



FTF 2016
TECHNOLOGY FORUM

KINETIS EXPERT CONFIGURATION TOOLS

FTF-DES-N1958

GREG HEMSTREET
ERICH STYGER

PUBLIC USE



Kinetis SDK Technical Overview

Agenda:

- Kinetis Expert Tools Overview
- Kinetis Expert Tool Details
 - Configurations...
 - Power Estimation tool demo
 - Pins tool demo
 - Clocks tool demo
 - SDK Builder demo
- Question & Answer

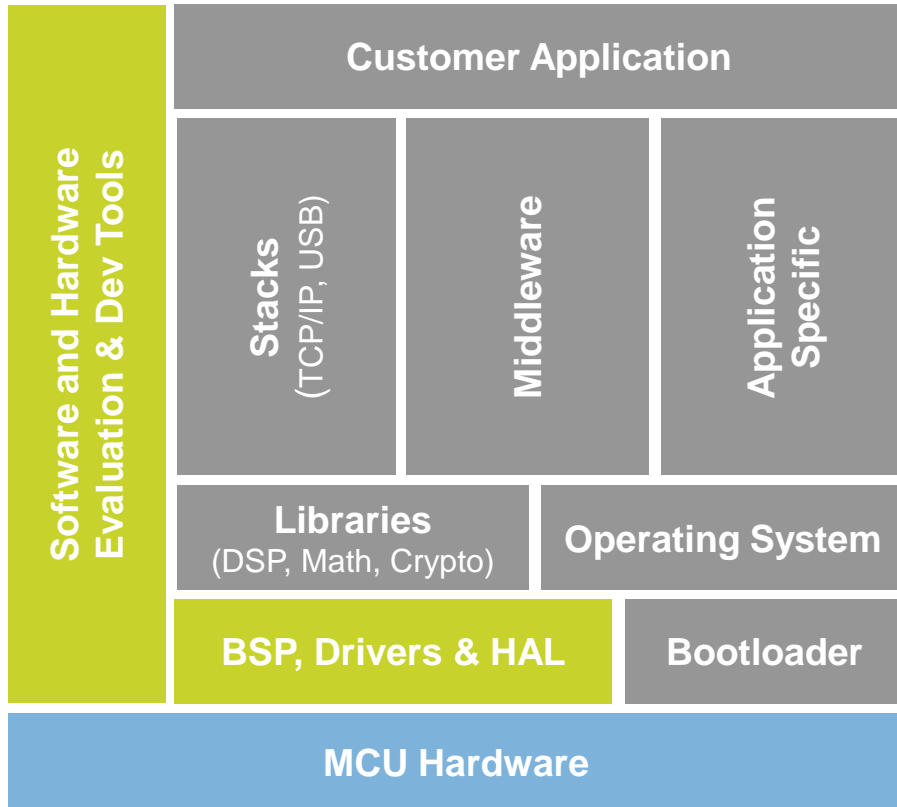
KINETIS EXPERT OVERVIEW







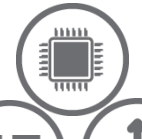
Kinetis Expert (KEx) System Configuration Tools



Integrated configuration and development tools for Kinetis MCUs.



Kinetis Expert is a suite of evaluation and configuration tools that helps guide users from first evaluation to production software development. The tools are available in online and desktop editions.

-  **SDK Builder** packages custom SDKs based on user selections of MCU, evaluation board, and optional software components.
-  **Project Generator** creates new or clones existing SDK projects.
-  **Power Estimation** tool provides energy and battery-life estimates based on a user's application model
-  **Power Analyzer** measures and displays energy consumption data
-  **Pins, Clocks, and Peripherals** tools generate initialization C code for custom board support.



Design considerations

Suite of tools

- Next generation of Processor Expert technologies
- Extensible – new tools can be added, when available
- Configures the SDK for use with standard and custom boards
- Supports rapid embedded application development

Cloud Solution (kex.nxp.com)

- No installer, no updates, always available
- Ability to create and share configurations

Desktop Solution

- Mostly connected application
- New processors updated automatically
- Same User Interface as online tools

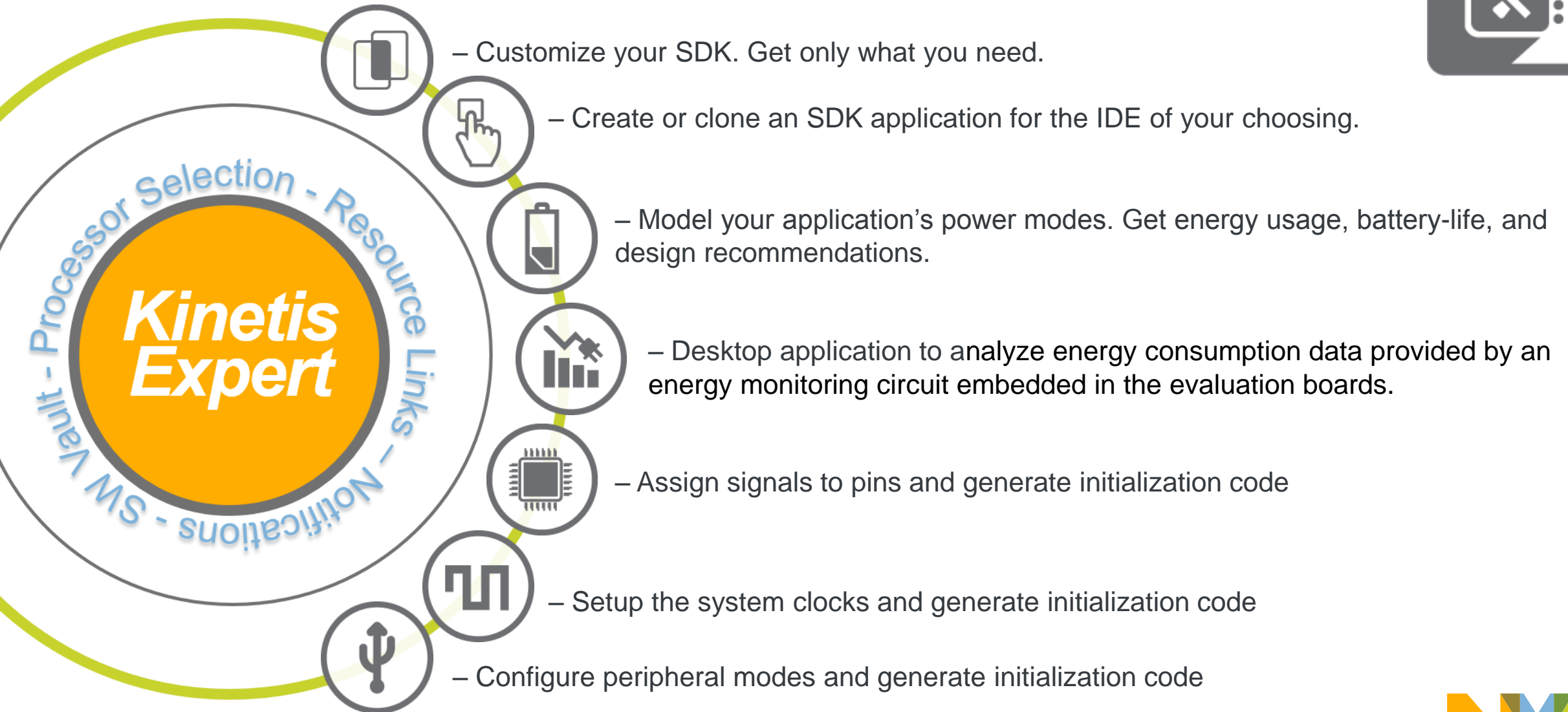
Configuration tools for:

- Kinetis microcontrollers
- LPC microcontrollers*
- C-M cores on i.MX processors**
- Other processors*

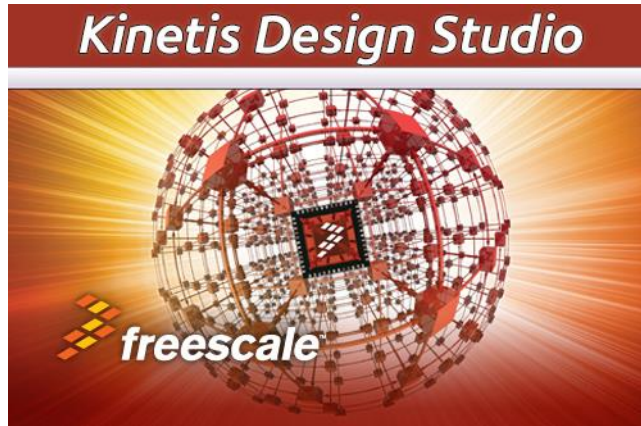
* Limited coverage in 2016

** Not all tools apply

Kinetis Expert (KEx) System Configuration Tools



Kinetis SDK v2 – Toolchain Support



(Kinetis Design Studio project importer)



Kinetis SDK Technical Overview

Agenda:

- Kinetis Expert Tools Overview
- Kinetis Expert Tool Details
 - Configurations...
 - Power Estimation tool demo
 - Pins tool demo
 - Clocks tool demo
 - SDK Builder demo
- Question & Answer

KINETIS EXPERT ONLINE SYSTEM

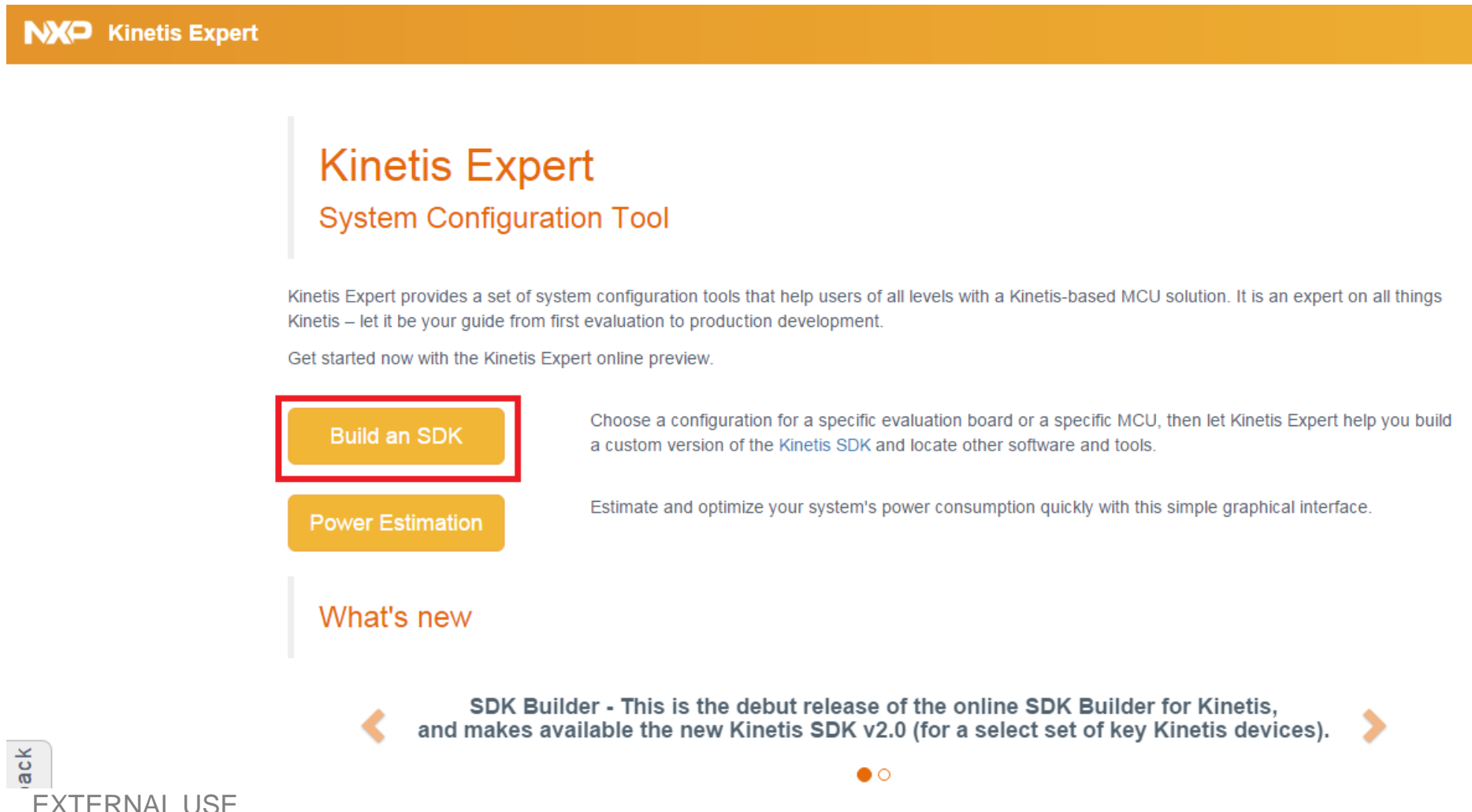


Kinetis Expert Tools – kex.nxp.com

- Get your SDK, use the KEx tools online or as Desktop applications...
- Leverages NXP common web services
 - Signon authentication system connected with our export compliance system and licensing mechanisms.
 - Notifications for software updates
- Available in English and Chinese for localized use
- Supports multiple “Configurations”, each configuration is the collection of data input from the set of tools
 - With validation between tools; consistent with the Kinetis SDK APIs.
 - Configurations can be named, show basic SoC / board information and offer optional software options.
 - Configurations can be downloaded from the online tools to desktop tools (and reuploaded) using a .mex file format.
- KSDK 2.0 is distributed via Kinetis Expert Tool (KEX)
 - Offers ability to customize download options by toolchain, RTOS, and specific device
 - Configurations stored in web interface for downloads
 - Downloads automatically generated
 - A monolithic download with all supported boards/devices is no longer offered

Kinetis Expert Tool – kex.nxp.com

- Start with “Build an SDK”



