**NXP Semiconductors**
User's Guide

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# FRDM-K32L2B3 Freedom Board

# Contents

# Chapter 1
# Overview

The FRDM-K32L2B3 Freedom board is designed to work in a stand-alone mode or as the main board of the Arduino boards. The FRDM-K32L2B3 is a modular development platform that enables rapid prototyping and tool reuse through reconfigurable hardware.

# Chapter 2
# FRDM-K32L2B3 features

The FRDM-K32L2B3 supports the following features:

- MK32L2B31VLH0A MCU (Arm® Cortex®-M0+ core, 48-MHz clock, up to 256 KB of Flash, 32 KB of RAM, 64LQFP package)
- I/O headers for easy access to MCU I/O pins
- Compatible with Arduino boards
- On-board debug circuit: MK20DX128VFM5 (OpenSDA) with a virtual serial port
- NXP inertial sensor FXOS8700CQ
- Reset button and two user buttons
- 2 user LEDs
- Four-digit segment LCD module
- Dual-role USB interface with a micro USB connector

# Chapter 3
# Get to know the FRDM-K32L2B3

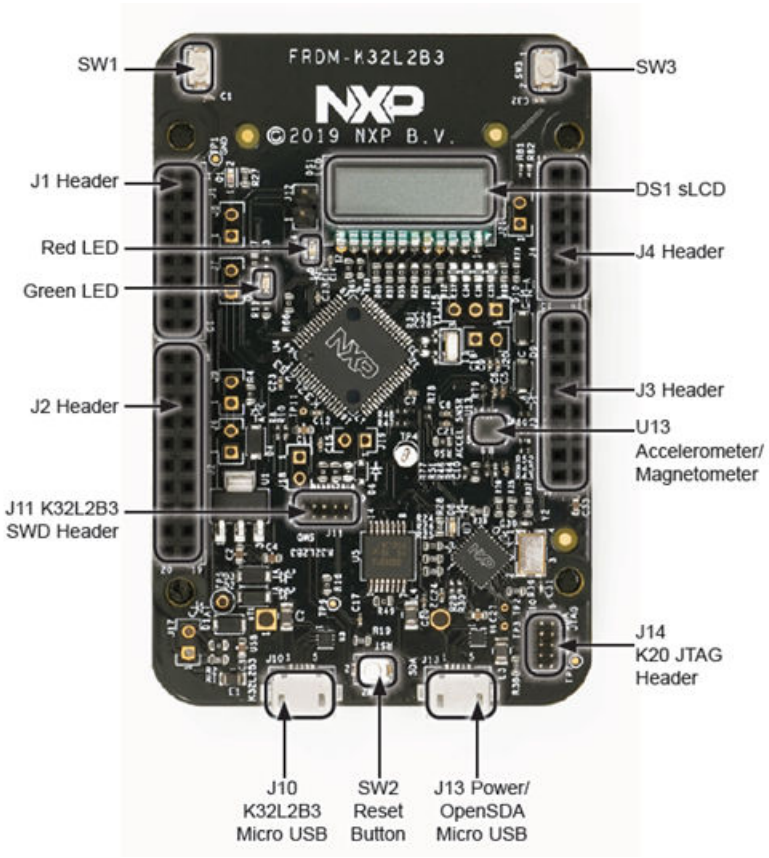


**Figure 1. FRDM-K32L2B3 top side**

The FRDM-K32L2B3 features two MCUs: the target MCU and the serial and debug adapter (OpenSDA) MCU. The target MCU is a K32 L series family device (K32L2B31VLH0A). The OpenSDA MCU is a Kinetis K series K20 family device (MK20DX128VFM5).

# Chapter 4
# References

The documents listed below should be referenced for more information on the K32 L series, Freedom System, and MCU modules. These can be found in the documentation section at www.nxp.com/FRDM-K32L2B3.

