

# **CMPE-250 Introduction to Embedded Systems**

## **NXP Freedom Board FRDM-KL46Z**

### **OpenSDA Bootloader and Firmware Application**

#### **Update under Windows 7**

The NXP Freedom Development Platform FRDM-KL46Z, (Freedom Board), has a built-in open serial and debug adapter (OpenSDA) that is used to program and debug the board through a USB connection to a Windows computer. The board has hardware to implement OpenSDA v.1. There are also two OpenSDA software components on the board: a bootloader and a firmware application. The bootloader that ships on the board from NXP is compatible with Microsoft Windows 7 but not Windows 8 or Windows 10. Likewise, the firmware application that ships on the board supports an MSD bootloader that is not compatible with later versions of Windows and lacks desired functionality of new OpenSDA firmware applications. The objective of this procedure is to use Windows 7 to update the FRDM-KL46Z with a newer bootloader and a firmware application that will work on later versions of Windows and provide default functionality needed for the course.

#### **Materials**

- Computer running Windows 7 with USB 2.0 (or later) type A port
- USB cable: type A male to type mini-B male
- NXP Freedom Development Platform FRDM-KL46Z (Freedom board)
- Bootloader file, PEmicro OpenSDA bootloader v1.11:  
BOOTUPDATEAPP\_Pemicro\_v111.SDA
- Firmware application file, Arm Mbed DAPLink v2.46:  
0246\_k20dx\_frdmkl46z\_0x8000.bin

#### **Procedure**

1. Update the bootloader on FRDM-KL46Z. This step must be performed under Windows 7.
  - a. Insert the A plug of the USB cable into a USB 2.0 (or later) port on the Windows 7 computer.
  - b. Put the FRDM-KL46Z in bootloader mode. While pressing the reset button RST SW2, (shown in Figure 1), insert the mini-B plug of the USB cable into the Open SDA USB connector of the FRDM-KL46Z. Continue holding the reset button until the OpenSDA green LED D8 blinks, and then release the button. At this point, the LED will blink about once per second, indicating that the board's OpenSDA K20 microcontroller is ready to be programmed.

