output 2

## 3.9 Output Signal Definitions

The MPC17510EJ IC has three output signals that are used to drive a DC brushed motor, and an auxiliary output designed to drive a high-side MOSFET. These signals are:

**Table 6. Output Signal Definitions**

Name	Description
OUT1	Output 1 of the H-Bridge
OUT2	Output 2 of the H-Bridge
Q1D	Auxiliary Output

## 3.10 Screw Terminal Connections

The FRDM-17510EJ-EVB board features screw terminal connections to allow easy access to MPC17510EJ signals and supply rails.

**Table 7. Screw Terminals**

Name	Signal	Signal Description
J5	OUT1	H-Bridge output 1
	OUT2	H-Bridge output 2
J6	CRES	Charge pump voltage for H-Bridge and Auxiliary out gate drive
	VM	Motor supply input (this is also the supply for the on board voltage regulator)
	GND	This is the primary ground connection for the motor power supply
J7	Q1D	Auxiliary on board MOSFET output (Drain)
	GND	This is the ground connection intended for the auxiliary output
	GOUT	Auxiliary output gate drive for off board MOSFET
J8	SNS	Not used
	ANL	Not used
	GND	Additional ground

## 3.11 Jumper J9

The FRDM-17510EJ-EVB has provision (not populated) for a jumper to accommodate higher currents than the on board fuse is capable of handling (1.25 A). If the fuse is bypassed, use extreme care to make sure that the maximum current for the MPC17510EJ is not exceeded (1.2 A nominal, 3.8 A peak/transients).



## 4 FRDM-KL25Z Freedom Development Platform

The Freescale Freedom development platform is a set of software and hardware tools for evaluation and development. It is ideal for rapid prototyping of microcontroller-based applications. The Freescale Freedom KL25Z hardware, FRDM-KL25Z, is a simple, yet sophisticated design featuring a Kinetis L Series microcontroller, the industry's first microcontroller built on the ARM<sup>®</sup> Cortex<sup>™</sup>-M0+ core.

