IoT Sensing SDK Getting started with IoT Sensing SDK (ISSDK) middleware

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User guide

Document information

Information	Content
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Abstract	Getting started with IoT Sensing SDK (ISSDK) v1.8 middleware



Getting started with IoT Sensing SDK (ISSDK) middleware

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Getting started with IoT Sensing SDK (ISSDK) middleware

1 Prerequisites

This document assumes completion of the following prerequisites prior to attempting to use the ISSDK v1.8 middleware:

- One of the recommended IDEs is installed on the development PC (see the release notes)
- A FRDM-K22F-A8974 sensor kit is connected to the development PC
- User understanding of the debug environment set up for the Freedom family of development boards using OpenSDA or third-party debugger with their IDE of choice
- User familiarity with the MCUXpresso SDK and MCUXpresso SDK Builder

2 Overview

The IoT Sensing Software Development Kit (ISSDK) is the embedded software framework that enables the NXP digital and analog sensors platforms for IoT applications. ISSDK provides a unified set of sensor support models that target the NXP portfolio of sensors across a broad range of Arm Cortex core-based Microcontrollers. ISSDK is offered as a middleware component in MCUXpresso SDK for supported microcontrollers. ISSDK relies on the SDK 2.x drivers and project release infrastructure to create a unified user experience. ISSDK v1.8 combines a set of robust sensor drivers and algorithms along with example applications to allow a user to get started using NXP sensors quickly.

For more information on ISSDK, go to <u>www.nxp.com/iotsensingsdk</u>.

2.1 ISSDK architecture

Figure 1 shows the high-level *layer cake* architecture of the ISSDK v1.8 middleware. ISSDK is designed to provide separable layers of functionality that a customer can choose to use or ignore based on their specific needs. In addition, the ISSDK architecture is portable due to the use of open APIs (ARM Ltd. CMSIS Driver APIs). ISSDK is designed to allow users to start with the smallest production footprint (memory and CPU load) as is practical for their particular application. Typically, the smallest production footprint is achieved by selecting the Bare Metal option; however, some applications may prefer using one of the RTOSs supplied with MCUXpresso SDK 2.x.

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In the following sections, this guide focuses on how ISSDK can be deployed via MCUXpresso for a specific Freedom Sensor Toolbox sensor demonstration kit called the FRDM-K22F-A8974. This kit combines the Kinetis FRDM-K22F development board with an FRDM-STBI-A8974 sensor shield to provide a standalone, low-cost sensor development platform.

3 NXP Freedom Sensor Toolbox Sensor Development Ecosystem

NXP provides a sensor development ecosystem called the Freedom Sensor Toolbox. This ecosystem is designed to provide solutions for hardware and software that enable customers to evaluate and prototype with sensors quickly and easily. ISSDK v1.8 is deployed on top of the Freedom Sensor Toolbox hardware platforms and is expected to become the embedded software support platform for the ecosystem.

The following figure shows how the Freedom Sensor Toolbox development hardware can be used to explore the ISSDK v1.8 software. In this example, the MCUXpresso IDE is used to compile, load, and launch an existing project into the FRDM-K22F-A8974 kit. The customer may then launch a terminal emulator to examine the debug console output provided for many ISSDK v1.8 projects.

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Figure 2. Freedom Sensor Toolbox development environment

More information about the Freedom Sensor Toolbox development ecosystem can be found at http://nxp.com/sensortoolbox. The remainder of this document focuses on the steps involved in using the FRDM-K22F-A8974 development kit with the ISSDK enablement software.

Project deployment 4

ISSDK v1.8 is fully integrated into the MCUXpresso SDK Builder delivery system. MCUXpresso includes both cloud and locally based tools to collect and build projects from the MCUXpresso SDK repositories, MCUXpresso SDK 2.x is built using a hierarchy of deployed Git repositories. Specific project codebases are built through the online tool. A given codebase is specified by its target (device, board, or kit desired), the version of MCUXpresso SDK 2.x, the supported IDEs (MCUXpresso IDE, IAR, Keil, GCC), and the target Host OS (Windows, Mac, or Linux).

