

FRDM-KL25Z

Freescale Freedom Development Platform for the Kinetis L Series KL25 Family



Preliminary Document Final version will be available September 25th

Get to know the FRDM-KL25Z



FRDM-KL25Z Hardware Features

FRDM-KL25Z is a low-cost evaluation and development platform to demonstrate the capability of the Kinetis-L family of MCUs, ARM[®] Cortex[™]-M0+ based and targeting energy-efficient applications.

The Freescale Freedom development platform is form-factor compatible with popular third-party hardware designed to work with Arduino[™] and Arduino-compatible boards, providing engineers the "freedom" to connect to a broader range of expansion boards to achieve even greater technological breakthroughs.

FRDM-KL25Z Hardware Features

- Easy access to MCU I/O with a tri-color LED
- Touch-sensing interface with a touch pad slider
- Battery-ready, low-power operation
- Power-measurement access points
- I2C to Low-g sensor
- Standard-based form factor with expansion board options
- Built-in debug interface for flash programming, run-control and monitoring



Step-by-Step Installation Instructions

This quick start guide is designed to provide step-by-step guidelines to get you ready to develop your applications using the FRDM-KL25Z within minutes.



Before connecting the hardware

- 1. Download and install **Windows USB Driver OpenSDA Support** from P&E Micro Systems v11_120720 or later, at <u>http://www.pemicro.com/opensda</u>
- 2. Download and extract **FRDM**-**KL25Z_v1.00 zip file** or later, available H<u>ERE</u> on E14 Community
- 3. During manufacturing OpenSDA MSD Application was already preloaded in the board, so when you will connect for the first time FRDM-KL25Z a "Freescale MSD USB Device" will be detected and the right driver should automatically installed by Windows, then an "OpenSDA - CDC Serial Port" will be detected by Windows and might request a driver file available in the "Windows Driver" folder Device from the FRDM-KL25Z v1.00 zip file.



NOTE : During the installation some warning messages concerning Windows compatibility might appear, just click on "**Continue**"

Getting Started with OpenSDA MSD Flash Programmer

NOTE : FRDM-KL25Z were already preprogrammed in factory with OpenSDA MSD Flash Programmer application so you can move directly to step 4.

1. Enter FRDM-KL25Z in **Bootloader** mode using the following procedure:

- Unplug the USB cable if attached
- Press and hold the RESET/Bootloader button
- Plug in a USB cable from a USB Host to the OpenSDA USB port
- Release the RESET/Bootloader button
- A new removable drive should now be visible with a volume label of "BOOTLOADER"



- 3. Load the OpenSDA MSD Flash Programmer application using the following steps:
 - Drag/drop or copy/paste the application file MSD-FREEDOM-KL25Z.SDA available in the "SDA application" folder from the FRDM-KL25Z_v1.00 zip file to the "BOOTLOADER" drive
 - Unplug the USB cable and plug it in again
 - A new removable drive should now be visible with a volume label of "FRDM-KL25Z"



- 4. Use the MSD Flash Programmer as below:
 - Drag/drop or copy/paste an s-record (commonly a .s19 or .srec) precompiled demo file available in the "S-RECORD project examples" folder from the FRDM-KL25Z_v1.00 zip file to the "FRDM-KL25Z" drive.
 - If programming is successful, the embedded application will begin execution automatically.
 - Unplug and re-attach the USB cable to program another embedded application.



5. List of the S-RECORD project example available and description :

• blinky-blue.srec RGB LED is blinking blue

• blinky_green.srec RGB LED is blinking green

• blinky_red.srec RGB LED is blinking red

• blinly_rgb.srec RGB LED is blinking blue, then green, then red ...

• changing_rgb.srec

RGB LED is lighting in blue, then green, then red ...

accelero_I2C_rgb.srec

RGB LED changes color according to inclination detected by the accelerometer embedded in FRDM-KL25Z and connected through the I2C to the MCU