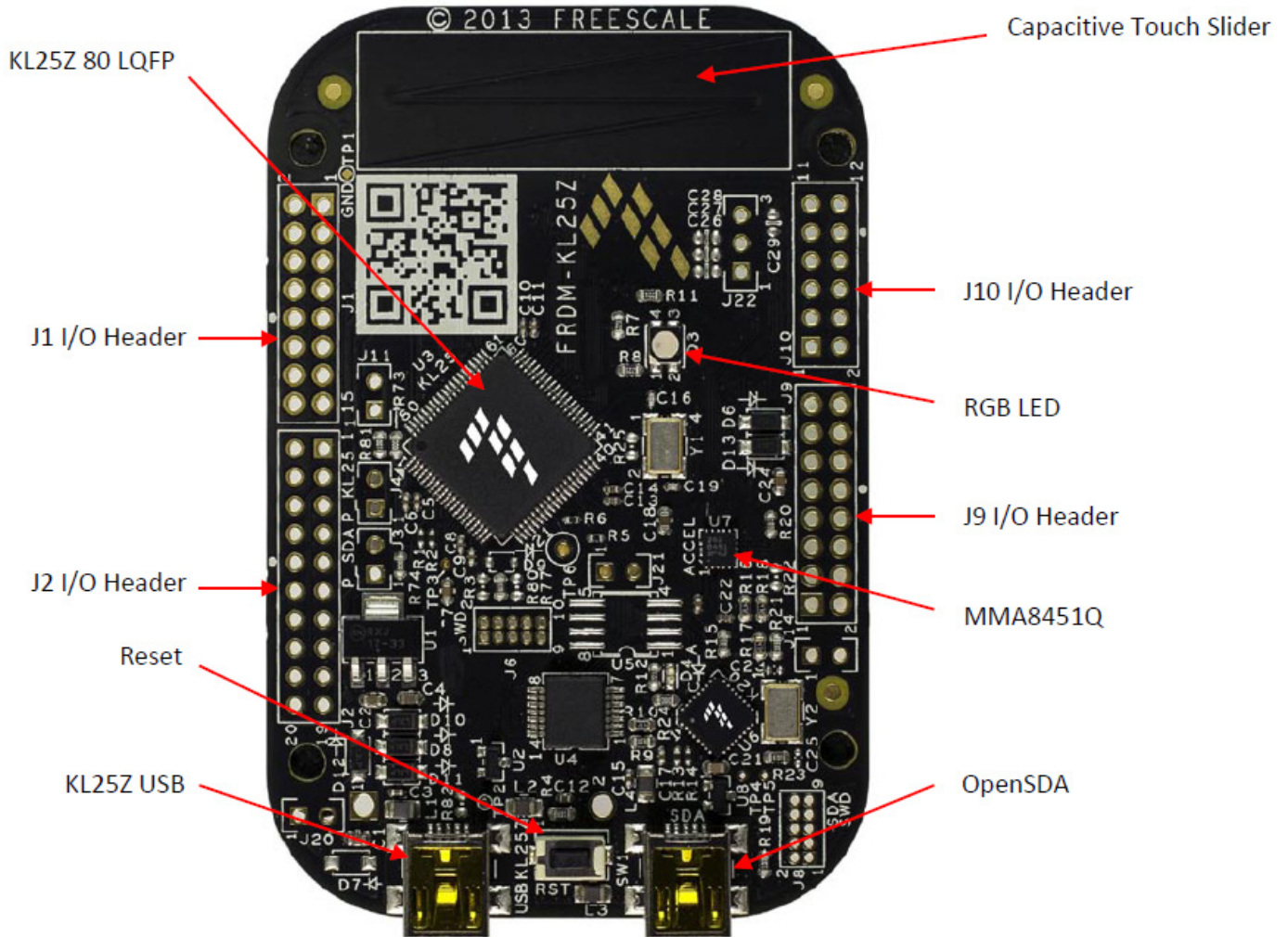


Figure 3. FRDM-KL25Z

## 4.1 Connecting FRDM-KL25Z to the Board

The FRDM-17510EJ-EVB kit may be used with many of the Freedom platform evaluation boards featuring Kinetis processors. The FRDM-KL25Z evaluation board has been chosen specifically to work with the FRDM-17510EJ-EVB kit because of its low cost and features. The FRDM-KL25Z board makes use of the USB, built in LEDs, and I/O ports available with Freescale's Kinetis KL2x family of microcontrollers. The main functions provided by the FRDM-KL25Z are to allow control of a DC brushed motor using a PC computer over USB, and to drive the necessary inputs on the FRDM-17510EJ-EVB evaluation kit to operate the motor.

The FRDM-17510EJ-EVB is connected to the FRDM-KL25Z using four dual row headers. The connections are as follows:

**Table 8. FRDM-17510EJ-EVB to FRDM-KL25Z Connections**

FRDM-17510EJ-EVB		FRDM-KL25Z		Pin Hardware Name		Description
Header	Pin	Header	Pin	FRDM-17510EJ-EVB	FRDM-KL25Z	
J1	1	J9	1	GND	PTB8	System ground
J1	2	J9	2	N/C	SDA_PTD5	No connection
J1	3	J9	3	GND	PTB9	System ground
J1	4	J9	4	N/C	P3V3	No connection
J1	5	J9	5	GND	PTB10	System ground
J1	6	J9	6	N/C	RESET/PTA20	No connection
J1	7	J9	7	RUNPWRGD	PTB11	Regulator voltage present
J1	8	J9	8	N/C	P3V3	No connection
J1	9	J9	9	N/C	PTE2	No connection
J1	10	J9	10	N/C	P5V_USB	No connection
J1	11	J9	11	GND	PTE3	No connection
J1	12	J9	12	N/C	GND	System ground
J1	13	J9	13	N/C	PTE4	No connection
J1	14	J9	14	N/C	GND	No connection
J1	15	J9	15	N/C	PTE5	No connection
J1	16	J9	16	EN	P5-9V_VIN	No connection
J2	1	J1	1	N/C	PTC7	Enable
J2	2	J1	2	GIN	PTA1	No connection
J2	3	J1	3	N/C	PTC0	General purpose auxiliary input
J2	4	J1	4	N/C	PTD4	No connection
J2	5	J1	5	IN1	PTC3	No connection
J2	6	J1	6	N/C	PTD4	Input 1
J2	7	J1	7	IN2	PTC4	No connection
J2	8	J1	8	READY	PTA12	Input 2
J2	9	J1	9	N/C	PTC5	Green LED (from KL25Z)
J2	10	J1	10	SNSIN	PTA4	No connection
J2	11	J1	11	N/C	PTC6	Not used
J2	12	J1	12	N/C	PTA5	No connection
J2	13	J1	13	N/C	PTC10	No connection
J2	14	J1	14	N/C	PTC8	No connection
J2	15	J1	15	N/C	PTC11	No connection
J2	16	J1	16	N/C	PTC9	No connection
J3	1	J2	1	N/C	PTC12	No connection
J3	2	J2	2	N/C	PTA13	No connection
J3	3	J2	3	N/C	PTC13	No connection
J3	4	J2	4	N/C	PTD5	No connection
J3	5	J2	5	N/C	PTC16	No connection
J3	6	J2	6	N/C	PTD0	No connection
J3	7	J2	7	N/C	PTC17	No connection
J3	8	J2	8	N/C	PTD2	No connection
J3	9	J2	9	N/C	PTA16	No connection
J3	10	J2	10	N/C	PTD3	No connection
J3	11	J2	11	N/C	PTA17	No connection

Table 8. FRDM-17510EJ-EVB to FRDM-KL25Z Connections (continued)

FRDM-17510EJ-EVB		FRDM-KL25Z		Pin Hardware Name		Description
Header	Pin	Header	Pin	FRDM-17510EJ-EVB	FRDM-KL25Z	
J3	12	J2	12	N/C	PTD1	No connection
J3	13	J2	13	N/C	PTE31	No connection
J3	14	J2	14	N/C	GND	No connection
J3	15	J2	15	N/C	N/C	No connection
J3	16	J2	16	N/C	VREFH	No connection
J3	17	J2	17	N/C	PTD6	No connection
J3	18	J2	18	N/C	PTE0	No connection
J3	19	J2	19	N/C	PTD7	No connection
J3	20	J2	20	N/C	PTE1	No connection
J4	1	J10	1	N/C	PTE20	No connection
J4	2	J10	2	N/C	PTB0	No connection
J4	3	J10	2	N/C	PTE21	No connection
J4	4	J10	4	N/C	PTB1	No connection
J4	5	J10	5	N/C	PTE22	No connection
J4	6	J10	6	N/C	PTB2	No connection
J4	7	J10	7	N/C	PTE23	No connection
J4	8	J10	8	N/C	PTB3	No connection
J4	9	J10	9	N/C	PTE29	No connection
J4	10	J10	10	ANLIN	PTC2	Not used
J4	11	J10	11	N/C	PTE30	No connection
J4	12	J10	12	N/C	PTC1	No connection

## 5 Installing the Software and Setting up the Hardware

### 5.1 Installing Motor Control GUI on your Computer

The latest version of the Motor Control GUI 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](http://www.freescale.com/analogtools) and select your kit. Click on that link to open the corresponding Tool Summary Page. Look for “Jump Start Your Design”. Download to your computer desktop the Motor Control GUI software.

Run the install program from the desktop. The Installation Wizard will guide you through the rest of the process.