4.1 MCUXpresso SDK Builder

MCUXpresso SDK Builder is a cloud-based system used to build MCUXpresso SDK 2.x packages. ISSDK is an optional component that can be deployed by MCUXpresso in two ways:

- If the customer selects a FRDM sensor kit, such as the FRDM-K22F-A8974, then the ISSDK sensor drivers and example applications appropriate for that kit are deployed into the package.
- If the customer selects a supported device or FRDM board and checks the box for optional ISSDK support, then all the sensor drivers and example applications are deployed into the package.

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Note, in both cases, the MCUXpresso SDK 2.x drivers and example applications are also deployed alongside the ISSDK files.

Figure 3 shows the MCUXpresso environment for deploying ISSDK (see https://mcuxpresso.nxp.com/en/configuration-settings). In this example, the customer has selected the FRDM-K22F-A8974 kit, the MCUXpresso IDE, and Windows host operating system. Notice that ISSDK middleware component has been selected by default because the target is a board/shield kit. When the customer selects the Build SDK Package, the request is sent to the build servers. Requests for packages are served in order and when the package is ready, a notification is returned to the customer. The customer may download the package (a zip file) and deploy it into their local system.

Buil Generat Develope Selections	d SDK for FRDM-H e a downloadable SDK archive for u r Environment Settings here will impact files and examples projects inc	K22F-A8974 use with desktop MCUXpres uuded in the SDK and Generated Proj	so Tools. eets	
	Host OS	Toolchain / I	DE KEL CONTRACTOR	SDK 2.12.0 (released 2022-06- Version SDK Tag REL_2.12.0_MAJOR_RF
Searc	h		Q	UNSELECT ALL
	Name	Category	Description	Dependencies
	Nxp iot sensing sdk	Middleware	IoT Sensing SDK (ISSDK) provides sensor drivers and referenc (more)	<u> </u>
	SDMMC Stack	Middleware	Stack supporting SD, MMC, SDIO	
	CMSIS DSP Library	CMSIS DSP Lib	CMSIS DSP Software Library	
	emWin	Middleware	emWin graphics library	
	Fatfs	Middleware	FAT File System stack	
	FreeMASTER	Middleware	FreeMASTER communication driver for 32bit platforms	
	LVGL	Middleware	LVGL Open Source Graphics Library	•
Figui	re 3. MCUXpress	o SDK Builder	webpage	aaa-047113

4.2 Deployment directory structure

Once the MCUXpresso package has been downloaded, the user can extract the package on their local machine. Figure 4 displays the MCUXpresso directory structure.

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Name	Туре
boards	File folder
CMSIS	File folder
components	File folder
📜 devices	File folder
📜 docs	File folder
📜 middleware	File folder
📜 tools	File folder
COPYING-BSD-3	File
FRDM-K22F-A8974_mar	nifest_v3_10 XML Document
KA_OPT_NXP_Software_	License RTA TXT File
MFC_SLDA	Adobe Acrobat Document
SW-Content-Register	TXT File
	aaa-047114

The CMSIS, devices, docs, RTOS, and tools directories are unchanged from standard MCUXpresso SDK 2.x deployments. ISSDK v1.8 projects appear as new targets in the boards directory. Figure 5 illustrates the directory where frdmk22f_a8974 (ISSDK) reference example projects are available, as well as the base projects for the frdmk64f.



In addition, a new middleware component is created that contains the ISSDK drivers, algorithms, and other support files as shown in <u>Figure 6</u>.

