TWR-K80F150M User's Guide

1 Introduction

The K80F150M Tower MCU Module (TWR-K80F150M) is a low-cost evaluation, demonstration, and development board, which features the Kinetis 150 MHz K80 low-power MCU. The TWR-K80F150M microcontroller module can operate in stand-alone mode or as part of the Freescale Tower System, a modular development platform that enables rapid prototyping and tool re-use through reconfigurable hardware. Take your design to the next level and begin constructing your Tower System today by visiting freescale.com/tower for additional Tower System microcontroller modules and compatible peripherals.

Contents

1.1 Features

The following list summarizes the features of the K80F150M Tower MCU boards:

- MK80FN256VDC15 MCU
- 150 MHz Cortex-M4 core, 256KB Flash, 256 KB SRAM, 121 XFBGA, with QuadSPI controller, ROM Bootloader, SDRAM controller and USB
- Tower compatible processor board
- Onboard debug circuit: K20DX128VFM5 OpenSDA with virtual serial port
- 2 x 32 Mbit (4 MB) Dual On-board QuadSPI memory @ 1.8 V
- 64 Mbit (8 MB) SDRAM Memory
- Five user-controlled status LEDs
- Two capacitive touch pads
- Two mechanical push buttons
- Standalone full-speed USB host and device function
- Potentiometer
- MicroSD Card Slot
- EMVSIM Card Interface
- Ten axis sensor system
    - FXOS8700CQ 3D Accelerometer + 3D Magnetometer
    - MPL3115A2 Digital Pressure Sensor
    - FXAS21002C 3-axis gyroscope
- Socket for Touch Keypad plug-in (TWRPI-TOUCH-STR)
- Board power select with 3.3 V or 1.8 V MCU operation
- Independent, battery-operated power supply for real-time clock (RTC) module
- Battery holder for 20 mm lithium battery (e.g. 2032, 2025)