The screenshot shows the Kinetis Expert website interface. At the top is a blue header with the NXP logo and the text "Kinetis Expert". Below this is a main content area with a light blue background. The title "Kinetis Expert" is in a large, bold, blue font, followed by the subtitle "System Configuration Tool" in a smaller blue font. A paragraph of text describes the tool's purpose: "Kinetis Expert provides a set of system configuration tools that help users of all levels with a Kinetis-based MCU solution. It is an expert on all things Kinetis – let it be your guide from first evaluation to production development." Below this is a link: "Get started now with the Kinetis Expert online preview." There are two main buttons: "Build an SDK" (highlighted with a red border) and "Power Estimation". The "Build an SDK" button is accompanied by a description: "Choose a configuration for a specific evaluation board or a specific MCU, then let Kinetis Expert help you build a custom version of the Kinetis SDK and locate other software and tools." The "Power Estimation" button is accompanied by the text: "Estimate and optimize your system's power consumption quickly with this simple graphical interface." Below these buttons is a section titled "What's new" with a blue arrow pointing left and a blue arrow pointing right. The text in the center reads: "SDK Builder - This is the debut release of the online SDK Builder for Kinetis, and makes available the new Kinetis SDK v2.0 (for a select set of key Kinetis devices)." At the bottom of the page, there is a navigation bar with a "back" button, the number "10", and the text "EXTERNAL USE". The NXP logo is also present in the bottom right corner.

NXP Kinetis Expert

Kinetis Expert

System Configuration Tool

Kinetis Expert provides a set of system configuration tools that help users of all levels with a Kinetis-based MCU solution. It is an expert on all things Kinetis – let it be your guide from first evaluation to production development.

Get started now with the Kinetis Expert online preview.

Build an SDK

Choose a configuration for a specific evaluation board or a specific MCU, then let Kinetis Expert help you build a custom version of the [Kinetis SDK](#) and locate other software and tools.


Power Estimation

Estimate and optimize your system's power consumption quickly with this simple graphical interface.

What's new

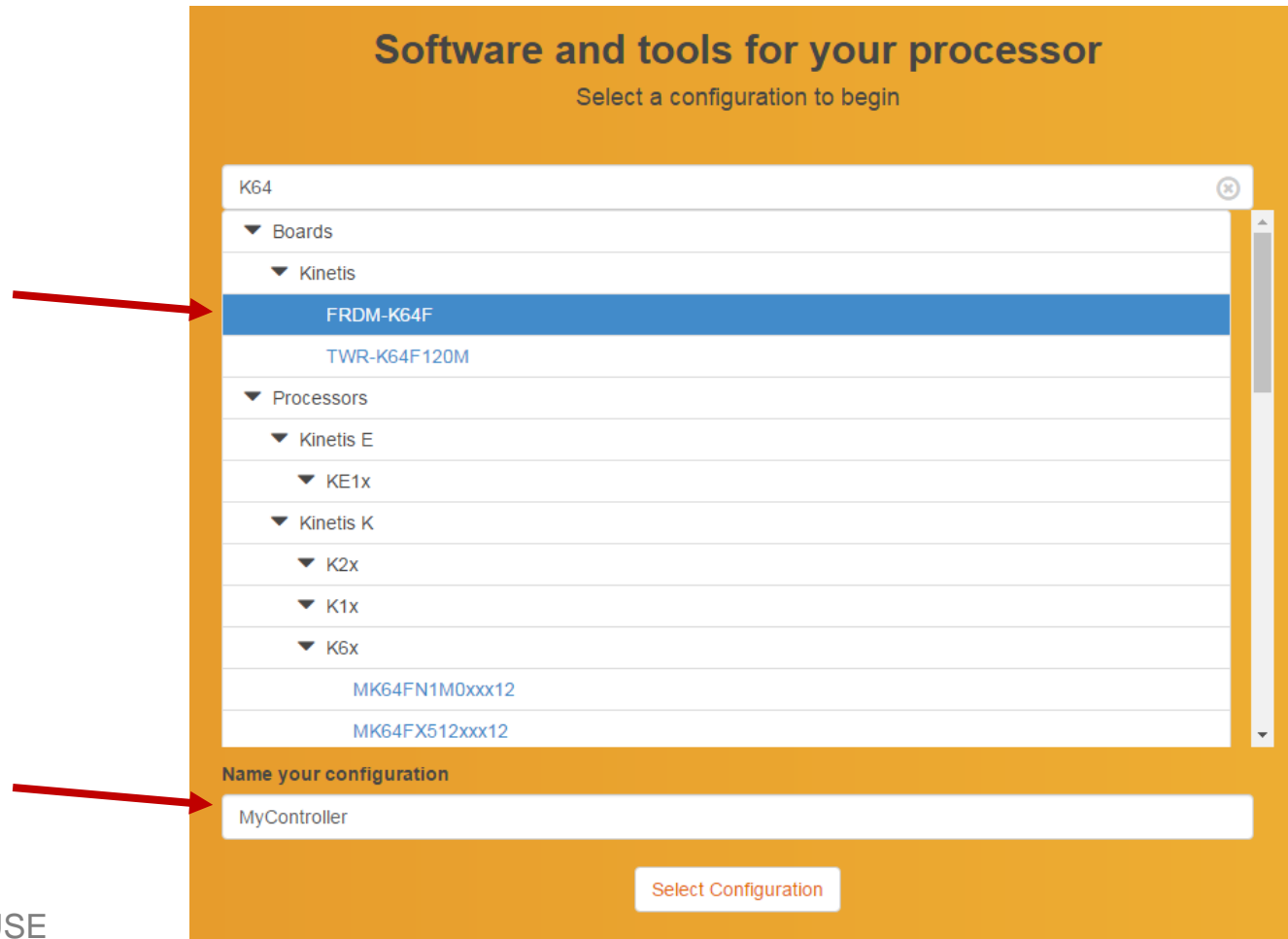
◀ **SDK Builder - This is the debut release of the online SDK Builder for Kinetis, and makes available the new Kinetis SDK v2.0 (for a select set of key Kinetis devices).** ▶

back 10 EXTERNAL USE



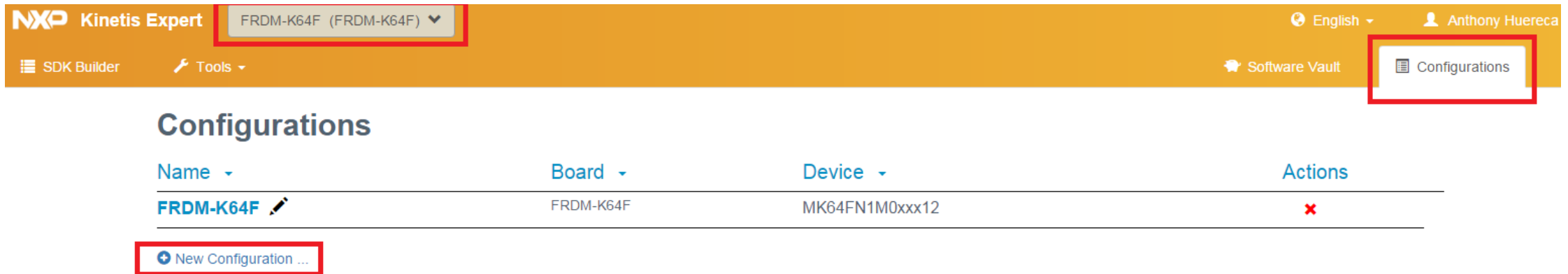
Kinetis Expert Tool – Create new configuration