Name	Туре
J freemaster	File folder
🧵 issdk	File folder
📜 rtcesl	File folder
🣜 sdmmc	File folder
middleware_baremetal_MK22F512	CMAKE File
	aaa-047116
Figure 6. Middleware components available as par	t of SDK package

5 Build and run a sensor driver example

Choose FRDM-K22F-A8974 kit configuration and download SDK package from MCUXpresso SDK Builder. Figure 7 and Figure 8 illustrate how to get the FRDM-K22F-A8974 SDK package from MCUXpresso configuration.

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Figure 7. FRDM-K22F-A8974 kit configuration and SDK package download

Install downloaded SDK package into MCUXpresso IDE (drag and drop SDK package into "Installed SDKs" view). Start SDK import wizard, import any existing ISSDK example by choosing frdmk64_agm01 board for your project, build the imported project and load the image to FRDM-K22F-A8974 kit. These actions create a standalone project in your workspace. See Figure 8.

NXP Semiconductors

IoT Sensing SDK

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E 😿 A I	
There are no projects in your workspace. To add a project:	
Create a new MCUXpresso IDE C/C++ project.	
in <u>Create a project</u>	Home Overview What's New First Steps Web Resources Documentation IDE
	Welcome to MCUXpresso IDE
	MCUXpresso IDE provides an easy-to- use Eclipse-based development
	ARM Cortex-M cores, including LPC and Kinetis microcontrollers and LMX RT
	editing, compiling, and debugging
	specific debugging views, code trace
	In the last continuation track
MCUXpresso IDE - Quickstart/Pa	anel
No project selected Create or import a project	Installed SDKs To install an SDK, simply drag and drop an SDK (bit pfleyfolder) or an SDK (bit repository into the Installed SDK' view. [Common 'mcwpress,
New project	Installed SDIG: Available Boards, Available Devices V FRDM-K22F-A8974 10.0 Name SDK Version Manifest Version Location V Examples
 Import project(s) from file system. Build your project 	B SDK_2xr,FR0M-K22F 2110 (SH 2022-01-3.9.9) Common \SDK_2,110,FR0M-K22F abget SDK_2xr,FR0M-K22F abget 2110 (Sbep147) 38.0 Common \SDK_2,110,FR0M-K22F abget 323 (strand-310) 33.0 Common \SDK_2,110,FR0M-K22F abget 22F abget(strand-stran
Build	Image: Start Control C
Debug your	L11.0_LPCXPRESSOSS16-, > 0 Totchains 0 Totchains Settings > 0 Concornents
Debu ① Importing project(s) for device: N	MK22FN512cos12 using board: FRDM-K22F-A8974
SDK MCUs 8 A	selection page
MCUs from installed SDKs. Please click above or visit	Rese select an available board for your project.
additional SDKs.	
V K2x MK22FN512xxx12	
> KE1x > LPC550x_50x	(adaptive)
Selected Device: MK22FN512xxx1	12 using board: FRDM-K22F-A8974 SDKs for selected MCU
Target Core: cm4 Description: Kinetis K22-120 M	Hz, Cost Effective, Full-Speed US8 America SDK Versi. Manifest. Location WESDK 2x FEDM-H22F- 21/20 (dsta 3:100
	S SDK Import Wizard
	▲ You have selected 1 project to import: Temfa224,8974_fnis9774cf.interupt?. The source from the SDV will be copied into the workspace. If you want to use linked files, olease untio the SDV 2x FRDM-022F.
	You have selected 1 project to import: Traini221_8874_fix18874c1 interrupt: The source from the SDK will be copied into the workspace. If you want to use linked files, please unzip the SDK_2x_fRDM-Id22F- Import projects
	Vou Nave selected 1 project to import: Ndm2221_88974d_this8974d_intempt: The source from the SDK will be copied into the workspace. If you want to use linked files, please untip the SDK_2X_FRDM-4227- import projects Project name perfits. If indm224.88974
	Nou have selected 1 project to import: Indim221,48744, 56488744, 564888744, 564888744, 5648888744, 56488888944, 56488889446, 56688888944
	Not have selected 1 project to import: Tradmozd, 48774, 5648744, 56487
	Not have selected 1 project to import Tedmo224,89744,56887464.jetempic: Decomposition to SDK will be copied into the workspace if you want to use linked files; please wantp the SDK 2x FRDM-4225. Import projects Project class? Project class? Project class? Import projects Project class? Project class? Project class? Import projects Project class? Project Class? Project class? Import projects Project class? Import project Project class? Import project Project class? Import project Class? Project Class? Project class? Import object? Project
	Not have reflected 1 project to import. Tridm222,48774,54887746,14887748,14887748,14887746,14887746,14887746,14887746,1488774
	but are stretched 1 project to import. TudmA22,4874.5,64874.6,148774.6,148774.6,148774.6,148774.6,148774.6,148774.6,148774.6,148774.6,148774.6,148774.6,148774.6,148774.6,14874.6