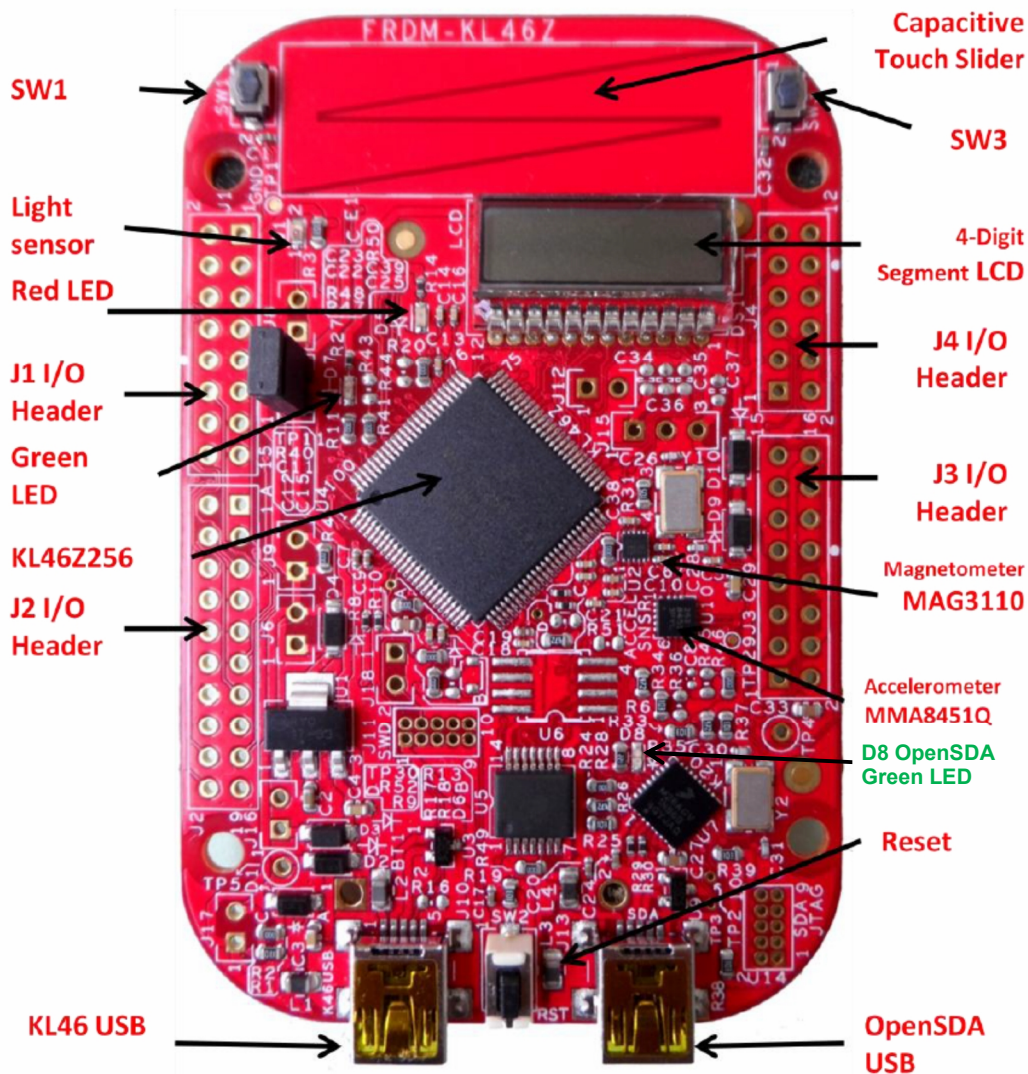


Figure 1. NXP FRDM-KL46Z connectors and components  
[adapted from *FRDM-KL46Z User's Manual* (FRDM-KL46Z-UM), Rev. 1.0]


- c. If Windows launches an AutoPlay window, as shown Figure 2, click Open folder to view files, and continue to step 1.d. Otherwise explore the computer to verify that Windows has detected BOOTLOADER as a removable storage device and assigned a drive letter: click the  start menu icon at the left of the Windows task bar, then click Computer along the right side, and look under Devices with Removable Storage in the right pane of resulting Windows Explorer window.



Figure 2. BOOTLOADER AutoPlay window

- d. Check the version of the board's current bootloader. In the BOOTLOADER removable storage, open SDA\_INFO.HTM, and look at the Bootloader Version in the Your Hardware Information section, as shown in Figure 3. If the version is 1.11 or later, skip to step 2.d. Otherwise, continue with step 1.e.