- After logging in, select the board or device
- Optionally rename the configuration



Kinetis Expert Tool – Multiple Configurations

- If a new device or board is desired, then need to create a new configuration
- Go to the Configurations tab, and click on “New Configuration...”
 - Or use drop-down box at top of the screen



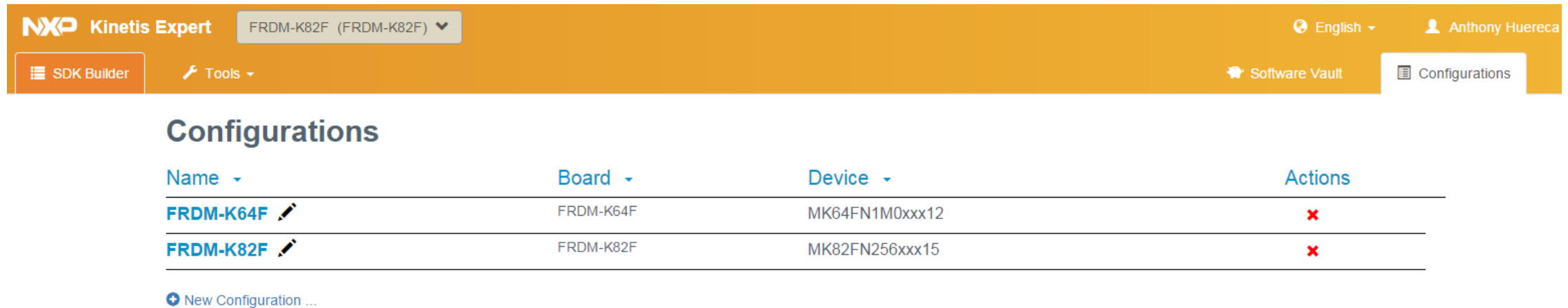
The screenshot shows the Kinetis Expert Tool interface. At the top, there is a navigation bar with the NXP logo, 'Kinetis Expert', and a dropdown menu showing 'FRDM-K64F (FRDM-K64F)'. Other elements in the bar include 'SDK Builder', 'Tools', 'Software Vault', 'English', and 'Anthony Huereca'. A 'Configurations' tab is highlighted in the top right. Below the navigation bar, the 'Configurations' section is titled, and a table lists the current configuration:

Name	Board	Device	Actions
FRDM-K64F	FRDM-K64F	MK64FN1M0xxx12	





Below the table, there is a button labeled '+ New Configuration ...'.

Kinetis Expert Tool – Multiple Configurations

- Switch between boards/devices on the Configurations tab or via drop down box



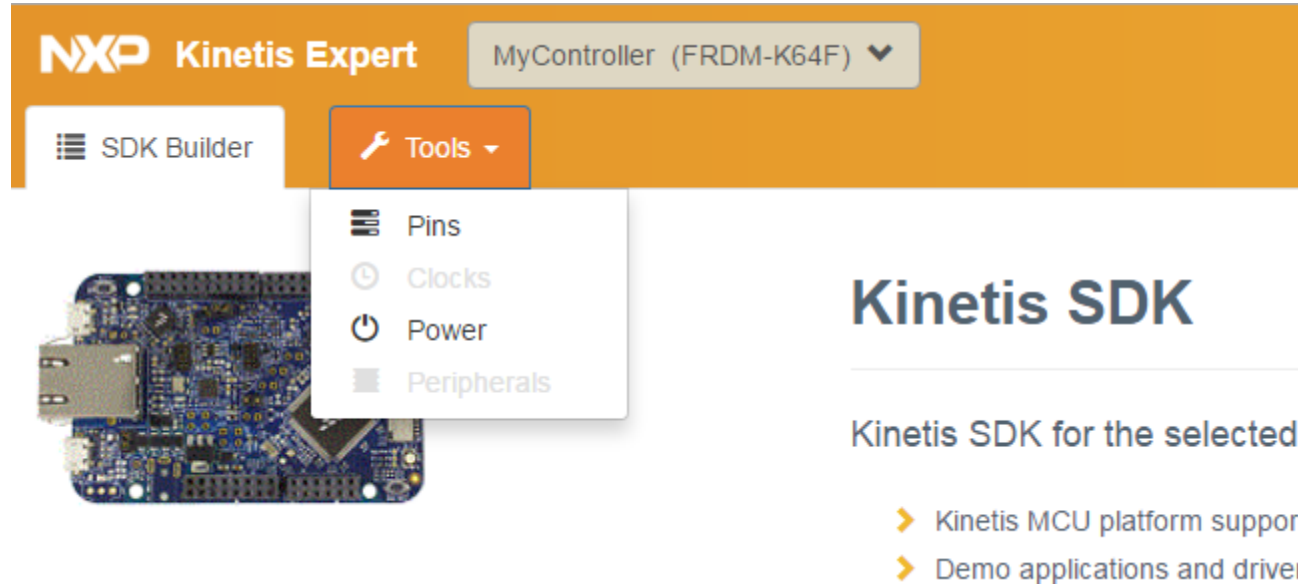
The screenshot shows the NXP Kinetis Expert tool interface. The top navigation bar is orange and contains the NXP logo, the text "Kinetis Expert", a dropdown menu for "FRDM-K82F (FRDM-K82F)", a language selector for "English", and a user profile for "Anthony Huereca". Below the navigation bar, there are buttons for "SDK Builder", "Tools", "Software Vault", and "Configurations". The "Configurations" tab is active, displaying a table with the following data:

Name	Board	Device	Actions
FRDM-K64F 	FRDM-K64F	MK64FN1M0xxx12	
FRDM-K82F 	FRDM-K82F	MK82FN256xxx15	

Below the table, there is a link for "New Configuration ...".

Configuration Tools

- Tools menu selects unique configuration tools



- Not every tool supports every device/board configuration... if the tool is dimmed, it is not yet available... but we're working on it!