Notice that the code is ready to start in the file *fxls8974cf_interrupt.c*, which is the main application for this example.

Start the program execution. The blue LED begins to flash on the FRDM-K22F board.

Next, start a terminal emulation program with the serial port set as shown in Figure 9.

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Display Port Capture Pins Send Echo Port I2C I	2C-2 I2CMisc Misc	<u>\n</u> Clear	Freeze	<u> </u>
Display Port Capture Pins Send Echo Port 12C 1 Baud 115200 • Port 3 • Open Parity Data Bits • 1 bit • 2 bits © None © ATS/CTS © Space • 5 bits © DTR/DSR © RS485rts	2C-2 I 2DMisc Misc Spy Change wate Flow Control ansmit Xoff Char: 19 Winsock is: C Raw C Teinet	<u>in</u> <u>Clear</u>	Status Con RXU TXU DCI DSF Bing Erro	a mected (2) (2) (3) (3) (8) (1) (3) (6) (9) (4) (4) (4) (5) (6) (9) (5) (6) (9) (6) (7) (6) (7) (7) (7) (7) (7) (7) (7) (7

Figure 9. Terminal emulation program with serial port set

Figure 10 displays the debug console window and output.

늘 RealTerm: Serial Capture Program 2.0.0.57 ISSDK FXLS8974 sensor driver example demonstration with interrupt mode Successfully Initialized Timandra with WHO_AM_I = 0x86 Successfully Applied FXLS8974 Sensor Configuration 81 Y= 38 Z= 1071 -20 Y= -35 Z= 1075 -16 Y= -20 Z= 1090 -24 Y= -24 Z= 1082 -24 Y= -31 Z= 1094 -20 Y= -31 Z= 1094 -20 Y= -16 Z= 1079 -24 Z= 1086 Υ = -16 Z= 1086 -8 Z= 1079 3 Υ = -8 Y= -31 Z= 1082 aaa-047120

Figure 10. Debug console output

In this example, each data ready interrupt from the FXLS8974CF triggers the application to read the raw X-, Y-, Z-axis accelerometer values.

6 Build and run pedometer algorithm example

ISSDK also provides reference pedometer algorithm example using NXP accelerometers. The example demonstrates configuration of all registers required to use the sensor as the acceleration source for the pedometer. Pedometer algorithm measures step counts based on fxls8974cf accelerometer data.

In order to build and run the pedometer algorithm example, click the SDK import wizard and import ISSDK pedometer algorithm example by choosing the frdmk22f_a8974 board

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for your project. The SDK import wizard and the imported ISSDK pedometer algorithm create a standalone project in your workspace. See <u>Figure 11</u>.

