Using the FRDM-K22F to Evaluate K02 and K22FN Devices
Hardware and Software Considerations

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1 Introduction

This Application Note provides instructions on how to begin evaluating K02FN or K22FN code on the superset FRDM-K22F evaluation board. Although the supported devices are compatible, there are some pinout, memory map, and module differences that must be considered when developing your project.

As a reminder, the next-generation of Kinetis microcontrollers offers a number of optimized products. The streamlined K02 MCUs provide an entry point into the Kinetis K portfolio, running at 100 MHz with FPU. These products provide a balance between power consumption and performance. Also included in this next generation are the cost-effective Kinetis K22 MCUs, which expand the existing Kinetis USB MCU portfolio to include power-efficient devices running at frequencies up to 120 MHz, with FPU and up to 512 KB Flash. These K22 devices include a wide range of intelligently integrated features, such as crystal-less USB support.

Freescale offers a single evaluation board, the Freescale Freedom FRDM-K22F, to support both the K02FN and the K22FN family of devices. This evaluation board contains

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MK22FN512VLH12, a compatible, superset device. Using the K02 devices as an example, this Application Note provides the following information:

1. Differences between MK02FN128VLH10 and the superset device on the Freescale FRDM-K22F
2. Considerations, including device configuration, that should be made when starting software development
3. An example of how to migrate software from the Freescale Freedom board to a custom K02 board

Additional questions and support can be found through the Freescale Kinetis Community at https://community.freescale.com/community/kinetis.

2   Comparing K22 to K02 devices

This section explains the differences between the K22 and K02 devices, including modules differences, memory, and pinout.

2.1   Module comparison

When developing code for K02, consider that K02 is a subset of the K22, so it has fewer modules and some feature differences. Table 1 shows the module differences. **Bold text** indicates slight differences between the two devices.

Table 1. MK22FN512VLH12 vs. MK02FN128VLH10 features differences

Feature Lists	MK22FN512VLH12	MK02FN128VLH10
High Speed Run Max Freq.	120 MHz	**100 MHz**
Normal Run Max Freq.	80 MHz	**72 MHz**
Floating Point Unit	Yes	Yes
DMA	16-ch	**4-ch**
Flash	512 KB	**128 KB**
SRAM	128 KB	**16 KB**
External Bus Interface (Flexbus)	Yes	**No**
System Register File	Yes	**No**
Enhanced UART	1 (ISO 7816 + FIFO)	**1 (FIFO)**
UART (standard)	2	**1**
LPUART	1	**No**
DSPI	1x w/ 1word FIFO 1x w/ 4 word FIFO	**1x w/ 4 word FIFO**
I^2C	2	**1**
I^2S/SAI	1x(8FIFO,16FRAME)	**No**
USB OTG	USB FS OTG 2.0	**No**
USB 120mA Reg	Yes	**No**

Table 1. MK22FN512VLH12 vs. MK02FN128VLH10 features differences

Feature Lists	MK22FN512VLH12	MK02FN128VLH10
Motor Control/General purpose/PWM	2x8ch	**1x6ch**
Quad decoder/General purpose/PWM	2x2ch	2x2ch
MCG	PLL and FLL	**FLL**
IRC48M	Yes	Yes
RTC (32 KHz Osc, Vbat)	Yes	**No**
16-bit SAR ADC (w/ temp sense) Total	2	**1**
12-bit DAC	2	**1**
Analog Comparator (w/ 6-bit DAC)	2	2
RNGA	Yes	**No**
Serial Programming Interface	EzPort	**No**
GPIO Count	64LQFP: 40	**64 LQFP: 46**
GPIO w/ dig. Filter (port D only)	16 pins - 121MAPBGA only, 8-pins in other packages	**8 pins**
PTE16-PTE19 available	No	**Yes**
Differential ADC channels on PTE16-PTE19	No	**Yes**

2.2   Pinout differences

The FRDM-K22F is populated with a MK22FN512VLH12, a 64 LQPF package. This package is also available for MK02FN128VLH10. When debugging code on FRDM-K22F targeted for the K02, the user must take into account the fact that the K02 has four additional GPIO pins instead of USB pins, as shown in Table 2. Note that PTE16 through PTE19 are not available on the K22 because those pins are used for the USB module. Additionally, the 32 KHz crystal oscillator pins XTAL32 and EXTAL32 are not available on K02 and VBAT is not supported.

