UM11204
FRDM-KE16Z Freedom Board User's Guide

Rev. 0 — 12 March 2019

1 Overview

The FRDM-KE16Z Freedom board is designed to work in standalone mode or as the main board of FRDM-TOUCH, FRDM-MC-LVBLDC, and Arduino boards. The FRDM-KE16Z Freedom board is a modular development platform that enables rapid prototyping and tool reuse through reconfigurable hardware.

2 FRDM-KE16Z features

The FRDM-KE16Z board supports the following features.

- MKE16Z64VLF4 MCU (Arm® Cortex®-M0+ core, 48 MHz clock, 64 KB Flash, 8 KB RAM, 48 LQFP package)
- I/O headers for easy access to MCU I/O pins
- Compatible with FRDM-TOUCH, FRDM-MC-LVBLDC, and Arduino boards
- On-board debug circuit: MK20DX128VFM5 (OpenSDA) with virtual serial port
- NXP inertial sensor, FXOS8700CQ
- Reset pushbutton, two user buttons, and one RGB LED
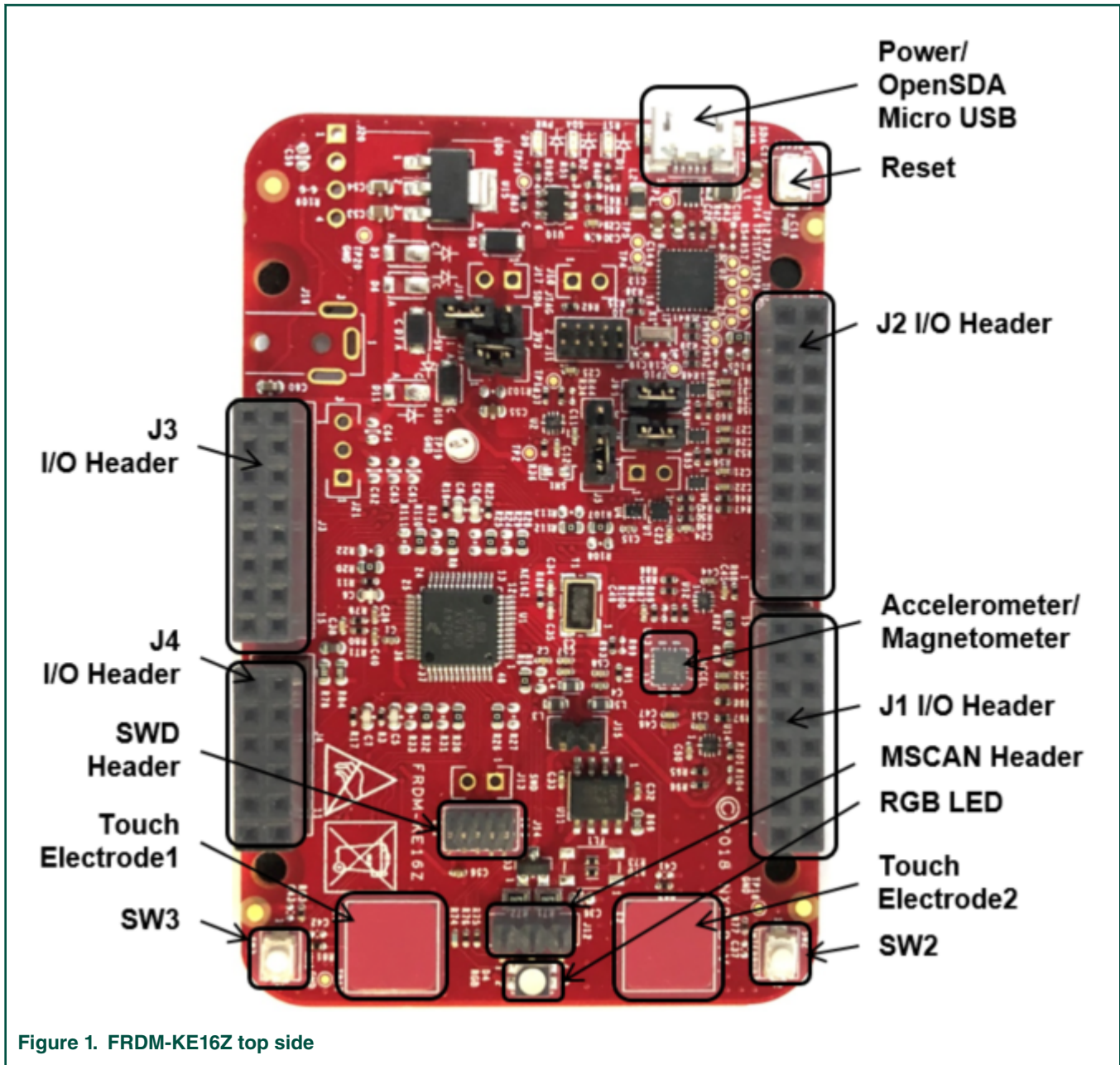- Touch electrodes in self-capacitive mode