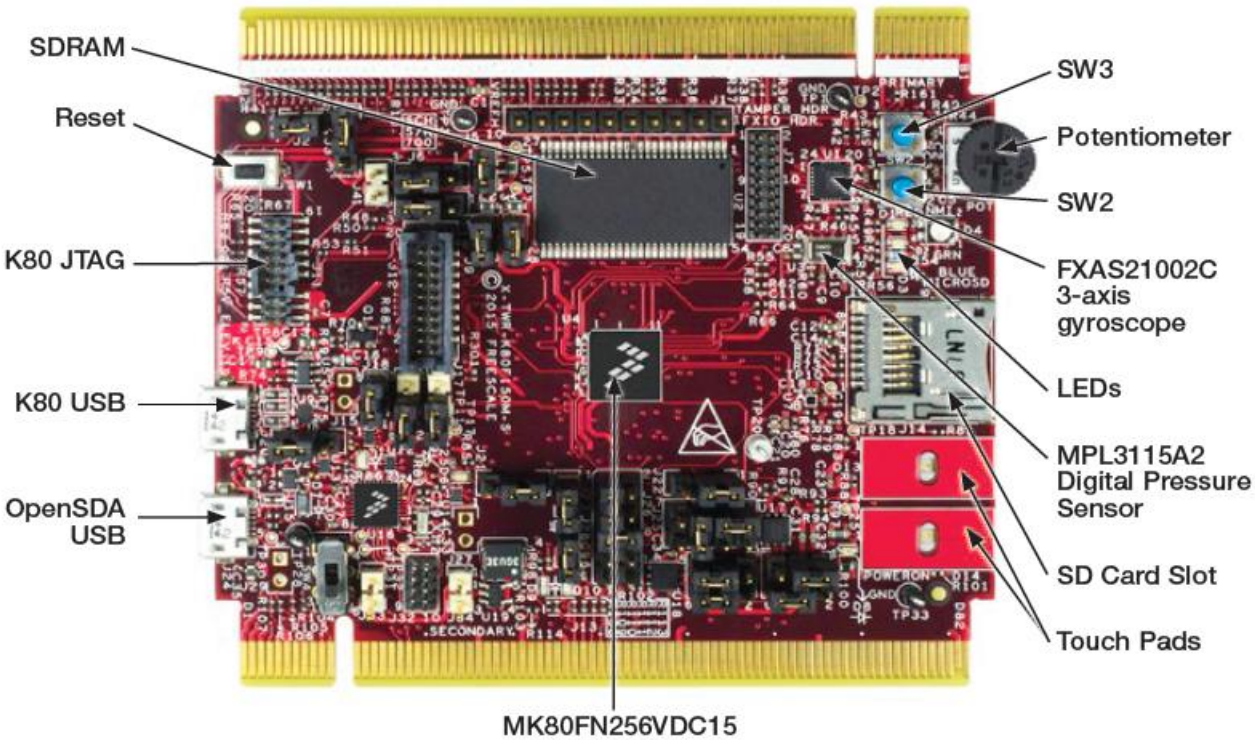

Figure 1. Front side of the TWR-K80F150M module

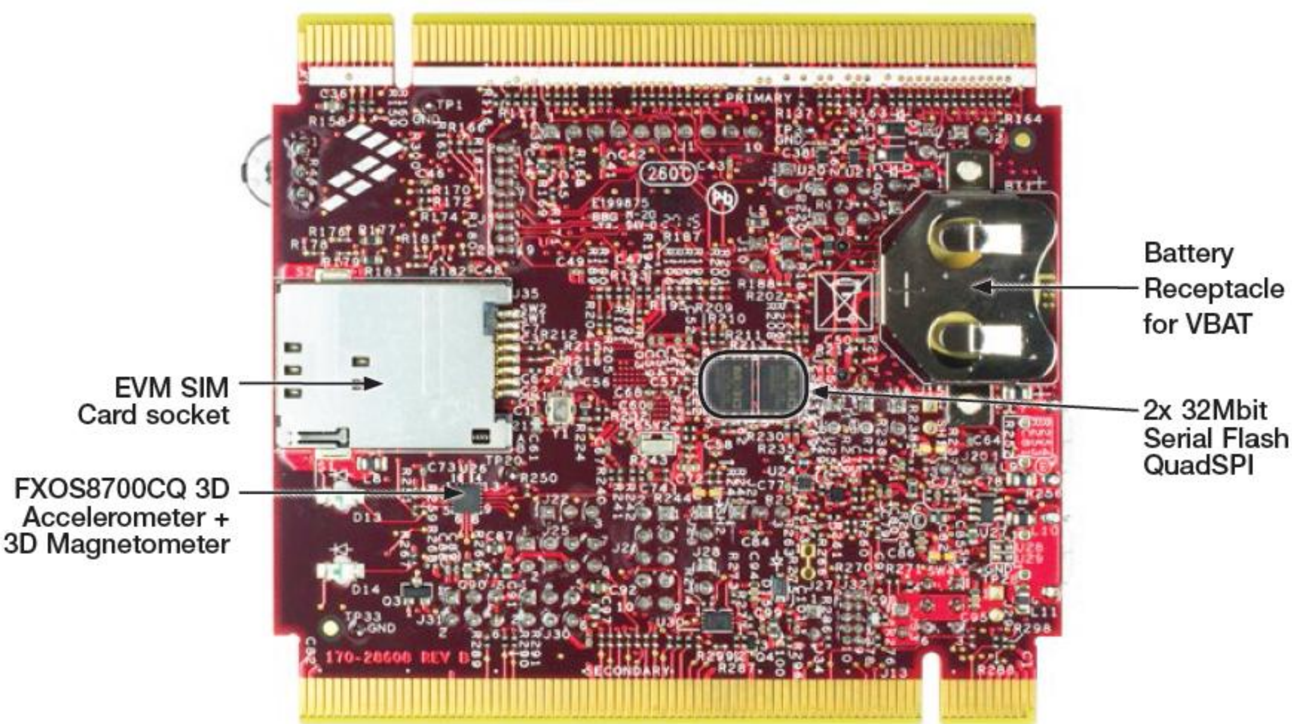

Figure 2. Back side of the TWR-K80F150M module

1.2 Getting started

You can find a printed version of the Quick Start Guide in the TWR-K80F150M box that contains the list of recommended steps for getting started. You can see http://freescale.com/twr-k80f150m/startnow for more getting started instructions, downloads, and information.

2 Contents

The TWR-K80F150M includes:

- TWR-K80F150M board assembly
- Quick Start Guide
- USB A to micro-B cable for debug interface and power supply

3 Hardware description

The TWR-K80F150M is a Tower MCU Module featuring the MK80FN256VDC15–an ARM® Cortex®-M4F based MCU with 256 KB on-chip flash, 256 KB on-chip SRAM, Dual QuadSPI controller, SDRAM controller, and USB controller in a 121 pin XFBGA package. It has a maximum core operating frequency of 150 MHz. It is intended for use in the Freescale Tower System but can operate as a stand-alone module. An on-board debug circuit, OpenSDA, provides the SWD debug interface and power supply input through a single USB micro-AB connector. The following sections describe the hardware in more detail. The following figure shows a block diagram for the TWR-K80F150M.