For your reference, the signal pinouts are listed in Table 2 based on their respective data sheets: K22P121M120SF7 and K02P64M100SFA. For detailed pinout and multiplexing information, please refer to these documents.

Table 2. Pinout differences

64 LQFP	K22	K02
1	PTE0/CLKOUT32K	PTE0/CLKOUT32K
2	PTE1/LLWU_P0	PTE1/LLWU_P0
3	VDD	VDD
4	VSS	VSS
5	**USB0_DP**	**PTE16**

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Table 2. Pinout differences

64 LQFP	K22	K02
6	**USB0_DM**	**PTE17**
7	**VOUT33**	**PTE18**
8	**VREGIN**	**PTE19**
9	ADC0_DP0/ADC1_DP3	ADC0_DP0
10	ADC0_DM0/ADC1_DM3	ADC0_DM0
11	ADC1_DP0/ADC0_DP3	ADC0_DP3
12	ADC1_DM0/ADC0_DM3	ADC0_DM3
13	VDDA	VDDA
14	VREFH	VREFH
15	VREFL	VREFL
16	VSSA	VSSA
17	VREF_OUT/CMP1_IN5/CMP0_IN5/ADC1_SE18	VREF_OUT/CMP1_IN5/CMP0_IN5
18	DAC0_OUT/CMP1_IN3/ADC0_SE23	DAC0_OUT/CMP1_IN3/ADC0_SE23
19	**XTAL32**	**CMP0_IN4**
20	**EXTAL32**	**PTE24**
21	**VBAT**	**PTE25**
22	PTA0	PTA0
23	PTA1	PTA1
24	PTA2	PTA2
25	PTA3	PTA3
26	PTA4/LLWU_P3	PTA4/LLWU_P3
27	PTA5	PTA5
28	PTA12	PTA12
29	PTA13/LLWU_P4	PTA13/LLWU_P4
30	VDD	VDD
31	VSS	VSS
32	PTA18	PTA18
33	PTA19	PTA19
34	RESET_b	RESET_b
35	PTB0/LLWU_P5	PTB0/LLWU_P5
36	PTB1	PTB1
37	PTB2	PTB2
38	PTB3	PTB3

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Table 2. Pinout differences

64 LQFP	K22	K02
39	PTB16	PTB16
40	PTB17	PTB17
41	PTB18	PTB18
42	PTB19	PTB19
43	PTC0	PTC0
44	PTC1/LLWU_P6	PTC1/LLWU_P6
45	PTC2	PTC2
46	PTC3/LLWU_P7	PTC3/LLWU_P7
47	VSS	VSS
48	VDD	VDD
49	PTC4/LLWU_P8	PTC4/LLWU_P8
50	PTC5/LLWU_P9	PTC5/LLWU_P9
51	PTC6/LLWU_P10	PTC6/LLWU_P10
52	PTC7	PTC7
53	PTC8	PTC8
54	PTC9	PTC9
55	PTC10	PTC10
56	PTC11/LLWU_P11	PTC11/LLWU_P11
57	PTD0/LLWU_P12	PTD0/LLWU_P12
58	PTD1	PTD1
59	PTD2/LLWU_P13	PTD2/LLWU_P13
60	PTD3	PTD3
61	PTD4/LLWU_P14	PTD4/LLWU_P14
62	PTD5	PTD5
63	PTD6/LLWU_P15	PTD6/LLWU_P15
64	PTD7	PTD7