Minport projects	
Project name prefix: frdmk22f_a8974	× Project name suffix:
Use default location	
Location: C:\Users\nxa11926\Documents\MCUXpressolDE_11.6.0_8152_e	ear2\Gemini\frdmk22f_a8974 Browse.
Project Type	Project Options
C Project C++ Project C Static Library C++ Static Library	SDK Debug Console ○ Semihost UART ○ Example default Copy sources Import other files
Examples	🖮 🖂 🔆 🗎 🖬 🖪
type to filter	
Name	Description Version
✓ ✓	The pedometer example implements the ISSDK FXLS8974CF sensor driv The FXLS8974CF FreMASTER example implements FreeMASTER demo
Image: Stats8974cf_interrupt Image: Stats874cf_motion_wakeup Image: Stats874cf_poll Image: Stats8974cf_spi	The FXLS8974CF Interrupt example application demonstrates the use of The FXLS8974CF motion wakeup example demonstrated SDCD block c The FXLS8974CF POLL example application demonstrates the use of the The FXLS8974CF POLL example application demonstrates the use of the
<pre>☐ ■ fxis8974cf_interrupt ☐ ■ fxis8974cf_motion_wakeup ☐ ■ fxis8974cf_poll ☐ ■ fxis8974cf_spi</pre>	The FXLS8974CF Interrupt example application demonstrates the use of The FXLS8974CF motion wakeup example demonstrated SDCD block c The FXLS8974CF POLL example application demonstrates the use of the The FXLS8974CF POLL example application demonstrates the use of the

Figure 11. SDK import wizard for pedometer project

Build the pedometer algorithm project in the MCUXpresso IDE and load the image to FRDM-K22F-A8974 kit. See Figure 12.

rdmk22f_a8974_fxls8974cf_interrupt	MCUXpresso IDE v11.6.0
rdmk22f_a8974_pedometer_a8974 <debug></debug>	
29 board	Home Overview What's New First Steps Web Resources Documentation IDE
cmsis_driver component	
a device	Welcome to MCUXpresso IDE
B drivers B golo_driver B interfaces B libs B pedometer B sensors	MCUXpresso IDE provides an easy-to- use Eclipse-based development environment for NXP MCUS based on ARM Cortex-M cores, including LPC and Kinetis microcontrollers and LNX RT crossover processors. It offers advanced
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ckstart Panel × 👓 Variables 💁 Breakpoints 😁	O 10 Installed SDKs I Properties Problems Console X 7 Terminal intege Info R Debugger Console S Offline Peripherals
MCUXpresso IDE - Quickstart Panel Project: frdmk22f_a8974_pedometer_a8974 (Debug)	へ DT Build Console (Indmi22f a8974.pedometer_a8974) UT Build Console (Indmi22f a8974.pedometer_a8974) unvocung: T-NO Lunker
ate or import a project	prm-none-eabi-gcc -nostdib -L"C:Ubsers\nxal192b\Documents\KUXpressolDE_11.6.0_8152_ear2\Gemini\trdmk22t_a89/A_pedometer_a89/A\libs femory region Used Size Region Size Kage Used
Kew project	PROGRAM_FLASH: 42548 B 512 KB 8.12%
Import SDK example(s)	SHAP_UPPER: 10558 B G4 KB 10-387 SRAP_UPPER: 0 GB G4 KB 0,00%
Import project(s) from file system	Finished building target: frdmk22f_a8974_pedometer_a8974.axf
d your project	Performing post-build steps
≪ Build ✓ Clean	<pre>mm-nome-abi-size "frdmk22f_a8974_pedometer_a8974.axf"; # arm-none-sabi-objcopy -v -0 binary "frdmk22f_a8974_pedometer_a8974.axf" " text data bss dec hex filename 42476 72 18796 33244 d080 frdmk22f a8974 pedometer a8974.axf</pre>
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Start the program execution. The green LED begins to flash on the FRDM-K22F-A8974 board.

Next, start a terminal emulation program with the serial port set as shown in Figure 9.

When the pedometer algorithm example runs successfully, the step counts are printed to the terminal as shown in Figure 13.

Note: To get the step counts to change, walk with the board.



Figure 13. Serial capture program displaying step counts

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