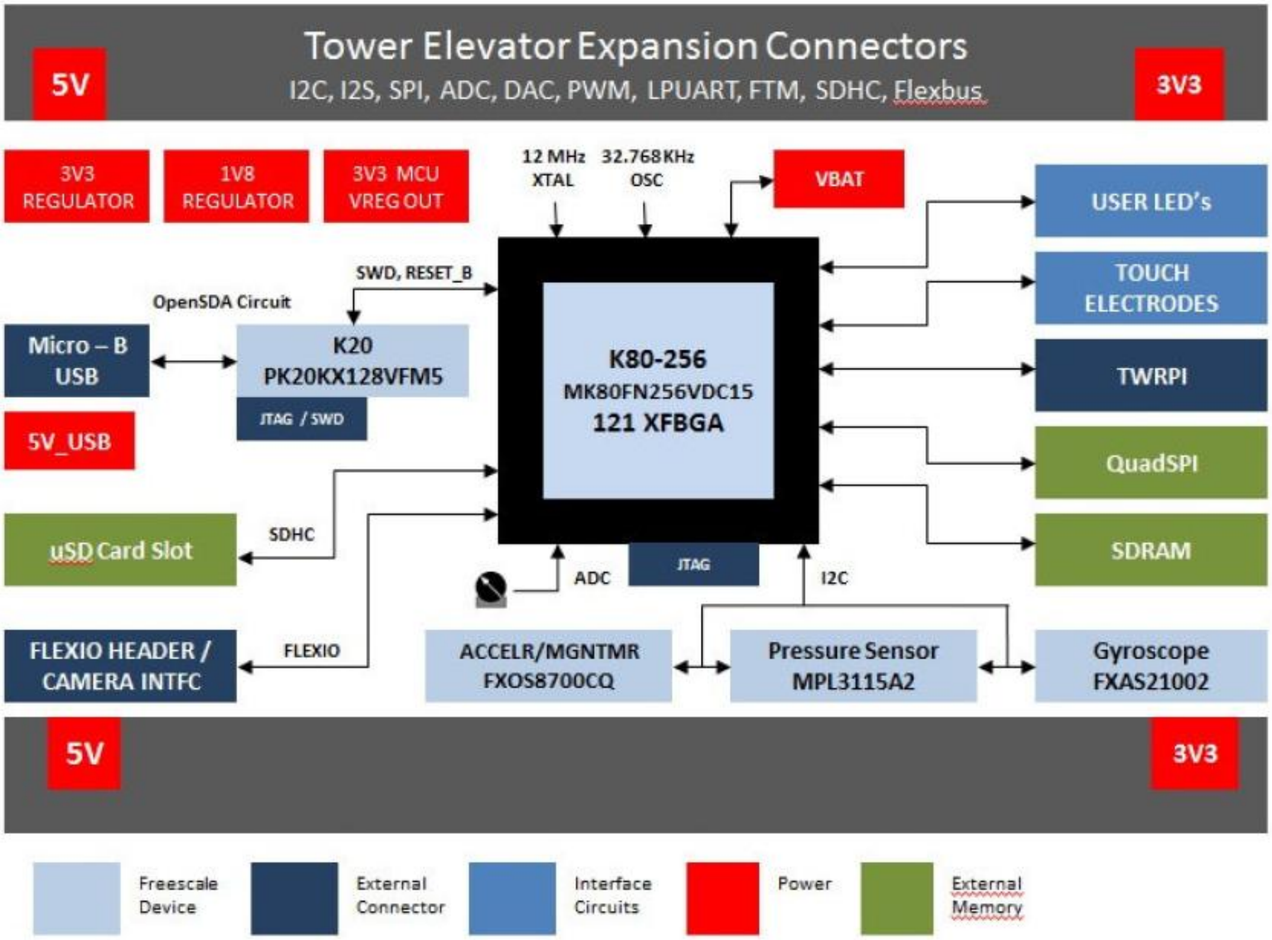

Figure 3. TWR-K80F150M Block Diagram

3.1. K80F150M microcontroller

The TWR-K80F150M module features the MK80FN256VDC15. The K80 microcontroller family is part of the Kinetis portfolio of devices built around an ARM Cortex-M4F core. Refer to the *K80 Family Reference Manual* (document K80P121M150SF5RM) for comprehensive information on the K80FN256VDC15 device. The key features of K80FN256VDC15 are as follows:

Table 1. K80FN256VDC15 key features

Feature	Description
Performance	• Up to 150 MHz ARM Cortex-M4 based core with DSP instructions and Single Precision Floating Point unit
Memory and memory expansion	• 256 KB program flash memory and 256 KB RAM • Dual QuadSPI with XIP • FlexBus external bus interface and SDRAM controller
Analog modules	• One 16-bit SAR ADCs, two 6-bit DAC and one 12-bit DAC • Two analog comparators (CMP) containing a 6-bit DAC and programmable reference input • Voltage reference 1.2 V
Communication interfaces	• USB full-/low-speed On-the-Go controller • Secure Digital Host Controller (SDHC) • FlexIO • One I2S module, three SPI, four I2C modules and five LPUART modules • EMVSIM module with ISO7816 smart card support
Security	• Hardware random-number generator • Supports DES, AES, SHA accelerator (CAU) • Multiple levels of embedded flash security
Timers	• One 4-channel Periodic interrupt timer • Two 16-bit low-power timer PWM modules • Two 8-channel motor control/general purpose/PWM timers • Two 2-channel quadrature decoder/general purpose timers • Real-time clock with independent 3.3 V power domain • Programmable delay block
Human machine interface	• Low-power hardware touch sensor interface (TSI) • General-purpose input/output
Operating Characteristics	• Main VDD Voltage and Flash write voltage range:1.71 V – 3.6 V • Temperature range (ambient): -40 to 105°C • Independent VDDIO for PORTE (QuadSPI): 1.71 V – 3.6 V

3.2. Clocking

The Kinetis microcontrollers start up from an internal digitally controlled oscillator (DCO). The software can enable an external oscillator if required. The external oscillator for the Multipurpose Clock Generator (MCG) module can range from 32.768 kHz up to a 32 MHz crystal or ceramic resonator. The external oscillator for the Real-Time Clock (RTC) module accepts a 32.768 kHz crystal.

Two crystals are provided on-board for clocking the K80F150M device: a 12 MHz crystal as the main oscillator to clock the MCG module and a 32.768 kHz crystal for clocking the RTC module.

3.3. System power

In standalone operation, the main power source for the TWR-K80F150M is derived from the 5.0 V input from either the USB micro-B connector, J24, or the debugger header, J11, when a shunt is placed on jumper J4.

There are multiple power configurations available to power both the MCU VDD domain and the VDDIO_E domain, while keeping the requirement that VDD>VDDIO_E during power up and power down. See sheet 3 of the *TWR-K80F150M Schematics* (document TWR-K80F150M-SCH) for further details.

When installed into a Tower System, the TWR-K80F150M can be powered from either an on-board power source or from another power source in the assembled Tower System.

The 3.3 V or 1.8 V power supplied to the MCU is routed through a jumper, J9. The jumper shunt can be removed to allow the following:

1) Alternate MCU supply voltages to be injected.
2) Measurement of power consumed by the MCU.

3.4. Real-Time Clock supply

The Real-Time Clock (RTC) module on the K80FN256VDC15 has two modes of operation: system power up and system power down. During system power down, the RTC can be powered from the backup power supply (VBAT) and electrically isolated from the rest of the MCU. The TWR-K80F150M provides a battery receptacle for a coin cell battery that can be used as the VBAT supply. The receptacle uses standard 20 mm diameter 3 V lithium coin cell batteries.

By default the VBAT supply comes from the MCU_PWR domain. This is selected via J3.

3.5. Serial and Debug Adapter version 2 (OpenSDAv2.1)

OpenSDAv2.1 is a serial and debug adapter circuit which includes an open-source hardware design, an open-source bootloader, and debug interface software. It bridges serial and debug communications between a USB host and an embedded target processor as shown in figure 4. The hardware circuit is based on a Freescale Kinetis K20 family MCU with 128 KB of embedded flash and an integrated USB controller. OpenSDAv2 comes preloaded with the CMSIS-DAP bootloader—an open-source mass storage device (MSD) bootloader—and the CMSIS-DAP interface firmware (also known as the mbed interface), which provides an MSD flash programming interface, a virtual serial port interface, and a CMSIS-DAP debug protocol interface. For more information on the OpenSDAv2 software, see http://freescale.com/opensda