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2.3   FRDM-K22F hardware
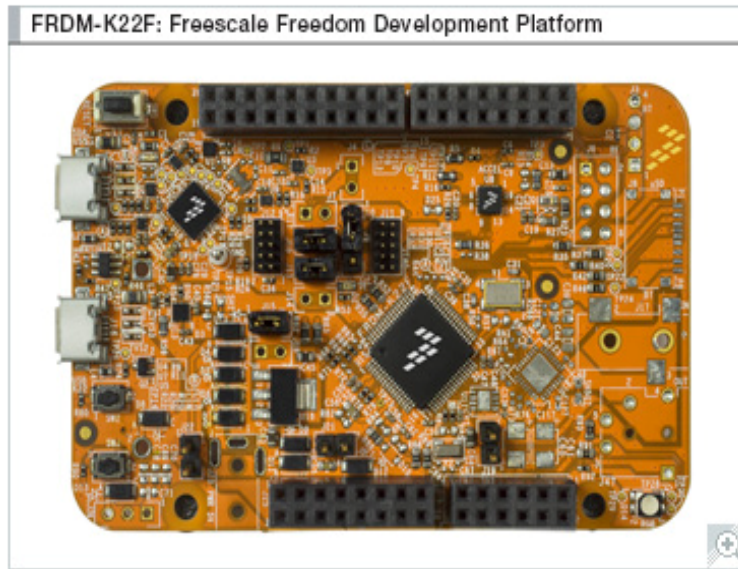
Figure 1. FRDM-K22F top view

Due to the previously mentioned pinout and module differences between the K02 and the K22, when developing code for the K02 on the K22 refer to Table 3 to ensure proper access to the signals and their limitations.

Table 3. Notes on FRDM-K22F

64 LQFP	K22	K02	Notes on FRDM-K22F
5	USB D+	PTE16	USB_DP through 330ohms, does not affect operation. Can be accessed through R37
6	USB D-	PTE17	USB_DN through 330ohms, does not affect K02 operation. Can be accessed through R38
7	Vout3.3	PTE18	VOUT_33 is not connected, it does not affect K02 functionality, Can be accessed through TP27
8	Vregin	PTE19	P5V_K22, this voltage is provided through the USB connector. PTE19 does not support 5 volts connection, so Make sure USB cable is not connected when testing K02.
19	XTAL32	CMP0_IN4	Remove R82, to isolate from the crystal. you can access the comparator through pin1 of R82
20	EXTAL32	PTE24	Remove R81 to isolate from the crystal, PTE24 can be accessed through pin1 of R81
21	VBAT	PTE25	Remove J21. PTE25 can be accessed from pin1 of J21

3   Software considerations

It is recommended that code development begin with Kinetis SDK. K02 is supported as standalone release Freescale Kinetis SDK_1.0.0 for KV30 and K02 devices, which includes demo code for the FRDM-K22F

targeted for K02, taking into account only the K02 features of memory and modules. For example, if you open the 'hello_world' project, you can see that the linker files and header files are for the K02, which allows code running on K22 to run properly on a K02 custom board.