- FRDM-K32L2B3-SCH (schematics)
- K32L2B3xRM (reference manual)
- Software package

# Chapter 5
# Hardware description

FRDM-K32L2B3 is a Freedom MCU module featuring the K32L2B3—a K32 L Series MCU in a 64 LQFP package. An on-board OpenSDA debug circuit provides the Serial Wire Debug (SWD) interface and a power supply input through a single micro-USB connector. The block diagram of the FRDM-K32L2B3 board is shown in Figure 2.

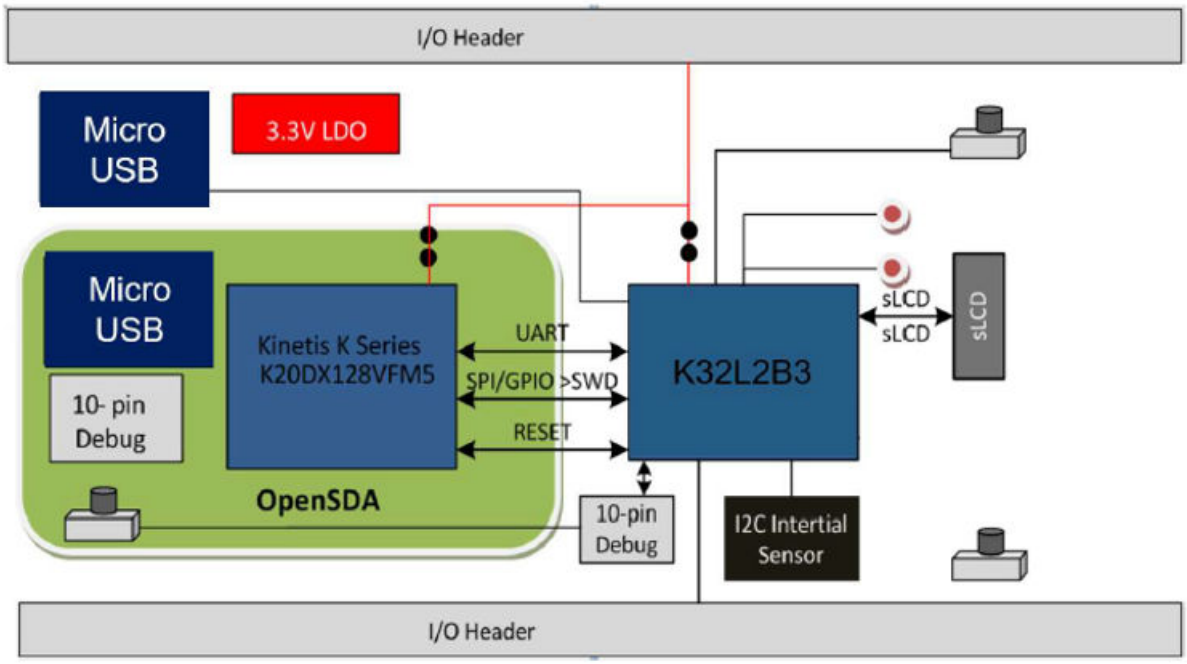


Figure 2. Block diagram of FRDM-K32L2B3

## 5.1 MCU

FRDM-K32L2B3 features the K32L2B31VLH0A MCU. This 48-MHz MCU is a part of the K32 L family and it is implemented in a 64 LQFP package. The features of the K32L2B31VLH0A MCU are as follows:

- 32-bit Arm Cortex-M0+ core, 48 MHz
- Memories
  - Up to 256 KB of flash
  - 32 KB of SRAM
- Clocks
  - Clock generation module with a High-frequency Internal Reference Clock (HIRC) of 48 MHz and two Low-frequency Internal Reference Clocks (LIRC) of 2 MHz and 8 MHz for the system and CPU clock generation
  - System oscillator supporting external crystals or resonators
  - Low-power 1-KHz RC oscillator for the RTC and COP watchdog
- Analog peripherals
  - 16-bit SAR ADC w/ DMA support