Kinetis Expert Power Estimation Tool

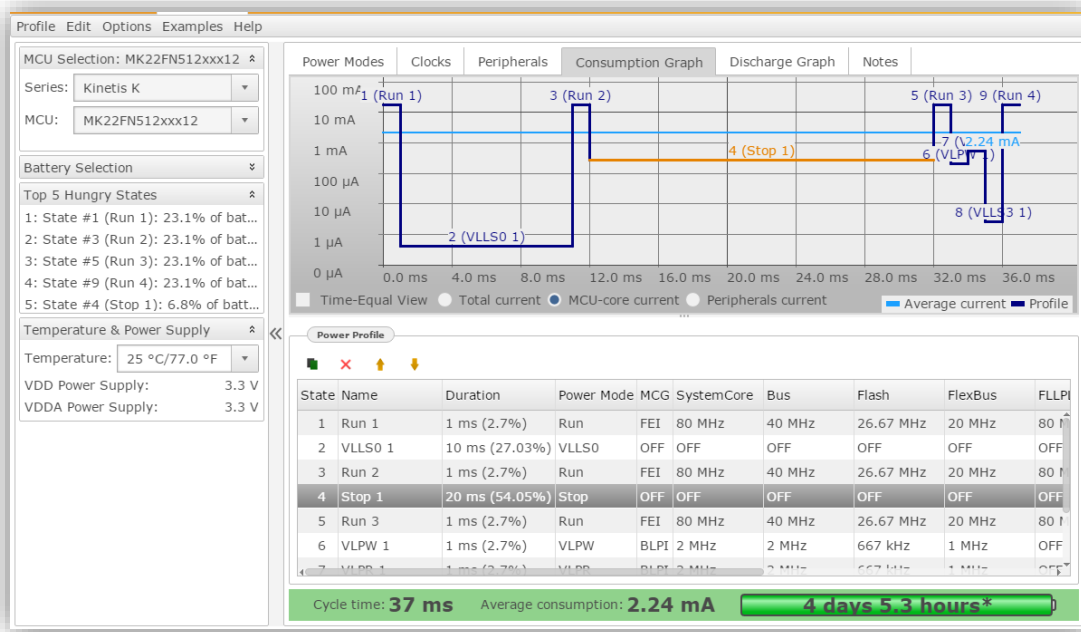
Learn more at: www.nxp.com/kinetis/powertool



Estimate and optimize your system's power consumption



Helps you design for efficient use of energy



Product Features

- Part of the Kinetis Expert suite of system configuration tools
- Online and Desktop versions available now
- Models application states and estimates the power profile
- Provides immediate energy consumption & battery life estimations
- Generates consumption and battery discharge graphs
- Provides ability to save & load profiles and generate reports
- Local and online versions to be available
- English & limited Chinese language support
- Backed by real power measurement data
- Quickly evaluate which Kinetis MCU fits your use-case and power budget
- Accelerates learning curve for advanced power management features
- Ideal tool for developing wearable and other battery-operated applications.



Power Estimation Tool Demo

1

1. Create a Configuration for FRDM-K64F

2. Choose the Pins tool

3. Let the browser load the rich user interface...



2



3

MCU Selection: MKL27Z64xxx4
Series: Kinetis L
MCU: MKL27Z64xxx4

Battery Selection: CR2032
Type: LiMnO2
Series: 1
Parallel: 1
Nominal Voltage: 3 V
Cut-off Voltage: 1.8 V
Capacity: 230 mAh
Self Discharge: 0.38 µA
Peak Current: 13 mA

Top 5 Hungry States
1: State #2 (VLPR 1): 99.9% of ba...
2: State #1 (Run 1): 0.1% of batt...
3: State #3 (LLS 1): 0% of batter...

Temperature & Power Supply
Temperature: 25 °C/77.0 °F
VDD Power Supply: 3.3 V
VDDA Power Supply: 3.3 V

State Name	Duration	Power Mode	MCG	SystemCore	BusFlash	FLLPLL	REF	Additional current	Consumption	Active peripherals
1 Run 1	20 ms (0.01%)	Run	HIRC 48 MHz	48 MHz	24 MHz	None	48 MHz IRC	0 µA	5.51 mA	0/21
2 VLPR 1	5 m (99.83%)	VLPR	LIRC 2 MHz	2 MHz	1 MHz	None	2 MHz IRC	0 µA	437 µA	0/20
3 LLS 1	500 ms (0.17%)	LLS	OFF	OFF	OFF	OFF	OFF	0 µA	1.71 µA	0/3

Cycle time: 5 m 520 ms Average consumption: 436.61 µA 21 days 22.3 hours*



Power Estimation – Desktop version....

Deep Sleep Profile - MCU Power Estimation Tool v1.0

Profile Edit Options Examples Help

MCU Selection: MKL27Z64xxx4

Series: Kinetis L

MCU: MKL27Z64xxx4

Battery Selection

CR2032

Type: LiMnO2

Series: 1

Parallel: 1

Nominal Voltage: 3 V

Cut-off Voltage: 1.8 V

Capacity: 230 mAh

Self Discharge: 0.38 μ A

Peak Current: 13 mA

Top 5 Hungry States

1: State #2 (Run FullSpeed): 3...

2: State #5 (Run FullSpeed2): ...

3: State #3 (VLLS1_Sleep): 12...

4: State #6 (VLLS1_Sleep2): 1...

5: State #1 (Run_Default): 0%...

Temperature & Power Supply

Temperature: 25 $^{\circ}$ C/77.0 $^{\circ}$ F

VDD Power Supply: 3.3 V

VDDA Power Supply: 3.3 V

Power Modes Clocks Peripherals Consumption Graph Discharge Graph Notes

Run

VLPR

Wait

VLPW

Stop

VLPS

LLS

VLLS3

VLLS1

VLLS0

Run

Min: 1.01 mA (excluding peripherals) (MCG - LIRC 2 MHz, SystemCore - 2 MHz, BusFlash - 1 MHz, FLLPLL - None, REF - 2 MHz IRC)

Max: 5.51 mA (excluding peripherals) (MCG - HIRC 48 MHz, SystemCore - 48 MHz, BusFlash - 24 MHz, FLLPLL - None, REF - 48 MHz IRC)

Description

- Default mode out of reset.
- On-chip voltage regulator is on.

Can enter from: Run, VLPR, Wait, VLPW, Stop (in 7.5 μ s), VLPS (in 7.5 μ s), LLS (in 7.5 μ s), VLLS3 (in 93 μ s), VLLS1 (in 152 μ s), VLLS0 (in 152 μ s)