3.1 Installing the KSDK standalone release

To get started with the KSDK, the first step is to install the KSDK for K02 from the website. Go to http://www.freescale.com/webapp/sps/site/prod_summary.jsp?code=KINETIS_SDK&fpsp=1&tab=Design_Tools_Tab and click on the link called "Freescale Kinetis SDK_1.0.0 for KV30 and K02 devices" that fits with your operating system.
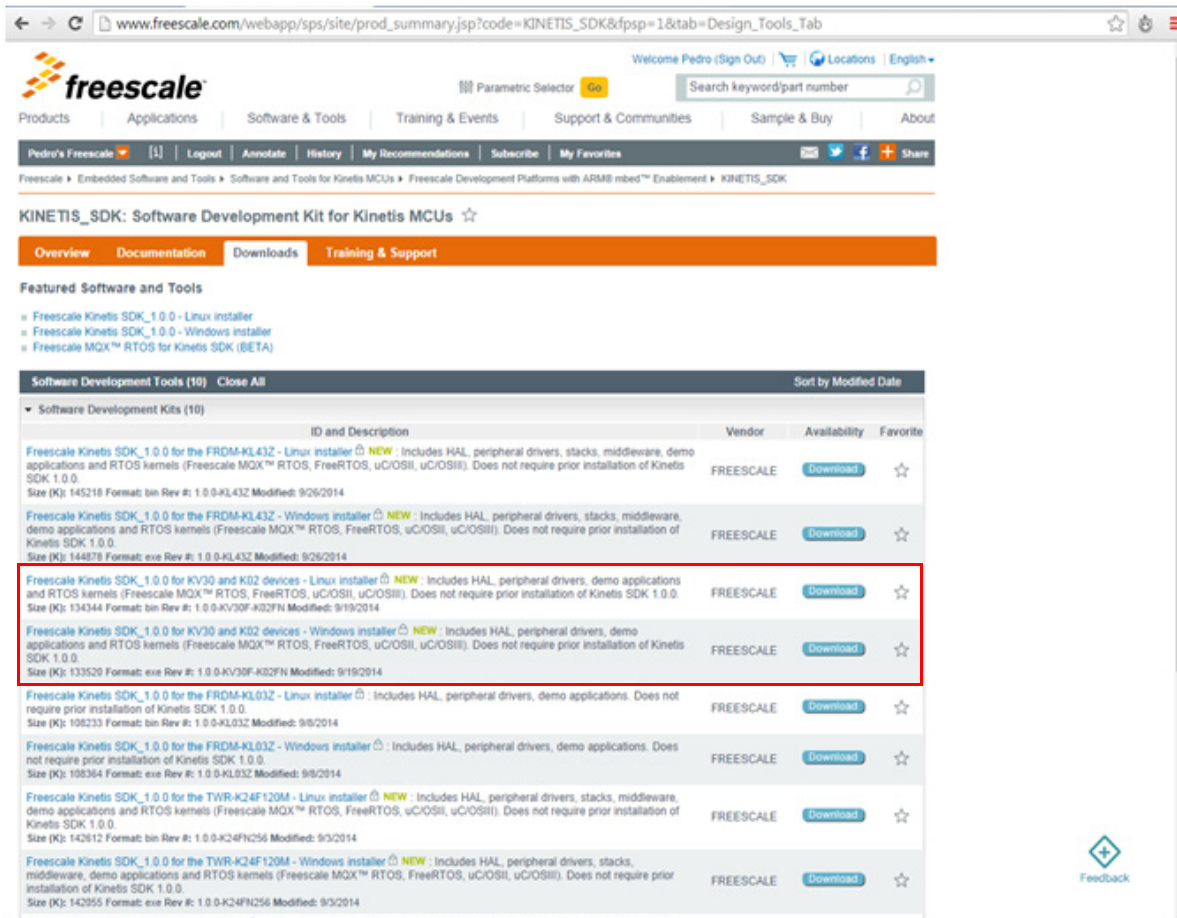
If you are not logged in, please do so. If you don't have a Freescale account, enter your email address and then follow the instructions.