  - 12-bit DAC w/ DMA support
  - Two high-speed analog comparators (CMP) with internal 6-bit Digital-to-Analog Converters (DAC)
  - VREF 1.2 V voltage reference
- Connectivity and communications interfaces
  - Two 8-bit Serial Peripheral Interfaces (SPI)
  - USB FS device controller
  - USB voltage regulator
  - Two $I^2C$ modules
  - Two low-power UART modules (LPUART)
  - UART with an ISO7816 module
  - FlexIO module (with 8 pins/4 shifters/4 timers implemented)
- Timers
  - 6-channel Timer/PWM module
  - Two 2-channel Timer/PWM modules
  - 2-channel Periodic Interrupt Timer (PIT)
  - Real-Time Clock (RTC)
  - Low-Power Timer (LPT)
  - System tick timer
- Human-Machine Interface (HMI)
  - Segment LCD controller—the maximum segment is 8 x 28/4 x 32
  - General-purpose input/output controller clocking

The K32 L series MCU starts up from the internal 48-MHz HIRC by default. The software can enable the main external oscillator (EXTAL/XTAL) if desired. The external oscillator ranges from 4 MHz to 40 MHz. The 8-MHz oscillator is the default external source for the system and RTC clocks (respectively) on the FRDM-K32L2B3 board.

## 5.2 System power

FRDM-K32L2B3 is compatible with DC 5 V and 3.3 V power supplies, because the K32L2B3 MCU can work at voltages from 1.71 V to 3.6 V.

The main power source for the FRDM-K32L2B3 module is derived from the OpenSDA USB micro-B connector (J13). One low-dropout regulator provides a 3.3-V supply from the 5-V input voltage. Refer to the "POWER" page of the FRDM-K32L2B3 schematics for more details. The OpenSDA MK20DX128VFM5 is always powered by 3.3 V.

## 5.3 Debug interface

There are two debug interfaces provided: the on-board OpenSDA circuit and the external Arm Cortex SWD connector (J11). The ARM Cortex SWD connector is a standard 10-pin connector that provides an external debugger cable access to the SWD interface of the K32L2B31VLH0A. Alternatively, the on-board OpenSDA debug interface can be used to access the debug interface of the K32L2B31VLH0A.

## 5.4 OpenSDA

The on-board MK20DX128VFM5-based OpenSDA circuit provides a SWD debug interface to the K32L2B31VLH0A. A standard USB A male to micro-B male cable can be used for debugging via the USB connector (J13). The OpenSDA interface also provides a USB-to-serial bridge. The drivers for the OpenSDA interface are at the official NXP website. These drivers and more utilities

are at www.nxp.com/design/microcontrollers-developer-resources/ides-for-kinetis-mcus/opensda-serial-and-debug-adapter:OPENSDA.