Can exit to: Run, VLPR, Wait, VLPW, Stop, VLPS, LLS, VLLS3, VLLS1, VLLS0

Available Peripherals

16-bit ADC

CMP & 6-bit DAC CRC

FlexIO I2C0 I2C1 LPTMR

LPUART0 LPUART1

MCGIRCLK MCGPCLK PIT

RTC SPI0 SPI1 TPM0

TPM1 TPM2 UART2 USB

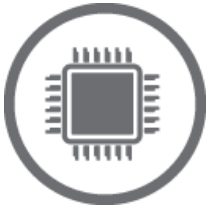
VREF

Power Profile

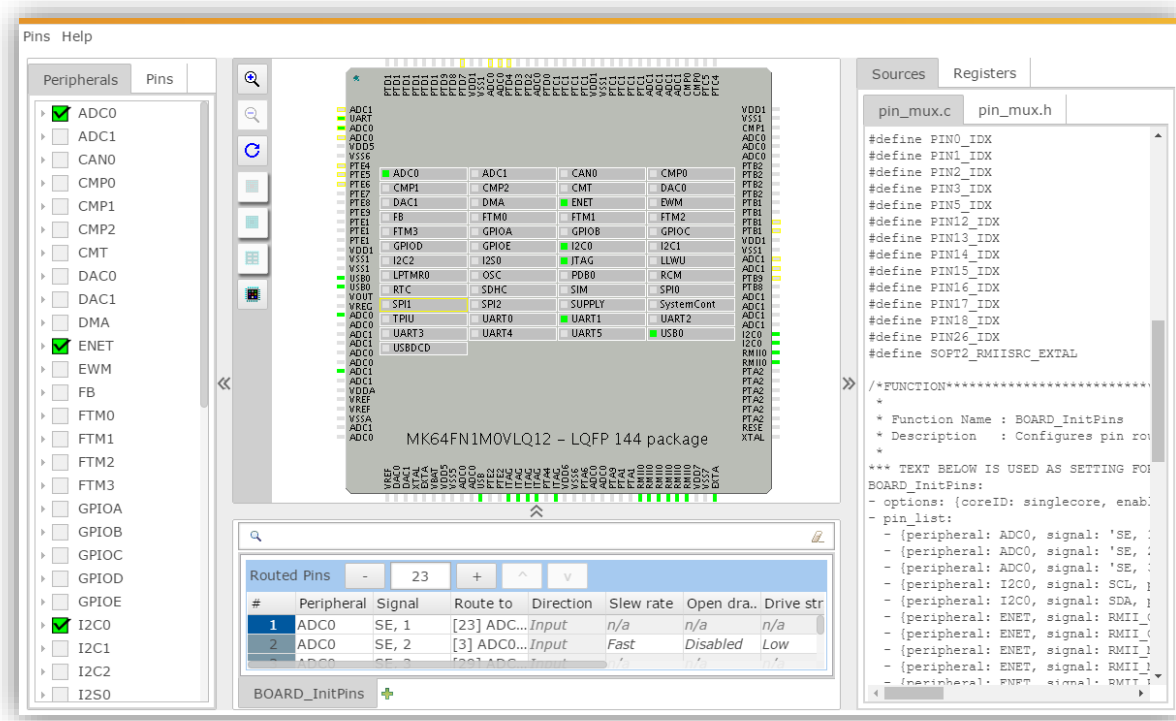
State	Name	Duration	Power Mode	MCG	Syste...	BusFla...	FLLPLL	REF	Additi...	Consu...	Active ...
1	Run_D...	10 μ s (0%)	Run	LIR...	8 MHz	4 MHz	None	8 MH...	0 μ A	1.6 mA	1/21
2	Run F...	3 ms (0.03%)	Run	HL...	48 MHz	24 MHz	None	48 M...	0 μ A	6.46 mA	4/21
3	VLLS1...	5 s (49.97%)	VLLS1	OFF	OFF	OFF	OFF	OFF	0 μ A	1.34 μ A	1/3
4	Run_D...	10 μ s (0%)	Run	LIR...	8 MHz	4 MHz	None	8 MH...	0 μ A	1.6 mA	1/21
5	Run F...	3 ms (0.03%)	Run	HL...	48 MHz	24 MHz	None	48 M...	0 μ A	6.46 mA	4/21
6	VLLS1...	5 s (49.97%)	VLLS1	OFF	OFF	OFF	OFF	OFF	0 μ A	1.34 μ A	1/3

Cycle time: 10 s 6.02 ms Average consumption: 5.21 μ A **4 years 253 days***

Kinetis Expert Pins Tool



Easy-to-use muxing and pin assignments for Kinetis MCU's



Product Features:

- Part of the Kinetis Expert suite of system configuration tools
- Online and Desktop editions released in May 2016
- Muxing and pin configuration with consistency checking
- ANSI-C configuration code
- Kinetis SDK support
- Graphical processor package view
- Multiple configuration blocks/functions
- Wizard for optimized assignments of functionality to available pins
 - Selection of Pins and Peripherals
 - Package with IP blocks
 - Routed pins with electrical characteristics
 - Registers with configured and reset values
 - Source code for C/C++ applications
- Documented and easy to understand source code
- Report generation
- Integrates with any compiler and IDE



Kinetis Expert Clocks Tool

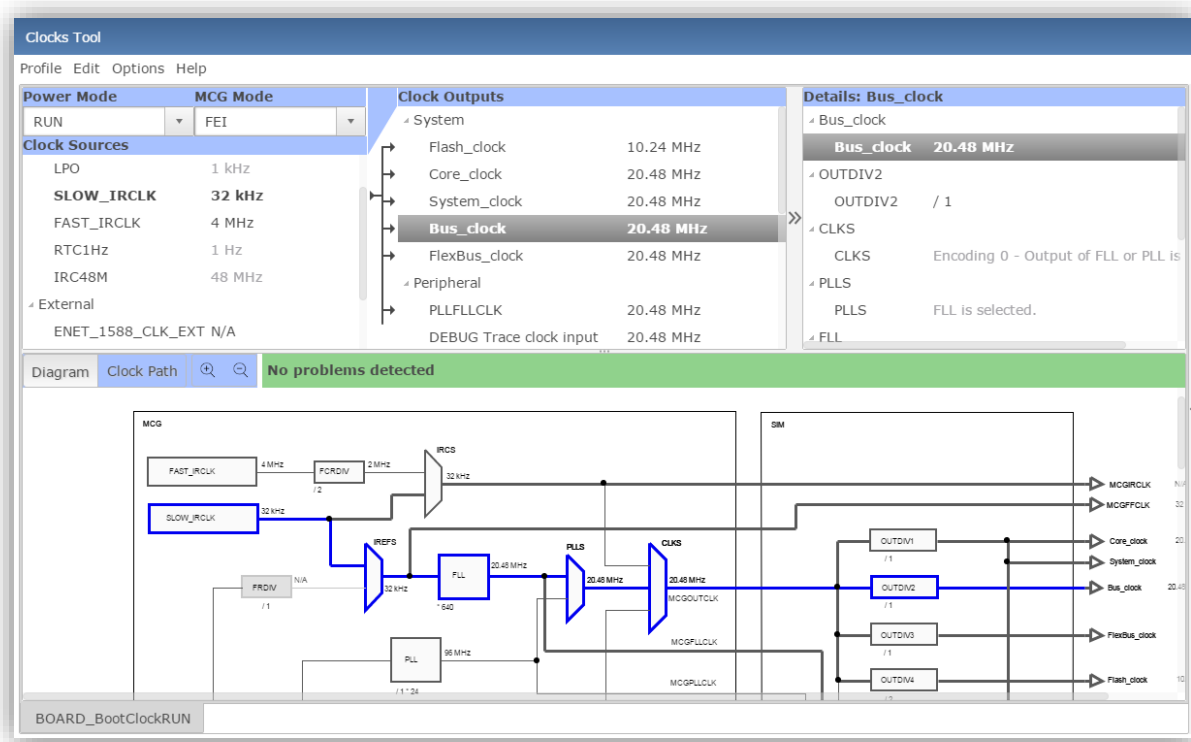


Easy-to-use clock configuration for Kinetis MCU's

Coming Soon

Product Features:

- Part of the Kinetis Expert system configuration tools
- Online and Desktop editions planned for release in **July 2016**
- System clock configuration with consistency checking
- ANSI-C initialization code
- Kinetis SDK v2 support
- Graphical clock diagrams
- Multiple configuration blocks/functions
 - Selection of Clock Sources
 - Configuration of prescalers and clock outputs
 - Details and Full Diagram views with clock path
 - Registers with configured and reset values
 - Source code for C/C++ applications
- Documented and easy to understand source code
- Report generation
- Integrates with any compiler and IDE



Clock Tool – Desktop version....