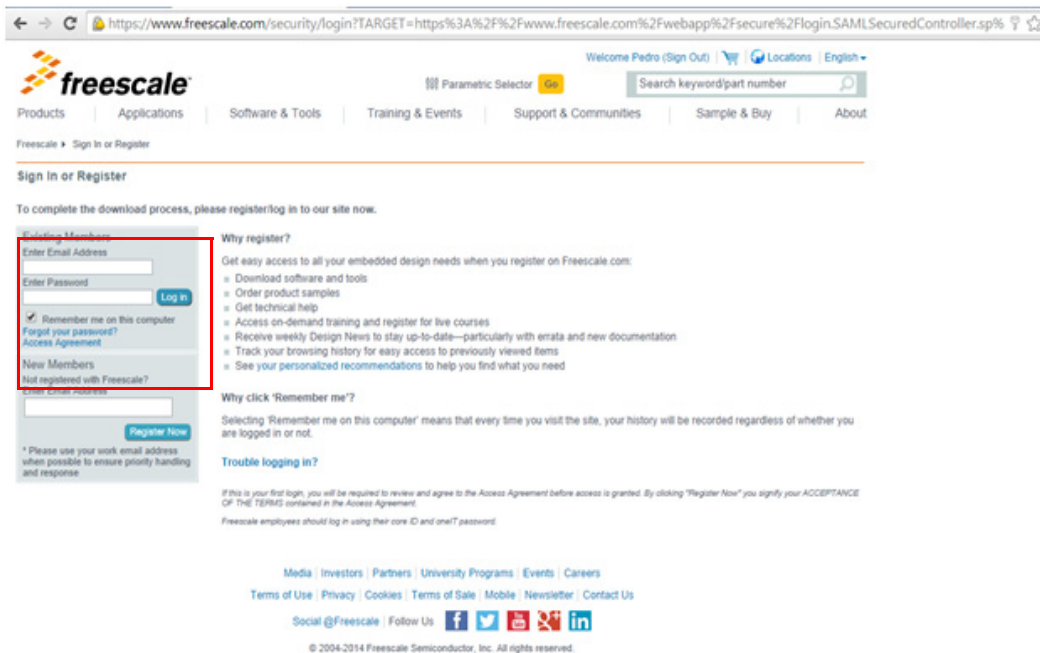
Once you are logged in, carefully read the license agreement. After the download is complete, click on the downloaded file and the following pop-up box will appear. Click "Run" to start installation.
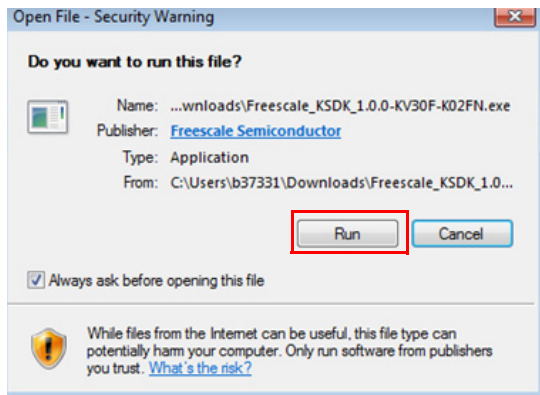
Select "Install a New Instance."
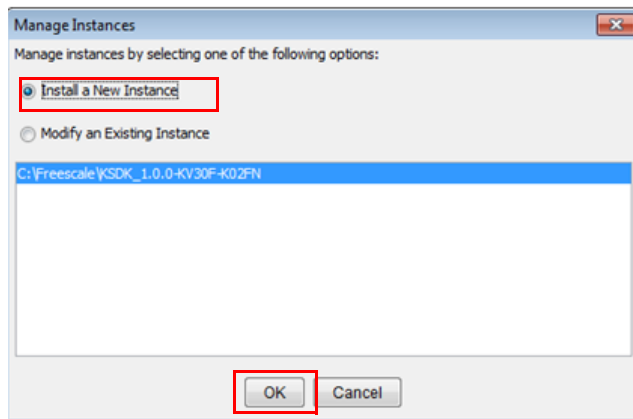
The installation wizard will launch and you must accept the terms of the License Agreement to continue.
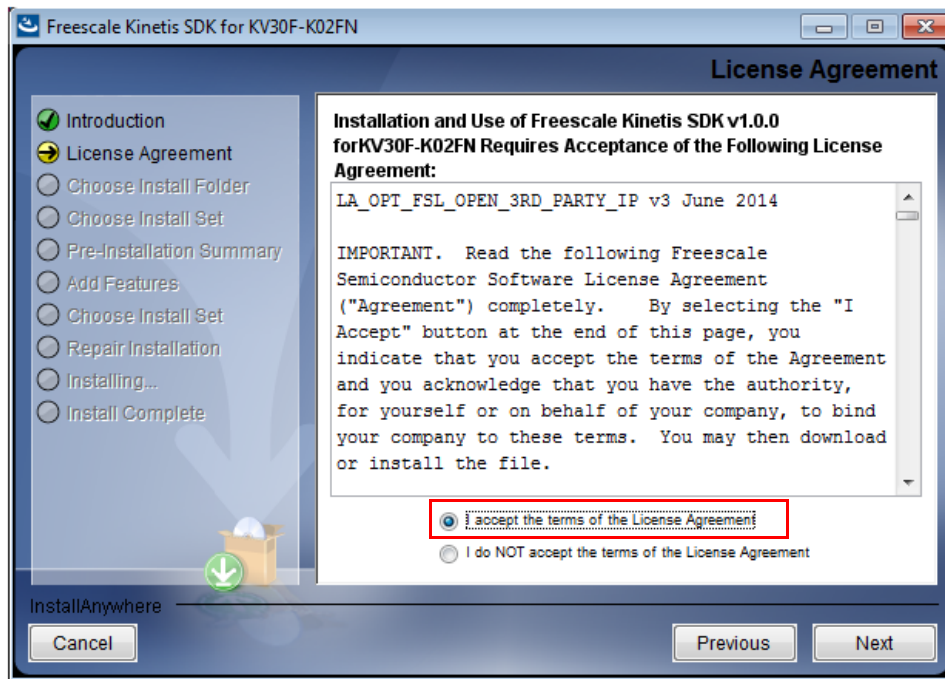