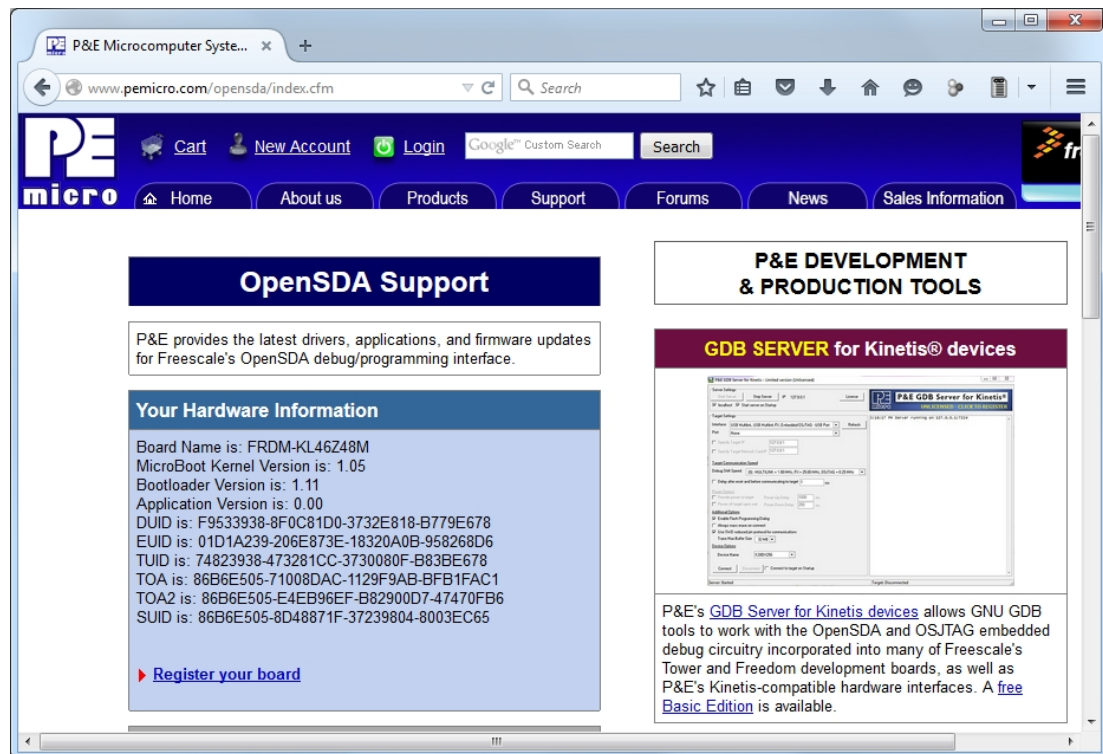





Figure 3. SDA\_INFO.HTM

- e. Download the BOOTUPDATEAPP\_Pemicro\_v111.SDA file from myCourses content under Laboratory Exercises → Lab Resources → OpenSDA Update for Windows 10. (It is also available as part of the OpenSDA Firmware zip package from PEmicro at <https://www.pemicro.com/opensda/>.)
- f. Copy the BOOTUPDATEAPP\_Pemicro\_v111.SDA file downloaded in step 1.e to the BOOTLOADER drive.
- g. Find the  Safely Remove Hardware and Eject Media icon in the notifications along the right side of the task bar, right-click on it, then select Eject OpenSDA MSD APP, and wait for the Safe to Remove Hardware notification for OpenSDA MSD APP.
- h. Remove the mini-B plug of the USB cable from the Open SDA USB connector of the FRDM-KL46Z. The bootloader version 1.11 will remain in the K20's flash memory.