To use the Motor Control GUI, go to the Windows Start menu, then Programs, then Motor Control GUI, and click on the Freescale icon. The Motor Control Graphic User Interface (GUI) appears. The GUI is shown in [Figure 4](#). The hex address numbers at the top are loaded with the vendor ID for Freescale (0x15A2), and the part ID (0x138). The left side panel displays these numbers only if the PC is communicating with the FRDM-KL25Z via the USB interface.

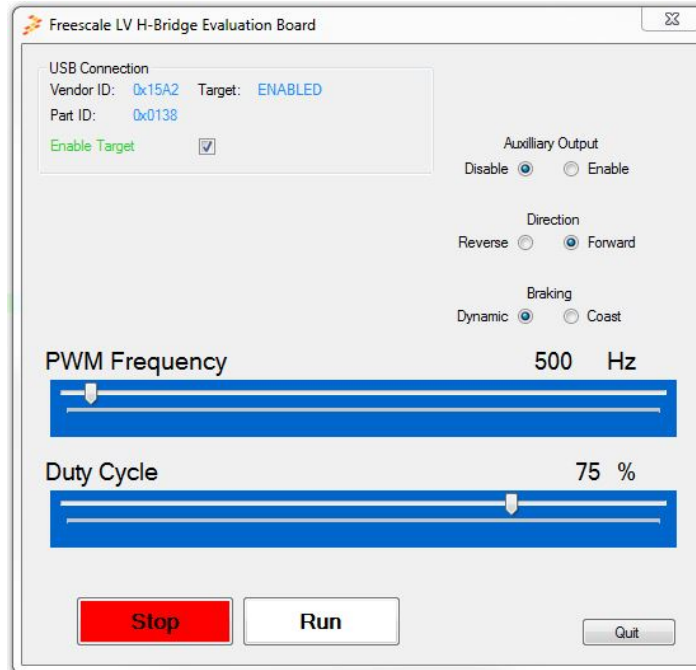


Figure 4. Motor Control GUI

## 5.2 Configuring the Hardware

Figure 5 shows the configuration diagram for FRDM-17510EJ-EVB.

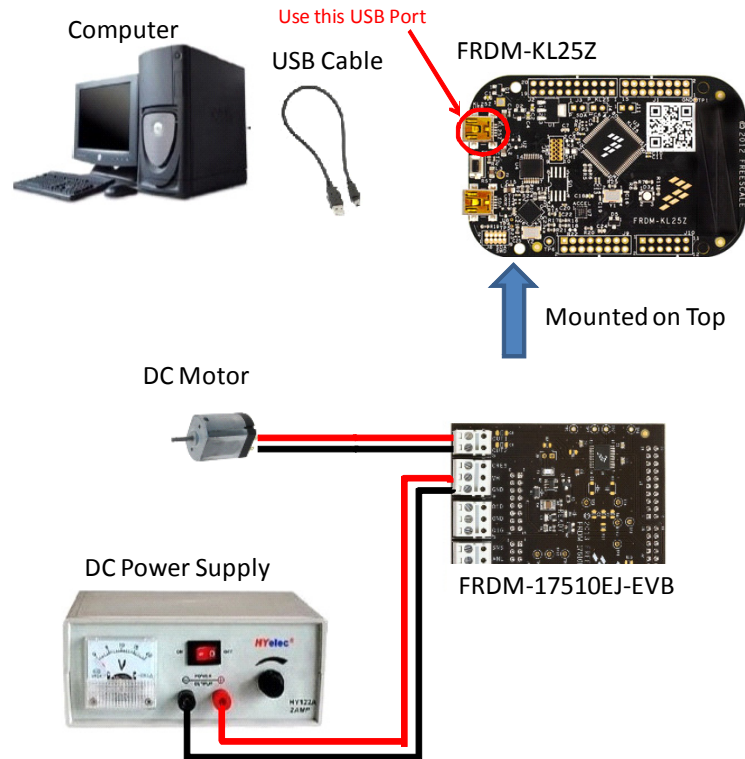


Figure 5. FRDM-17510EJ-EVB plus FRDM-KL25Z Board Setup

### 5.2.1 Step-by-step Instructions for Setting up the Hardware

When using the FRDM-17510EJ-EVB make sure that the following operating parameters are followed or damage may occur.