The default path for installation is: C:\Freescale\KSDK_1.0.0-KV30F-K02FN. If you want another path enter it or use the "Choose" button. Press "Next" to continue with installation.
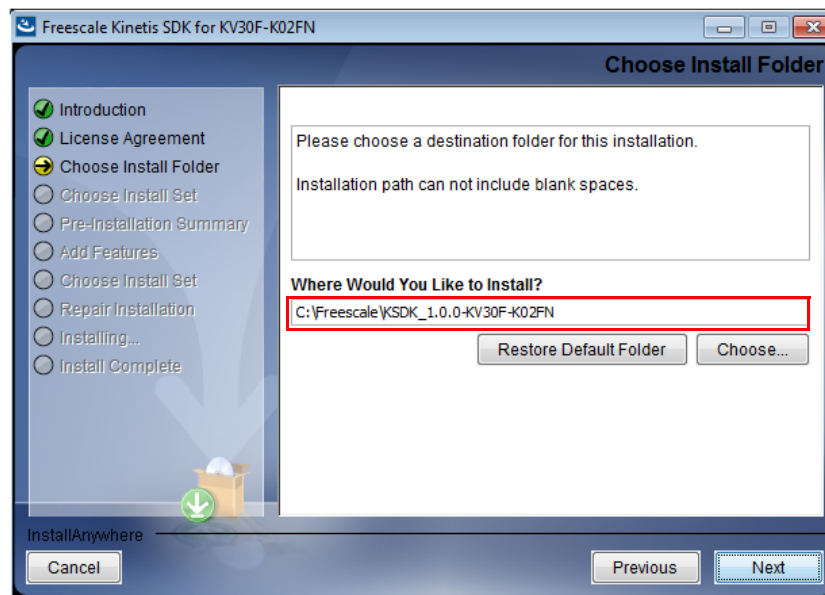
Select "Custom" if you want to install an Operating System. If not, select "Minimal."
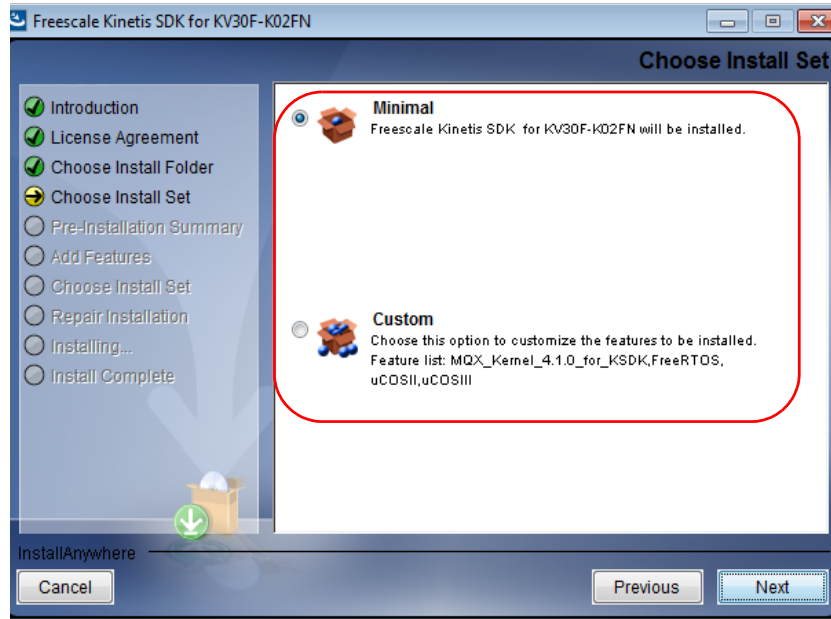
If you have already installed another version of KSDK, the next pop-up window will appear. If you are going to work with Kinetis Design Studio and/or Processor Expert software, we recommended that you backup the current value of the Environment Variable called "KSDK_PATH" and choose "YES."