3 Get to know the FRDM-KE16Z Freedom board

The FRDM-KE16Z Freedom board features two microcontrollers (MCUs): the target MCU and a serial and debug adapter (OpenSDA) MCU. The target MCU is a Kinetis E Series family device, KE16Z64VLF4. The OpenSDA MCU is a Kinetis K Series K20 family device, MK20DX128VFM5.

Contents

Figure 1. FRDM-KE16Z top side

4 Reference documents

For more information on the Kinetis E Series, Freedom System, and MCU modules, see the following document. The documents are listed in the documentation section of www.nxp.com/FRDM-KE16Z.

- FRDM-KE16ZSCH (schematics)
- KE1xZP48M48SF0RM (reference manual)
- SDK_2.5.0_FRDM-KE16Z

5 Hardware description

The FRDM-KE16Z Freedom board is a Freedom MCU Module featuring the KE16Z, a Kinetis E Series microcontroller in a 48 LQFP package. An onboard OpenSDA debug circuit provides a Serial Wire Debug (SWD) interface and a power supply input through a single micro-USB connector.

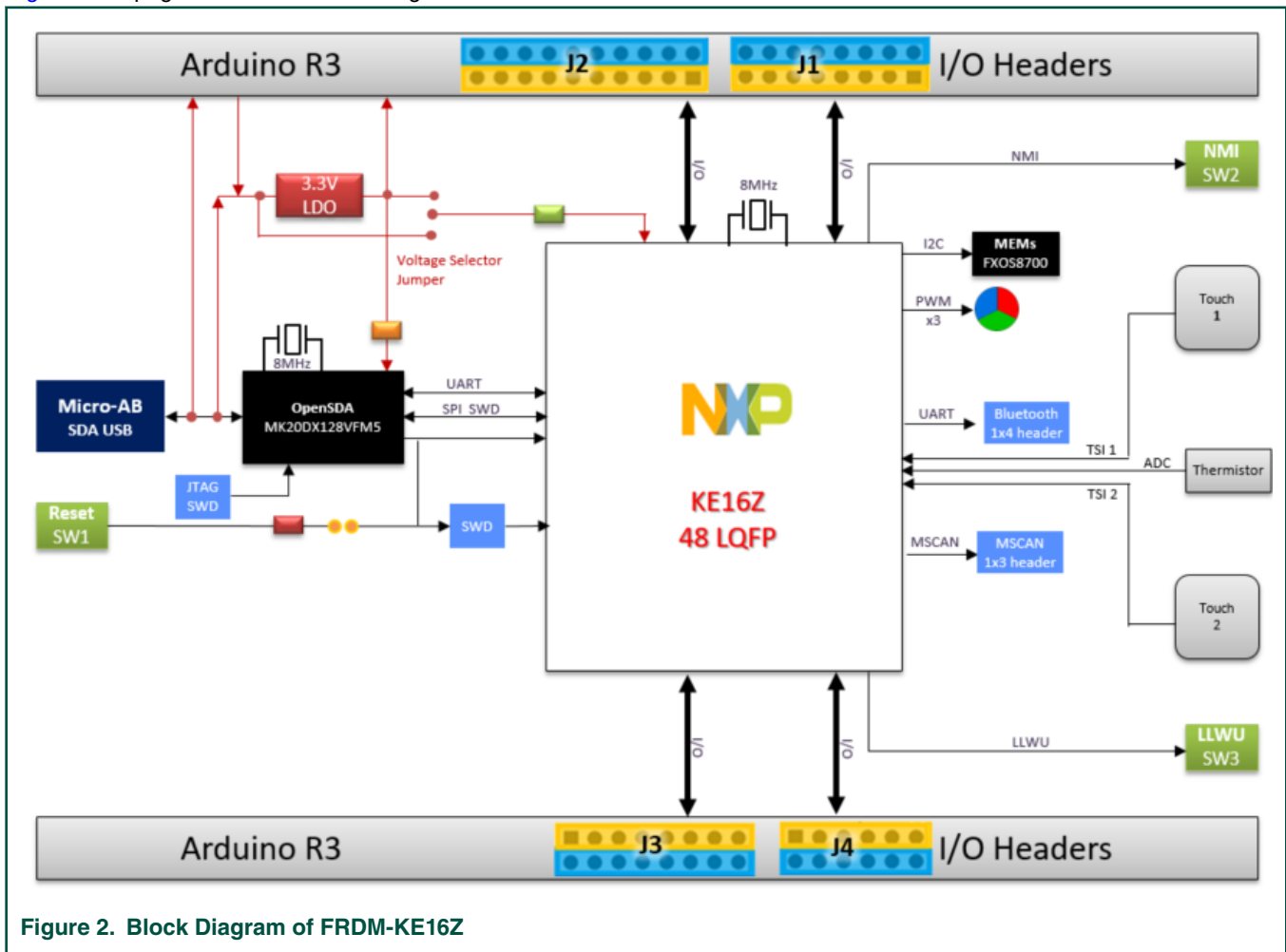Figure 2. on page 3 shows the block diagram of the FRDM-KE16Z Freedom board.