- The maximum motor supply voltage (VM) cannot exceed 15 V, and must be at least 5.0 V
- The nominal operating current of the DC motor cannot exceed 1.2 A (3.8 A peak)
- If the auxiliary output is used, do not exceed 12 V for the motor supply voltage (VM)

In order to perform the demonstration example, first set up the evaluation board hardware and software as follows:

1. Setup the FRDM-KL25Z to accept code from the mbed online compiler. mbed is a developer site for ARM based microcontrollers. The instructions are at [mbed.org](http://mbed.org)

**Note:** Switch to the other USB port on the FRDM-KL25Z, and back after the project is loaded.

2. Go to the Freescale page on mbed.org (and look for the repository named “LVHB DC Motor Drive”. Save the compiled code on your local drive, and then drag and drop it onto the mbed drive (which is the FRDM-KL25Z). Move the USB connector back to the other USB port on the FRDM-KL25Z.

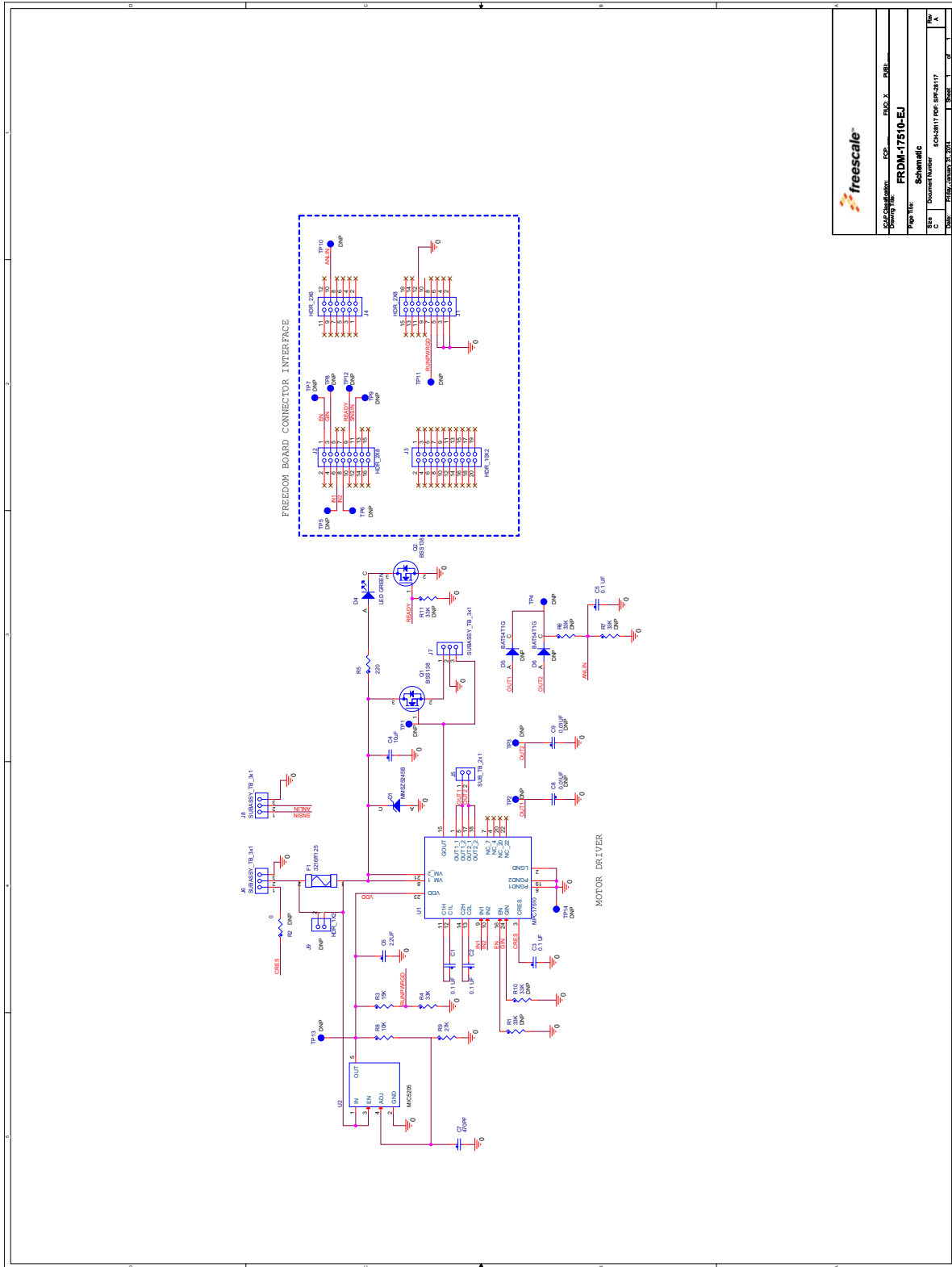
**Note:** You may be asked to create a user before you can download the code.