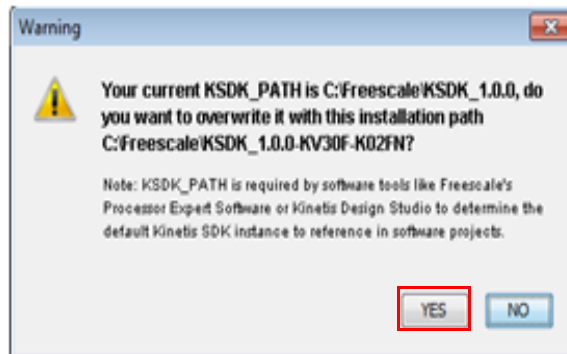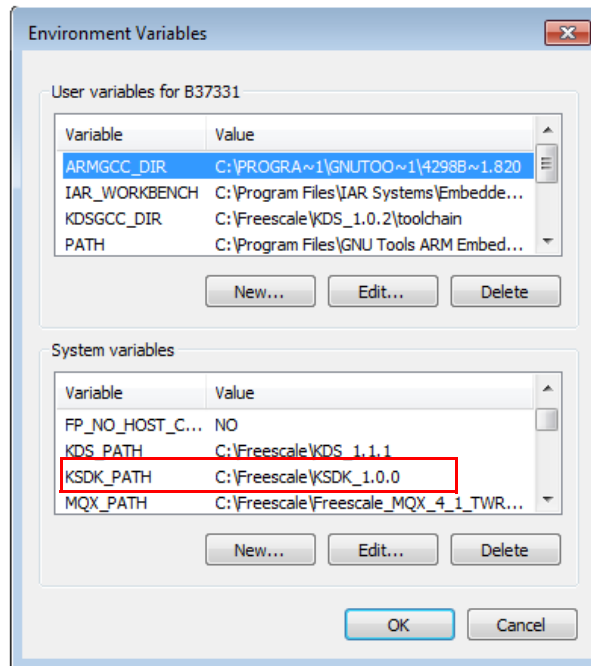
After installation is completed, you will need to restart your system.
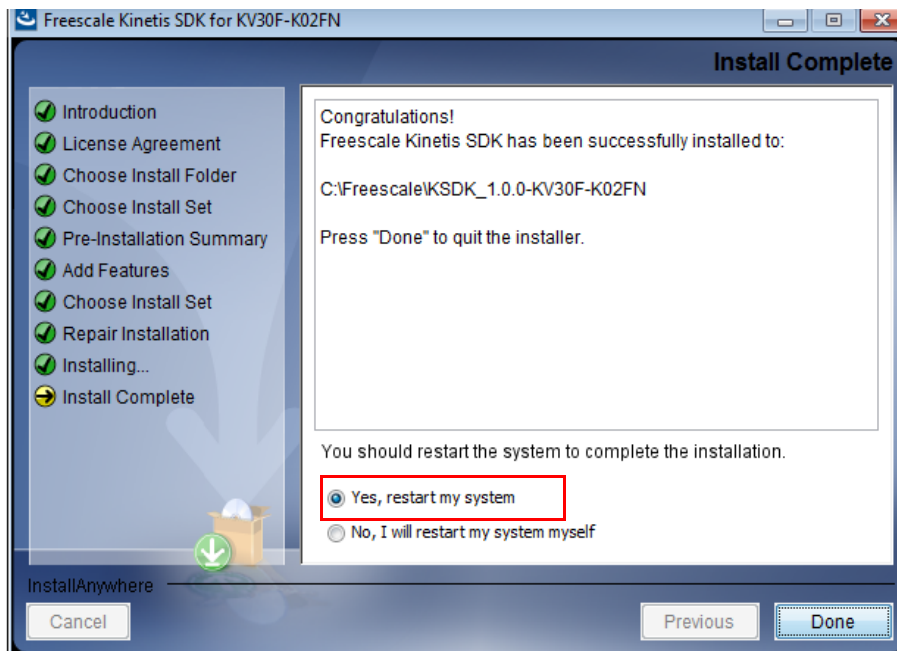
To build and run a KSDK demo application using IAR, refer to the "Kinetis SDK K22 User's Guide.pdf" file in section 4 called "Build and Run the KSDK Demo Applications using IAR." This file can be found on the path: <Install_dir>/doc. Table 4 shows paths on the document and the paths that must be used for FRDM-K22F with a K02 MCU.