• touch_blinky_blue.srec

RGB LED blinking frequency is defined by the touch sensor slider



Getting Started with IAR Embedded Workbench for ARM

- 1. Download and install IAR Embedded Workbench for ARM V6.4.20 or later, 30-day evaluation license: <u>http://www.iar.com/en/Products/IAR-Embedded-Workbench/ARM/</u>
- 2. Load the OpenSDA Debug Application using the following steps:
 - Enter FRDM-KL25Z in Bootloader mode using procedure 2-1
 - Drag/drop or copy/paste the application file DEBUG-APP.SDA available in the "SDA application" folder from the FRDM-KL25Z_v1.00 zip file to the "BOOTLOADER" drive
 - Unplug the USB cable and plug it in again
 - Windows should detect three new devices including "PeMicro OpenSDA Debug driver" and "OpenSDA – CDC Serial Port" and install automatically the right driver
 - Check in Windows device manager that Jungo/PEMicro OpenSDA Debug Driver and



Ports (COM & LPT)/OpenSDA-CDC Serial Port were correctly detected



- 3. Patch IAR EW for ARM V6.4.20 or later, to make it compatible with OpenSDA Debug
 - Copy the content of the folder "development tool patches\IAR_patch_v110\patch" from the FRDM-KL25Z_v1.00 zip file in the directory [Embedded Workbench path]\arm\bin\
- 4. Run IAR EW for ARM V6.4.20 or Later and build the project
 - Run IAR Embedded Workbench V6.4.20 or later, by selecting it from the Windows Start menu
 - Select File, Open and Workspace
 - Select **blinky.eww** available in the "**Project Example\build\iar\blinky**" folder from the FRDM-KL25Z_v1.00 zip file then **Open**
 - Right click on Blinky freedom FLASH_128KB (top left box) then Select **Options**
 - General Options, Target, SELECT Core "Cortex-M0+"
 - C/C++ Compiler, List, DESELECT options "Output list file" & "Output assembler file"
 - Assembler, List, DESELECT option "Output list file"
 - Debugger, Setup, SELECT Driver "PE micro"
 - Debugger, Download, Select ____ then "FlashKLxx128K.board" and "Open"
 - PE micro / Setup, SELECT P&E Hardware Interface Type "Tracelink USB"
 - PE micro / Setup, CHANGE JTAG/SWD speed value with **500kHz**, then press "**OK**"
 - Select Project then "Clean"
 - Select Project and "Rebuild All" or press 🞇

NOTE : During the compilation some warning messages may appear

- 4. Start the Debug Environment of IAR EW for ARM V6.4.20 or later
 - Press Download and Debug *b*
 - A PEMICRO Connection Manager window will appear,
 - SELECT the Interface "OpenSDA Embedded Tower Debug" then press "Connect (Reset)"

Connectior	port and Interface Type			Add LPT Port
Interface:	TraceLink - USB Port		-	Befresh List
Port: nterface De	ARM Cable, Connected via USB Multilink, USB Multilink Cyclone MAX - Serial Port Cyclone MAX - Ethernet Po	Parallel Port or BDM Lightning		(Help?)
Target CPL	TraceLink - USB Port			
CPU:	TraceLink - Ethernet Port OpenSDA Embedded Town	er Dehug - LISB Port		
		are oblig to be not	3	9
ro rarallel Iebug Shift V Use SV	Port wait states : IO_DELA) Speed = (64) : Shift Freq BDM_SPEED = 3; /D reduced pin protocol for	'_CNT = 1 uency = 0.382Mhz 2 communications		
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Start the debug session selecting Debug, Go or pressing 😕



- Demo of changing_rgb should start and RGB LED change of color
- Press Break button \P to pause the demo
- Press Stop Button 🗙 to stop the debug session and go back to Project Edition Mode





- 1. Download and install Keil MDK-ARM 4.54 or later, evaluation version : http://www.keil.com/arm/mdk.asp
- 2. (Re)Install Windows USB Driver OpenSDA Support from P&E Micro Systems v11_120720 or later, at http://www.pemicro.com/opensda
- 3. Patch Keil MDK-ARM or later, to make it compatible with OpenSDA Debug
 - Copy the content of the folder "development tool patches\Keil_patch_v110\patch" from the FRDM-KL25Z_v1.00 zip file in the directory [Keil Install Dir]\ARM\PEMicro

Download

- 4. Load the OpenSDA Debug Application
 - Follow step 3-2
- 5. Run Keil MDK-ARM or later and build the project
 - Run Keil uVision4 or later, by selecting it from the Windows Start menu
 - Select Project, Open Project
 - Select **Blinky.uvproj** available in the "**Project Example\build\keil\Freedom_Blinky**" folder from the FRDM-KL25Z_v1.00 zip file then **Open**
 - Right click on Blinky_Freedom Project (left panel) then Select Options for Target 'Blinky_Freedom'
 - Tab "Device" verify that "Freescale" "MKL25Z128xxx4" is selected
 - Tab "Output" select the option "Create HEX File" if you want to generate a precompiled S-record file usable with OpenSDA MSD Flash Programming demo (see step 2)