3. Connect the FRDM-17510EJ-EVB to the FRDM-KL25Z (this is best accomplished by soldering female connectors to the FRDM-KL25Z, and then connecting to the male pins provided on the FRDM-17510EJ-EVB)
4. Ready the computer, install the “DC Brushed Motor Driver GUI Software” (See [Section 5.1, Installing Motor Control GUI on your Computer](#), page 12 of this User Guide for instructions).
5. Attach DC power supply (without turning on the power) to the VM and GND terminals.
6. Attach a brushed DC motor load to the OUT 1 and OUT 2 output terminals. Optional: Attach an auxiliary output to Q1D (and GND).
7. Launch the “DC Brushed Motor Driver GUI Software”.

## Installing the Software and Setting up the Hardware

8. Make sure the GUI “sees” the FRDM-KL25Z. This can be determined by seeing the hex Vendor ID (0x15A2), and Part ID (0x138) under USB connection in the upper left hand corner of the GUI. If you do not you may need to disconnect and reconnect the USB cable to the FRDM-KL25Z.
9. Turn on the DC power supply.
10. Select “Enable Target” on the GUI. The demo is now ready to run.
11. Click the “Run” button to run the motor. Notice that many options of the GUI are disabled while the motor is running. To make changes, click the “Stop” button on the GUI, make the desired changes, and then click “Run” on the GUI to continue.
12. When finished, click “Enable Target” button on the GUI, and then “Quit”. Turn off DC power supply. Remove USB cable.