Figure 2. Block Diagram of FRDM-KE16Z

5.1 Microcontroller

The FRDM-KE16Z features the KE16Z64VLF4 MCU. This 48 MHz microcontroller is part of the Kinetis KE+ family and is implemented in a 64 LQFP package.

The features of the KE16Z64VLF4 MCU are:

- 32-bit Arm Cortex-M0+ core, 48 MHz
- Memories
    - 64 KB flash
    - 8 KB SRAM
- Clocks
    - Clock generation module with FLL for system and core clock generation
    - 48 MHz high accuracy fast internal reference clock (FIRC)

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- — 8 MHz/2 MHz high accuracy slow internal reference clock (SIRC)

- — 4-40 MHz fast external oscillator (OSC)

- — 128 KHz low-power oscillator (LPO)

- — Low-power FLL (LPFLL)

- Analog peripherals

  - — 1 x 12-bit SAR ADC with up to 16 channels input per module

  - — 1 x high-speed analog comparators (CMP) with internal 8-bit digital to analog converter (DAC)

- Connectivity and communications interfaces

  - — 1 x low-power serial peripheral interface (LPSPI)

  - — 1 x low-power inter-integrated circuit (LPI2C) module

  - — 3 x low-power universal asynchronous receiver/transmitter (LPUART) modules

  - — 1 x CAN module (MSCAN), with 5 receive buffers and 3 transmit buffers

    - ◦ Timers

  - — 2 x FlexTimer (FTM) modules

  - — 1 x 16-bit low-power timer(LPTMR) with flexible wake-up control

  - — 1 x 32-bit Periodic Interrupt Timer(LPIT)

  - — 1 x Programmable Delay Block(PDB) with flexible trigger system

  - — Real-time clock (RTC)

- Human-machine interface (HMI)

  - — Supports up to 32 interrupt request (IRQ) sources

  - — Up to 42 GPIO pins with interrupt functionality

  - — 25-channel touch sensing interface(TSI), supporting both self-capacitive and mutual-capacitive mode

5.2 Clocking

Kinetis E Series MCU startup from internal 48 MHz FIRC by default. Software can enable the main external oscillator (EXTAL/ XTAL) if desired. The external oscillator can range from 4 MHz to 40 MHz. An 8 MHz oscillator is the default external source for system clock and real-time clock respectively on the FRDM-KE16Z board.