 Tab "Debug" select Use: "Pemicro OSJtag then click on "Settings" button (if you don't have Pemicro option, reinstall P Windows drivers and Keil Patch) 	Multi " Linker Debug Utilities & EMicro Image: Permicro OSJtag/Multilink/Cyclo Settings
,	P&E Connection Manager - v1.27.00.00
 In the new window, select the Interface "OpenSDA Embedded Tower Debug" then Port USB should be detected. Define CPU "KL25Z128M4" Select "Use SWD reduced pin protocol for communications" Unselect "Show this dialog before attempting to contact target" Then press "OK" 	Please select connection interface, port, and settings for connection. Connection port and Interface Type Interface: OpenSDA Embedded Tower Debug - USB Port Port: USB1: OpenSDA (OpenSDA) Interface Firmware Version : Target CPU Information CPU: CPU: KL25Z128M4 BDM Communication Speed PC Parallel Port wait states : I0_DELAY_ONT = 0 Debug Shift Speed = (0): Shift Frequency = 10.000Mhz BDM_SPEED = 0 Image: Speed PC Parallel Port wait states : I0_DELAY_ONT = Debug Shift Speed = (0): Shift Frequency = 10.000Mhz BDM_SPEED = 0 Image: Speed PC Parallel Port wait states : I0_DELAY_ONT = Image: SwD reduced pin protocol for communications Image: Speed PC Parallel Port wait states : I0_DELAY_ONT = Image: SwD reduced pin protocol for communications Image: Speed PC Parallel Port wait states : Incommunications MCU Internal Bus frequency (FREQ) in Hz = 0 (Decimal) Reset Options Image: Options Image: Power Control for Cyclone / Multilink Universal PX Image: Provide power to target Regulator Output Voltage Power Down Delay 250 mS
	Show this dialog before attempting to contact target (Otherwise only display on Error)

- Tab "Utilities" select Use: "Pemicro OSJtag/Multi ..." 🖲 Use Target Driver for Flash Programming

- Press "**OK**" button

Pemicro OSJtag/Multilink/Cyclone 💌

- Select "Project" then "Clean Target"
- Select "Project" and "Rebuild All Target files" or press



- 6. Start the Debug Environment of KEIL MDK-ARM 4.54 or later
 - Press Download and Debug
 - Start the debug session selecting Debug, Run or pressing 📃
 - Demo of Red Green Led Color Changing should start
 - Press "Break" button 😵 to pause the demo (stop code execution)
 - Press "Reset" button 👫 if you want to restart program execution since the beginning
 - Press "Run" button 📃 to restart the code execution
 - Press "Start/Stop" Button 🕘 to leave the debug session and go back to Project Edition Mode



Measure real consumption from Kinetis L Series MCUs in different Low-Power Modes

1. Modify the FRDM-KL25Z hardware

WARNING : Order first a board-board connector hearder 2way, 1row, like Samtec TSW-102-07-G-S or Molex 0022284023 with the corresponding jumper.



• On the back side of the board, cut the strap between J4 pins



• Then you need to connect a jumper on the top side between two pins J4



- 2. Load the **OpenSDA MSD Flash Programmer application** using the following steps:
 - Drag/drop or copy/paste the application file MSD-FREEDOM-KL25Z.SDA available in the "SDA application" folder from the FRDM-KL25Z_v1.00 zip file to the "BOOTLOADER" drive
 - Unplug the USB cable and plug it in again
 - A new removable drive should now be visible with a volume label of "FRDM-KL25Z"
 - Windows should detect a new device "OpenSDA CDC Serial Port" and install automatically the right driver
 - Check in Windows device manager that Ports (COM & LPT)/OpenSDA-CDC Serial Port was correctly detected and save the COM Port number.