The screenshot displays the NXP Clock Tool interface for configuring the BOARD_BootClockRUN. The main window is titled '*Clocks - MK64FX512xxx12.mex (MK64FX512xxx12)'. The interface is divided into several panes:

- Power Mode:** RUN
- MCG Mode:** PEE (PLL Engaged Ex)
- Clock Sources:** A tree view showing internal and external sources. The 'OSC (System Oscillator)' is selected with a frequency of 8 MHz.
- Clock Outputs:** A table listing various system and peripheral clocks. The 'Flash clock' is highlighted with a frequency of 24 MHz.
- Details: Flash_clock:** A table showing parameters for the selected output, such as 'Flash clock' (24 MHz), 'FLASHCLK output of SIM', and 'OUTDIV4' (1/5).
- Diagram:** A block diagram showing the clock path from the MCG (Microcontroller Generator) through various dividers and PLLs to the SIM (System Integration Module). The path includes components like FCRDIV, FLL, PLL, CLKS, and OUTDIV1-4.
- Code Editor:** Displays the generated C code for the BOARD_BootClockRUN configuration, including constants for clock configuration and the main configuration function.

The code editor shows the following C code:

```

clock_config.h clock_config.c
const sim_clock_config_t simConfig_BOARD_BootClockRUN =
{
    .pllFllSel = 1U, /* PLLFLLSEL select */
    .er32kSrc = 0U, /* ERCLK32K selection */
    .clkdiv1 = 0x124000U, /* SIM_CLKDIV1 */
};
const osc_config_t oscConfig_BOARD_BootClockRUN =
{
    .freq = 8000000U, /* Oscillator frequency */
    .capLoad = 0x0U, /* Oscillator capacity load */
    .workMode = kOSC_ModeOscLowPower, /* Oscillator low power */
    .oscerConfig =
    {
        .enableMode = OSC_ER_CLK_DISABLE, /* Disable external referen
    };
}

/*****
 * Code for BOARD_BootClockRUN configuration
 *****/
void BOARD_BootClockRUN(void)
{
    CLOCK_SetSimSafeDivs();

    CLOCK_InitOsc0(&oscConfig_BOARD_BootClockRUN);
    CLOCK_SetXtal0Freq(BOARD_XTAL0_CLK_HZ);

    CLOCK_BootToPeeMode(mcgConfig_BOARD_BootClockRUN.oscSel, kMCG_PllClkSelP1
        &mcgConfig_BOARD_BootClockRUN.pll0Config);

    CLOCK_SetInternalRefClkConfig(mcgConfig_BOARD_BootClockRUN.irc1kEnableMod
        mcgConfig_BOARD_BootClockRUN.ircs, mcgConfi

    CLOCK_SetSimConfig(&simConfig_BOARD_BootClockRUN);

    CLOCK_EnableUsbfs0Clock(BOARD_BOOTCLOCKRUN_SIM_USB_SRC_SEL, BOARD_BOOTCLO

    SystemCoreClock = BOARD_BOOTCLOCKRUN_CORE_CLOCK;
}
    
```

At the bottom of the code editor, a status message reads: "Code successfully generated."



Kinetis SDK Technical Overview

Agenda:

- Kinetis Expert Tools Overview
- Kinetis Expert Tool Details
 - Configurations...
 - Power Estimation tool demo
 - Pins tool demo
 - Clocks tool demo
 - **SDK Builder demo**
- Question & Answer

KINETIS EXPERT SDK BUILDER




Kinetis Expert Tool – Build SDK


1. SDK Builder page
2. Shows configuration
3. Select optional items
4. Select the configuration options for RTOS, Host OS, toolchain, SDK version, and a unique package name
5. Then click on “Build SDK Package” button

The screenshot displays the NXP Kinetis Expert SDK Builder interface. The top navigation bar includes the NXP logo, 'Kinetis Expert', and a dropdown menu for 'MyController (FRDM-K64F)'. The main content area is titled 'Kinetis SDK' and shows a list of included components: Kinetis MCU platform support, Demo applications and driver examples, FatFS FAT file system, USB stack - host, device, OTG, MIP TCP/IP networking stack, and Documentation - SDK API reference manual and user guides. To the right, there are optional items: FreeRTOS (checked), μC/OS-II (unchecked), and μC/OS-III (unchecked). Below this, a message states: 'Your custom version of the Kinetis SDK is now ready to be packaged! Click the button below to complete the process.' A form contains fields for 'Package name' (SDK_2.0_FRDM-K64F), 'SDK version' (SDK 2.0), 'Supported toolchain(s)' (Kinetis Design Studio), and 'Host OS' (Windows). A prominent orange 'Build SDK Package' button is located below the form. The interface also shows a sidebar with board information for the FRDM-K64F, including device details (MK64FN1M0VLL12), core type (Cortex-M4F), memory size (1024 KB Flash, 256 KB RAM), and maximum CPU frequency (120 MHz). A 'Build SDK Package' button is also visible in the sidebar area.

Kinetis Expert Tool – Package Generation

- System may take some time to generate a package. Some configurations are pre-cached, but some may need to be generated
 - Generally takes about 5 minutes

[Build SDK Package](#) [SDK API Documentation v2.0](#) 

Building! In general, SDK builds should complete within a few minutes. However, depending on the complexity of the configuration and bandwidth of the build system, specific build may take up to 30 minutes to complete. 



Kinetis Expert Tool – Software Vault

- Once package is available for download, it will be found under the “Software Vault” tab
- Download package by clicking on the Download icon.