Table 4. Required Paths for FRDM-K22F with a K02 MCU

Documentation paths	FRDM-K22F with a K22 MCU paths
<Install_dir>/lib/ksdk_platform_lib/iar/<device_name>	<Install_dir>/lib/ksdk_platform_lib/iar/K02F12810
<Install_dir>/lib/ksdk_platform_lib/iar/<device_name>lib.eww	<Install_dir>/lib/ksdk_platform_lib/iar/K02F12810/ksdk_platform_lib.eww
<Install_dir>/lib/ksdk_platform_lib/iar/<device_name>/platform_lib.ewp	<Install_dir>/lib/ksdk_platform_lib/iar/K02F12810/ksdk_platform_lib.ewp
<Install_dir>/lib/ksdk_platform_lib/iar/K22F51212/lib.eww	<Install_dir>/lib/ksdk_platform_lib/iar/K02F12810/ksdk_platform_lib.eww
Debug - <install_dir>/lib/ksdk_platform_lib<toolchain>/<device_name>/output/Debug	Debug - <install_dir>/lib/ksdk_platform_lib/iar/K02F12810/debug
Release - <install_dir>/lib/ksdk_platform_lib/<toolchain>/<device_name>/output/Release	Release - <install_dir>/lib/ksdk_platform_lib/iar/K02F12810/release
<Install_dir>/lib/ksdk_platform_lib/<toolchain>/<device_name>/<build>	<install_dir>/lib/ksdk_platform_lib/iar/K02F12810/<build>
<Install_dir>/lib/ksd_platform_lib/iar/K22F51212/debug	<install_dir>/lib/ksdk_platform_lib/iar/K02F12810/debug
<install_dir>/demos/<demo_name>/<toolchain>/<board_name>/<demo_name>.eww	<install_dir>/demos/<demo_name>/<toolchain>/frdmk22f120mk02/<demo_name>.eww
<install_dir>/demos/hello_world/iar/twrk22f120m/hello_world.eww	<install_dir>/demos/hello_world/iar/frdmk22f120mk02/hello_world.eww

Table 5 shows the most important paths of KSDK for K02.

Table 5. KSDK Paths for K02

KSDK file type	K02 file path
Board	*<Install_dir>*\boards\frdmk22f120mk02
Lib	*<Install_dir>*\lib\ksdk_platform_lib\iar\K02F12810
Header Files	*<Install_dir>*\platform\CMSIS\Include\device\MK02F12810
Drivers	*<Install_dir>*\platform\drivers
Hal	*<Install_dir>*\platform\hal
Hal For SIM	*<Install_dir>*\platform\hal\sim\MK02F12810
Linker File	*<Install_dir>*\platform\linker\iar\K02F12810
Operative System Application Layer	*<Install_dir>**platform\osa*
Documents	*<Install_dir>**doc*

4   Revision history

Revision	Date	Comment
0	11/2014	Initial Release

Document Number: AN5040
Rev. 0
11/2014