- 3. Drag/drop or copy/paste the s-record precompiled demo file low_power_demo_freedom.srec available in the "S-RECORD project examples" folder from the FRDM-KL25Z_v1.00 zip file to the "FRDM-KL25Z" drive.
- 4. As Windows 7 doesn't offer anymore the hyperterminal tool, you need to download a version of this software, like "tera term Pro"
- 5. Additional tools
 - Plug the multimeter between the two pins from J4 (top side) and select mA mode
 - Run TeraTerm Pro, by selecting it from the Windows Start menu
 - Select "Serial" option and the Port COM Number corresponding to the "OpenSDA – CDC Serial Port" (information available in Windows Device Manager)
 Select "Setura" "Serial port – " and Baud Pate "10200" then "OK"
 - Select "Setup", "Serial port ..." and Baud Rate "19200" then "OK"

era Term: Serial port set	tup	×
Port:	COM14 -	ОК
Baud rate:	19200 -	
Data:	8 bit 👻	Cancel
Parity:	none 👻	
Stop:	1 bit 🔹	Help
Flow control:	none 👻	

- Press the Reset button on FRDM-KL25Z
- Hyperterminal window will update as below

COM14 - Tera Term VT	
File Edit Setup Control Window Help	
External Pin Reset KL25 Unrecognized Kinetis package code. Low Power Line with Cortex MØ+	
SRAM Size: 16 KB Silicon rev 15 Flash parameter version 0.0.8.0 Flash version ID 6.0.1.0 Flash size: 128 KB program flash, 4 KB protection region LLWU configured pins PTC3/SCI1_RX/FTM0_CH2 is LLWU wakeup source LLWU configured modules as LLWU wakeup sources = 0x01, *DE B U G D I S A B L E D* *Press SW3 then press Reset to re-enable debug*	
* KL Low Power DEMO * * Jul 24 2012 13:48:44 *	
<pre>in Run Mode ! in PEE mode now at 48000000 Hz Select the desired operation 0 for CASE 0: Enter ULLS0 with POR disabled (Very Low Leakage STOP 0) NO POR 1 for CASE 1: Enter ULLS0 with POR enabled (Very Low Leakage STOP 0) with POR 2 for CASE 1: Enter ULLS1 (Very Low Leakage STOP 1) 3 for CASE 2: Enter ULLS1 (Very Low Leakage STOP 3) 5 for CASE 3: Enter LLS with LPTMR 1 second wakeup loop (Low Leakage Stop) 4 for CASE 4: Enter ULLS3 (Very Low Leakage STOP 3) 5 for CASE 5: Enter ULLS(Low Leakage Stop) 6 for CASE 6: Enter ULPS(Uery Low Power Stop) 7 for CASE 7: Enter ULPS(Uery Low Power RUN) in BLPE (8 MHz Crystal) 8 for CASE 9: Enter ULPK(Uery Low Power RUN) 9 for CASE 9: Enter ULPK(Uery Low Power RUN) 9 for CASE 9: Enter ULPK(Uery Low Power WAIT) A for CASE 10: Enter WAIT B for CASE 10: Enter MAIT B for CASE 11: Enter PARTIAL STOP 1 with both system and bus clocks disabled D for CASE 13: Enter PARTIAL STOP 2 with system clock disabled and bus clock enabled E for CASE 15: Running coremark 2 times in RUN with CPO then without CPO F for CASE 16: Enable LPTMR to wakeup every 5 seconds from any mode except ULLS0 H for CASE 16: Enter ULPR at Core Frequency of 4 MHz J for CASE 19: Enter ULPR in BLPI at Core Frequency of 2 MHz K for CASE 19: Enter ULPR in BLPI at Core Frequency of 2 MHz J for CASE 19: Enter ULPR in BLPI at Core Frequency of 2 MHz J for CASE 12: To enable DEBUG</pre>	

- Select a power mode (typing 0 to 9 or A to L) then press any key to confirm
- You should now measure on multimeter the real current consumption Idd from KL25 in this mode



- 6. To RUN another Low Power Mode
 - Press the RESET button on the Freedom board
 - Return to Hyperterminal window and Select another power mode (typing 0 to 9 or A to L) and press any key to confirm



EXAMPLE of measurement for :

- CASE 0: Enter VLLS0 with POR disabled (Very Low Leakage STOP 0) NO POR
- CASE 20: Enter Compute Mode run for(i=0;i<wait_count;i++)



Coming soon ...



Getting Started with Processor Expert



Getting Started with CodeWarrior for Microcontroller v10.3