NXP Kinetis Expert FRDM-K64F (FRDM-K64F) English Anthony

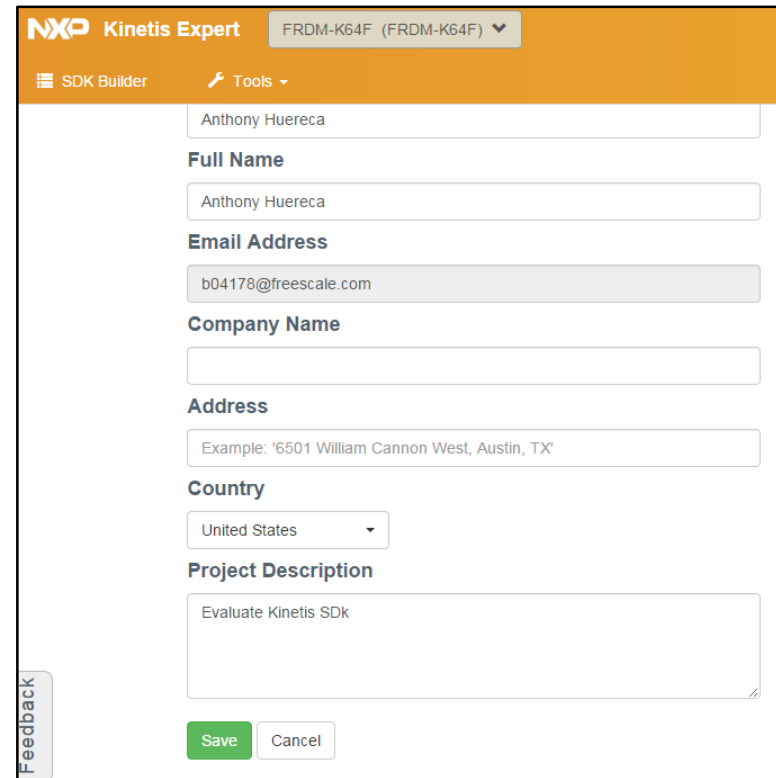
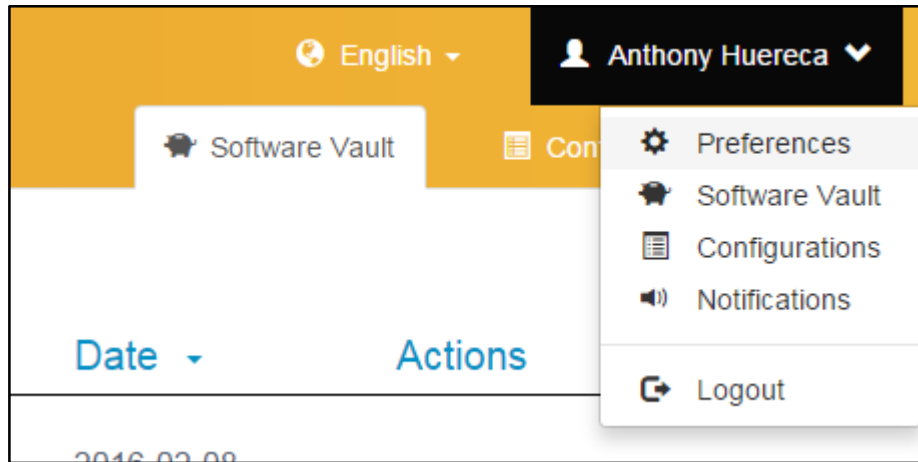
SDK Builder Tools **Software Vault** Configuration

File Vault

Name	Configuration	Date	Actions
 SDK_2.0_FRDM-K64F Board: FRDM-K64F, SDK version: KSDK 2.0.0, OS: Windows, Toolchain: ALL, Selected optional items: FreeRTOS (109MB)	FRDM-K64F	2016-02-08 06:44 AM GMT	

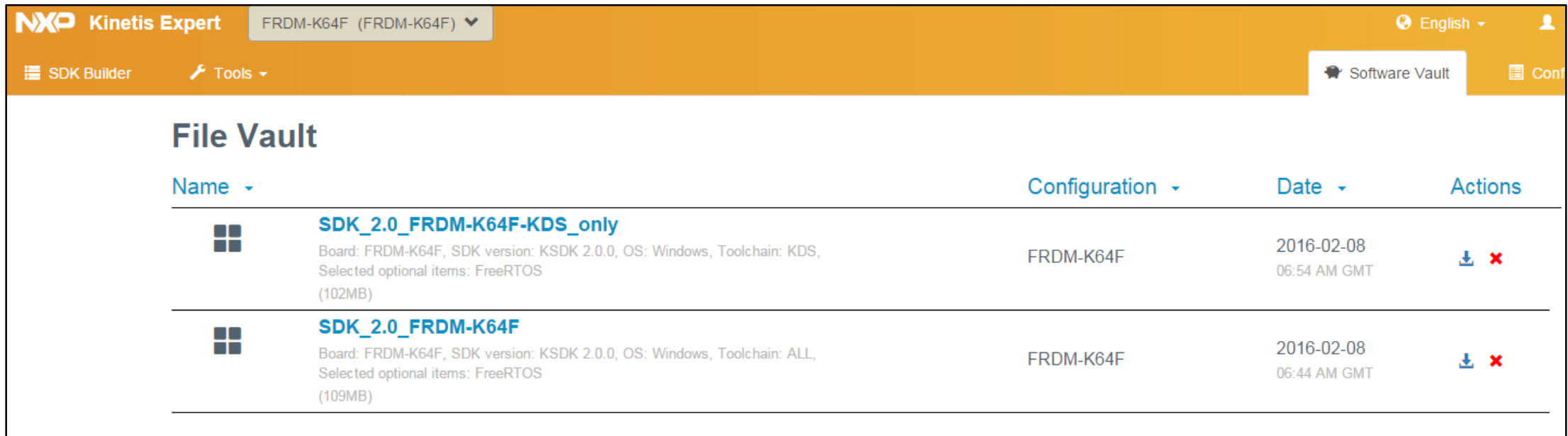
Kinetis Expert Tool – Download Link

- If the download icon is grayed out, you may need to set the Project Description filed in your preferences.
 - There will be a link, or you can access it by clicking on your name in the upper right hand corner
 - Fill out Project Description and hit Save. Then go back to the Software Vault to download









Kinetis Expert Tool – Multiple Packages

- You can go back to the SDK Builder tab to create other packages. These new packages will show up under the Software Vault
 - In this example, I've created another package that only includes KDS projects



The screenshot shows the NXP Kinetis Expert Software Vault interface. The top navigation bar includes the NXP logo, 'Kinetis Expert', a dropdown menu for 'FRDM-K64F (FRDM-K64F)', and language settings for 'English'. Below the navigation bar, there are tabs for 'SDK Builder', 'Tools', 'Software Vault', and 'Conf'. The main content area is titled 'File Vault' and displays a table of software packages.

Name	Configuration	Date	Actions
 SDK_2.0_FRDM-K64F-KDS_only Board: FRDM-K64F, SDK version: KSDK 2.0.0, OS: Windows, Toolchain: KDS, Selected optional items: FreeRTOS (102MB)	FRDM-K64F	2016-02-08 06:54 AM GMT	 
 SDK_2.0_FRDM-K64F Board: FRDM-K64F, SDK version: KSDK 2.0.0, OS: Windows, Toolchain: ALL, Selected optional items: FreeRTOS (109MB)	FRDM-K64F	2016-02-08 06:44 AM GMT	 



Kinetis SDK Technical Overview

Agenda:

- Kinetis Expert Tools Overview
- Kinetis Expert Tool Details
 - Configurations...
 - Power Estimation tool demo
 - Pins tool demo
 - Clocks tool demo
 - SDK Builder demo
- Question & Answer

QUESTIONS?





SECURE CONNECTIONS
FOR A SMARTER WORLD