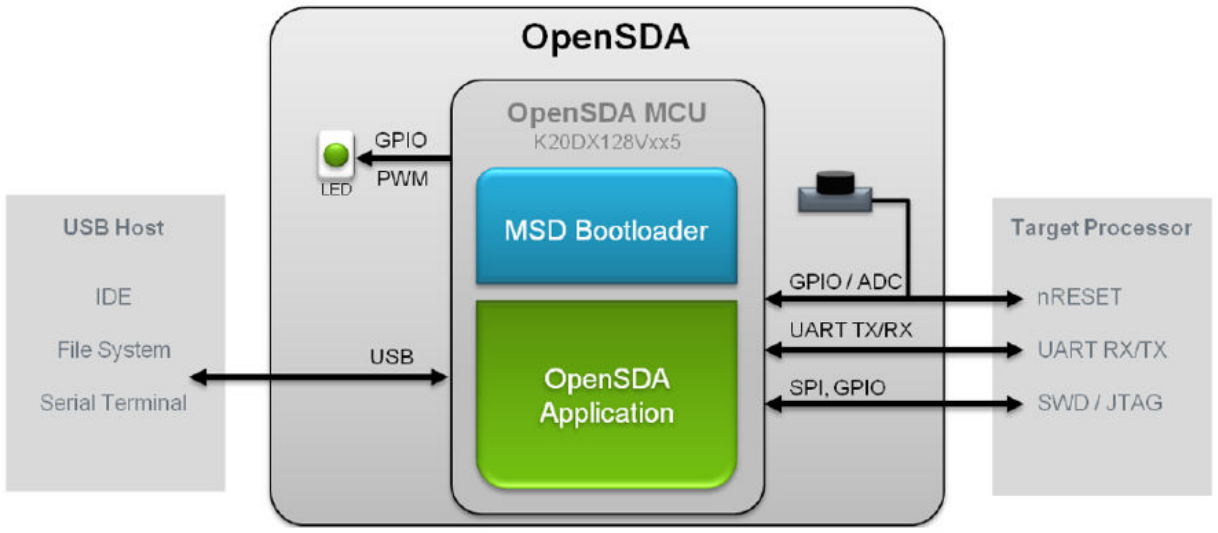


Figure 3. OpenSDA block diagram

## 5.5 Accelerometer and magnetometer

The FXOS8700CQ 6-axis digital sensor accelerometer and magnetometer is connected to the K32L2B31VLH0A MCU through an the $I^2C$ interface (I2C0) and GPIO/IRQ signals (PTE24 and PTE25).

## 5.6 Pushbuttons, visible light sensor, and LEDs

FRDM- K32L2B3 also features:

- Two push-button switches: SW1-PTA4 and SW3-PTC3
- Visible light sensor connected to the ADC input signals (ADC0_SE3/PTE22)
- Two LEDs

# Chapter 6
# FRDM-K32L2B3 jumper options and headers

FRDM-K32L2B3 jumper options and headers shows all jumper options on the FRDM-K32L2B3. The default installed jumper settings are indicated by in bold.

**Table 1. FRDM-K32L2B3 jumper options**

| Option | Jumper | Setting | Description |
|---|---|---|---|
| K32L2 SWD CLK | J18 | **ON** | Connect J11_4 to K32L2_SWD_CLK |
| | | OFF | Disconnect J11_4 to K32L2_SWD_CLK |
| MCU VDD current measurement | J17 | **ON** | Connect VDD to VDD_K32L2B3 |
| | | OFF | Allow current measurement on MCU VDD |
| VDD_K32L2 | J20 | **ON** | Connect VDD_K32L2 to P3V3_K32L2 |
| | | OFF | Disconnect VDD_K32L2 to P3V3_K32L2 |
| Visible light sensor | J8 | **ON** | Connect visible light sensor to PTE22 |
| | | OFF | Disconnect visible light sensor to PTE22 |
| SW3 | J21 | **ON** | Connect SW3 to PTC3 |
| | | OFF | Disconnect SW3 to PTC3 |
| VREGIN | J7 | **ON** | Connect VREGIN to P5V_K32L2 |
| | | OFF | Disconnect VREGIN to P5V_K32L2 |
| P3V3_SDA | J9 | **ON** | Connect P3V3_SDA to P3V3_VREG |
| | | OFF | Disconnect P3V3_SDA to P3V3_VREG |

# Chapter 7
# Known issue

In the SCH-46355 Rev A version, C1 is not DNP. Because there is only a weak internal pull-up resistor on the NMI pin (SW1), it may cause an unexpected NMI interrupt at powerup if the NMI is enabled, or boot a ROM entry (if it is enabled). Removing capacitor C1 prevents this. If a filter is required, an external pull-up resistor of 4.7 k and a capacitor of 100 pF are suggested. In Rev A1, capacitor C1 is DNP.

# Chapter 8
# Useful links

- www.nxp.com
- www.iar.com/NXP
- www.segger.com
  - www.segger.com/jlink-flash-download.html

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