# 6 Schematic

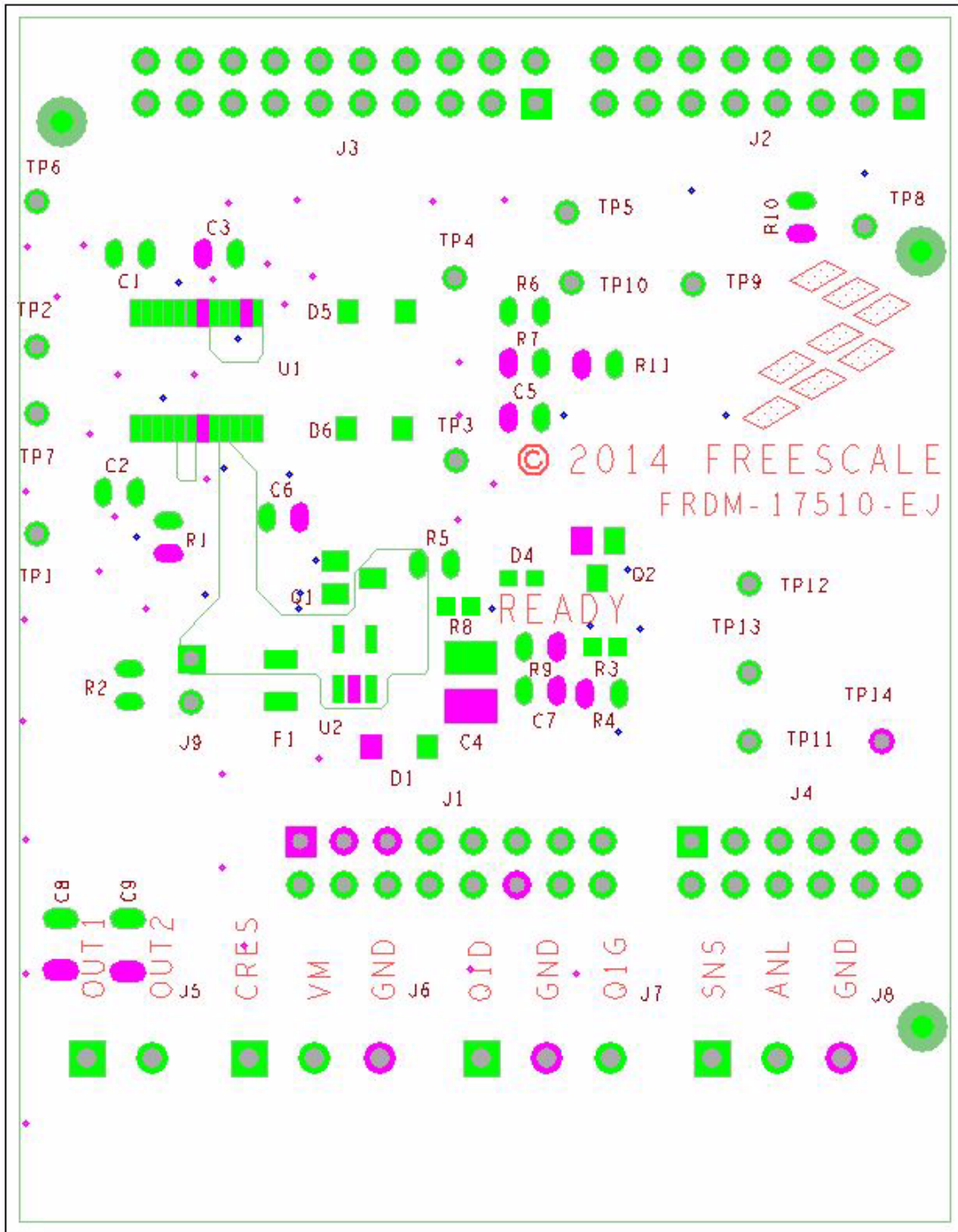


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Doc. Name: FRDM-17510-EJ	Doc. Y: DUB
Page No: 1	Doc. Z: DUB
Page Title: Schematic	Doc. AA: DUB
Doc. ID: SCH17510EJUG	Doc. AB: DUB
Doc. Rev: 1.0	Doc. AC: DUB
Doc. Date: 2015-03-20	Doc. AD: DUB
Doc. Author: [Redacted]	Doc. AE: DUB
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Doc. Approved: [Redacted]	Doc. AG: DUB
Doc. Disapproved: [Redacted]	Doc. AH: DUB
Doc. Cancelled: [Redacted]	Doc. AI: DUB

Figure 6. Evaluation Board Schematic

# 7 Silkscreen

## 7.1 Silkscreen





# 8 Board Bill of Materials

Table 9. Bill of Materials (1)