5.3 System power

The FRDM-KE16Z is compatible with DC 5 V and 3.3 V power supply, as KE16Z can work from 2.7 V to 5.5 V.

The main power source for the FRDM-KE16Z module is derived from the OpenSDA USB micro-B connector (J6). One low-dropout regulator provides 3.3 V supply from the 5.0 V input voltage. All of the user-selectable options can be configured headers J18, J19. For more information, see the POWER page of the FRDM-KE16Z schematics. Since, KE16Z64VLF4 MCU supports 2.7 V to 5.5 V power supply, MCU KE16Z can be 3.3 V powered by setting J19 2-3 connected, and 5 V powered by setting J19 1-2 connected. However, OpenSDA MK20DX128VFM5 is always 3.3 V powered.

5.4 Debug interface

There are two debug interface options provided: the onboard OpenSDA circuit and an external Arm Cortex SWD connector (J14). The Arm Cortex SWD connector is a standard 10-pin connector that provides an external debugger cable access to the SWD interface of the KE16Z64VLF4. Alternatively, the onboard OpenSDA debug interface can be used to access the debug interface of the KE16Z64VLF4.

5.5 OpenSDA

An onboard MK20DX128VFM5-based OpenSDA circuit provides an SWD debug interface to KE16Z64VLF4. A standard USB A male to micro-B male cable is used for debugging via the USB connector (J6). The OpenSDA interface also provides a USB to serial bridge. Drivers for the OpenSDA interface are provided in the P&E Micro OpenSDA Freedom Toolkit. These drivers and more utilities can be found online at http://www.pemicro.com/opensda .

5.6 Accelerometer plus magnetometer

An FXOS8700CQ 6-axis digital sensor accelerometer plus magnetometer is connected to the KE16Z64VLF4 MCU through an I2C interface (LPI2C0) and GPIO/IRQ signals (PTA3 and PTA2).

5.7 Thermistor, pushbuttons, and LEDs

The FRDM- KE16Z board also features:

- Thermistor connected to ADC input signals (ADC0_SE2/ADC0_SE3)
- Two pushbutton switches: SW2-PTD3, SW3-PTD2
- RGB LED

5.8 Touch electrodes

The FRDM-KE16Z board features two touch electrodes to demonstrate TSI functions in self-capacitive mode.

The touch electrode 1 is connected to TSI channel 0, and touch electrode 2 is connected to TSI channel 1.

The FRDM-KE16Z also outputs TSI signals to IO header J2 and J4 to support FRDM-TOUCH board, which demonstrates four touch keys in a mutual-capacitive mode, touch slider, and rotary.

6 FRDM-KE16Z jumper options and headers

The following is a list of all of the jumper options on the FRDM- KE16Z. The default installed jumper settings are indicated in bold.

Table 1. FRDM-KE16Z jumper options

Option	Jumper	Setting	Description
Power supply	J19	**1-2**	KE16Z64VLF4 MCU is 5 V powered
		2-3	KE16Z64VLF4 MCU is 3.3 V powered
MCU VDD current measurement	J18	**ON**	Connect VDD to VDD_KE16Z
		OFF	Allow current measurement on MCU VDD
Reset selection	J5	**1-2**	Reset from pushbutton SW1
		2-3	Bypass push button
MCU SWD DIO signal	J8	**ON**	Connect MCU SWD_DIO to OpenSDA
		OFF	Disconnect MCU SWD_DIO to OpenSDA
MCU SWD CLK signal	J9	**ON**	Connect MCU SWD_CLK to OpenSDA
		OFF	Disconnect MCU SWD_CLK to OpenSDA

7 Useful links

- www.NXP.com
    - NXP.com/Kinetis
- www.iar.com/NXP
- www.pemicro.com
    - http://www.pemicro.com/opensda
- www.segger.com
    - http://www.segger.com/jlink-flash-download.html

8 Revision history

Table 2. Revision history on page 6 summarizes the changes since the initial release.

Table 2. Revision history

Revision number	Date	Substantial changes
0	03/2019	Initial release

arm