2. Install the latest ARM Mbed DAPLink firmware on the FRDM-KL46Z.
  - a. If you just finished updating the bootloader in step 1, insert the mini-B plug of the USB cable into the Open SDA USB connector of the FRDM-KL46Z. (If you did not update the bootloader because it had already been updated, put the FRDM-KL46Z in bootloader mode by completing step 1.b.) At this point, the LED will blink about once per second, indicating that the board's OpenSDA K20 microcontroller is ready to be programmed.
    - ☞ Updating the bootloader causes the board to enter bootloader mode the next time it is connected to the Windows workstation through the OpenSDA USB connector.
  - b. If Windows launches an AutoPlay window, as shown Figure 2, click **Open folder to view files**, and continue to step 2.d. Otherwise explore the computer to verify that Windows has detected BOOTLOADER as a removable storage device and assigned a drive letter: click the  start menu icon at the left of the Windows task bar, then click **Computer** along the right side, and look under **Devices with Removable Storage** in the right pane of resulting Windows Explorer window.
  - c. Check the version of the board's current bootloader. In the BOOTLOADER removable storage, open SDA\_INFO.HTM, and look at the **Bootloader Version** in the **Your Hardware Information** section, as shown in Figure 3. If the version is 1.11 or later, skip to step 2.d. Otherwise, continue with step 1.e.
  - d. Download the 0246\_k20dx\_frdmkl46z\_0x8000.bin file from myCourses content under **Laboratory Exercises** → **Lab Resources** → **OpenSDA Update for Windows 10**. (It is also available from Arm Mbed at <https://developer.mbed.org/handbook/Firmware-FRDM-KL46Z>.)
  - e. Copy the 20140530\_k20dx128\_kl46z\_if\_opensda.s19 file to the BOOTLOADER drive.
  - f. Find the  **Safely Remove Hardware and Eject Media** icon in the notifications along the right side of the task bar, right-click on it, then select **Eject OpenSDA MSD APP**, and wait for the **Safe to Remove Hardware** notification for OpenSDA MSD APP.
  - g. Remove the mini-B plug of the USB cable from the Open SDA USB connector of the FRDM-KL46Z.
    - ☞ The DAPLink firmware will remain in the K20's flash memory.
  - h. Insert the mini-B plug of the USB cable into the Open SDA USB connector of the FRDM-KL46Z.
  - i. If Windows does not generate a notification at the right side of the Windows taskbar about installing device driver software, as shown in Figure 4, skip to step 2.j. Otherwise, click on the notification to open the **Driver Software Installation** window, shown in Figure 5. When this window indicates that the device is ready to use, the list of devices installed should be similar to the list in Figure 5, except perhaps for the mbed Serial Port. Skip to step 2.k.
    - ☞ If the **Driver Software Installation** window is not opened by clicking on the **Installing device driver software** notification, the notification will be replaced with the **Your device is ready to use** notification, shown in Figure 6.
    - ☞ On Windows 7, the mbed Serial Port driver will be installed for FRDM-KL46Z only if the driver has been previously installed on the computer. (The driver

and more details about Windows serial configuration with DAPLink are available from ARM Mbed at <https://armmbed.github.io/DAPLink/>.) (On Windows 10 with DAPLink firmware v.2.40 or later, the mbed Serial Port driver does not need to be installed, as Windows 10 automatically uses its USB serial device driver.)

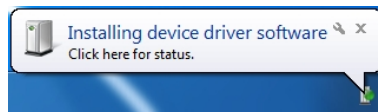


Figure 4. Windows driver installation for FRDM-KL46Z with DAPLink firmware

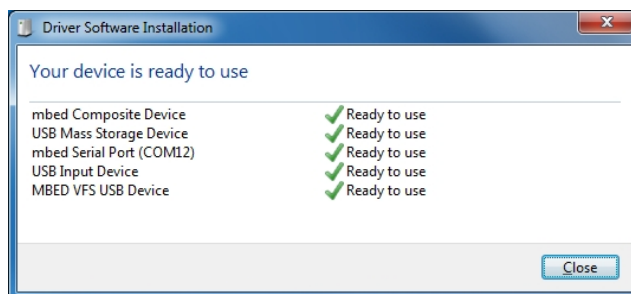


Figure 5. Successful Windows driver installation details for DAPLink board

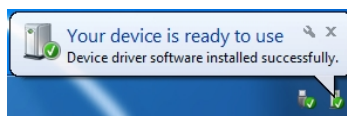


Figure 6. Successful Windows driver notification for mbed-enabled board

- j. If in step 2.i Windows did not generate a notification about installing device driver software as shown in Figure 4, verify that Windows has detected DAPLINK as a removable storage device and assigned a drive letter: click the start menu icon at the left of the Windows task bar, then click Computer along the right side, and look under Devices with Removable Storage in the right pane of the resulting Windows Explorer window.
- k. Find the Safely Remove Hardware and Eject Media icon in the notifications along the right side of the task bar, right-click on it, then select Eject MBED VFS USB Device, and wait for the Safe to Remove Hardware notification for MBED VFS USB Device.
- l. Disconnect the FRDM-KL46Z from Windows by unplugging the USB cable.

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This OpenSDA update procedure to Arm Mbed DAPLink v2.46 applies to Windows 7 and the NXP Freedom Development Platform FRDM-KL46Z, which includes OpenSDA v.1.

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