Item	Qty	Schematic Label	Value	Description	Part Number	Assy Opt
<b>Active Components</b>						
1	1	U1		Freescale MPC17510EJ H-Bridge Motor Driver	MPC17510EJ	(2)
2	1	U2		MIC5205 Linear Reg LDO 1.5 V-15 V 150 MA 2.5 V-16 V	MIC5205	(2)
<b>Transistors</b>						
3	2	Q1, Q2	SOT-23	Transistor NMOS 50 V 220 MA	BSS138	
<b>Diode</b>						
4	1	D1	SOD123	Diode Zener -- 15 V 0.5 W	MMSZ5245B	
<b>LED</b>						
5	1	D4	0603	LG L29K-G2J1-24-Z	LED Green Single 20 MA	
<b>Capacitors</b>						
6	3	C1, C2, C3	0.1 $\mu$ F	Ceramic 0.1 $\mu$ F 50 V 10% X7R	0805	
7	1	C4	10 $\mu$ F	Ceramic 10 $\mu$ F 35 V 10% X7R	1210	
8	1	C6	2.2 $\mu$ F	Ceramic 2.2 $\mu$ F 16 V 10% X7R	0805	
9	1	C7	0.01 $\mu$ F	Ceramic 0.01 $\mu$ F 50 V 5% X7R	1206	
<b>Fuse</b>						
10	1	F1	1.25 A	Fuse Fast 1.25 A 63 V SMT		
<b>Resistors</b>						
11	1	R3	15 K	Metal Film 15.0 k 1/10W 1%	0603	
12	1	R4	33 K	Metal Film 33 k 1/8W 5%	0805	
13	1	R5	220 $\Omega$	Metal Film 220 $\Omega$ 1/8 W 1%	0805	
14	1	R8	10 K	Metal Film 10 k 1/10 W 5%	0603	
15	1	R9	27 K	Metal Film 27 k 1/8 W 5%	0805	
<b>Connectors</b>						
16	2	J1, J2	HDR 2X8	HDR 2X8 TH 100MIL CTR TSW-108-07-G-D SAMTEC		
17	1	J3	HDR 2X10	HDR 2X10 TH 100MIL CTR TSW-110-07-S-D SAMTEC		
18	1	J4	HDR 2X6	HDR 2X6 TH 100MIL CTR TSW-106-07-S-D SAMTEC		
19	1	J5	TERM BLOCK 1x2	SUBASSEMBLY CON 1X3 TB TH 3.81MM SP 201H -- 138L + TERM BLOCK PLUG 3.81 MM 2 POS		
20	3	J6, J7, J8	TERM BLOCK 1x3	SUBASSEMBLY CON 1X3 TB TH 3.81MM SP 201H -- 138L + TERM BLOCK PLUG 3.81 MM 3 POS210-80099, 211-79220		

## 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
FRDM-17510EJ-EVB	Tool Summary Page	<a href="http://www.freescale.com/webapp/sps/site/prod_summary.jsp?code=FRDM-17510EJ-EVB">http://www.freescale.com/webapp/sps/site/prod_summary.jsp?code=FRDM-17510EJ-EVB</a>
MPC17510	Product Summary Page	<a href="http://www.freescale.com/webapp/sps/site/prod_summary.jsp?code=MPC17510">http://www.freescale.com/webapp/sps/site/prod_summary.jsp?code=MPC17510</a>
FRDM-KL25Z	Tool Summary Page	<a href="https://www.freescale.com/webapp/sps/site/prod_summary.jsp?code=FRDM-KL25Z">https://www.freescale.com/webapp/sps/site/prod_summary.jsp?code=FRDM-KL25Z</a>
mbed	Home Page	<a href="http://mbed.org">http://mbed.org</a>

### 9.1 Support

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

### 9.2 Warranty

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

## 10 Revision History

Revision	Date	Description of Changes
1.0	11/2014	• Initial Release



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[freescale.com](http://freescale.com)

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Document Number: KTFRDM17510EJUG  
Rev. 1.0  
11/2014