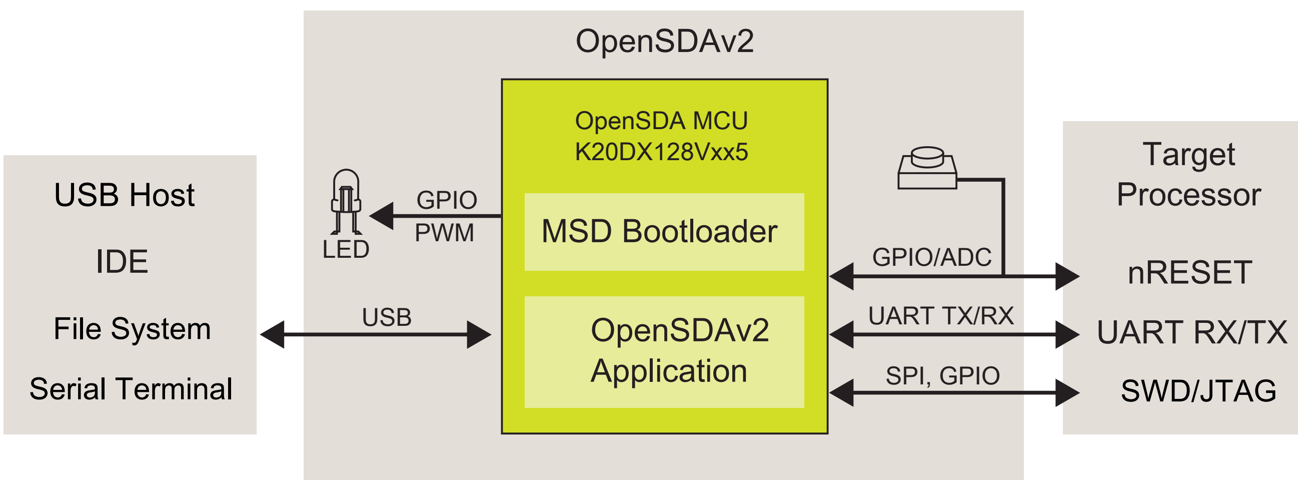

Figure 4. OpenSDAv2 high-level block diagram

OpenSDAv2 is managed by a Kinetis K20 MCU built on the ARM Cortex-M4 core. The OpenSDAv2 circuit includes a green status LED (D5) and a pushbutton (SW1). The pushbutton asserts the Reset signal to the K80 target MCU. It can also be used to place the OpenSDAv2 circuit into bootloader mode. SPI and GPIO signals provide an interface to either the SWD debug port or the K20. Additionally, signal connections are available to implement a UART serial channel. The OpenSDAv2 circuit receives power when the USB connector J24 is plugged into a USB host.

3.6. Cortex Debug connector

The Cortex Debug connector is a 20-pin (0.05 inch) connector providing access to the SWD and JTAG available on the K80 device. If using the Cortex Debug connector, it is recommended to isolate the OpenSDA circuit from the debug signals by removing the jumpers J16 and J17.

The K80 pin connections to the debug connector (J11) are shown in this table.

Table 2. Cortex Debug connector pinout

Pin	Function	TWR-K80F150M connection
1	VTref	3.3 V MCU supply (MCU_PWR)
2	TMS/SWDIO	PTA3/JTAG_TMS/SWD_DIO
3	GND	GND
4	TCK/SWCLK	PTA0/JTAG_TCLK/SWD_CLK
5	GND	GND
6	TDO/SWO	PTA2/JTAG_TDO/TRACE_SWO
7	Key	—
8	TDI	PTA1/JTAG_TDI
9	GNDDETECT	No Connect
10	nReset	RESET_b
11	Target Power	5 V supply (via J4)
12	TRACECLK	PTA12/TRACE_CLKOUT
13	Target Power	5 V supply (via J4)
14	TRACEDATA[0]	PTA16/TRACE_D0
15	GND	GND
16	TRACEDATA[1]	PTA15TRACE_D1
17	GND	GND
18	TRACEDATA[2]	PTA14/TRACE_D2
19	GND	GND
20	TRACEDATA[3]	PTA13/TRACE_D3

3.7. QuadSPI Memory

The FRDM-K82F also includes dual QuadSPI memory with execute in place (XiP) and On The Fly AES Decryption (OTFAD) capability. The on-board QuadSPI used is Macronix MX25U3235FZNI, which are each 32 Mb (4MB) in size. The QuadSPI interface offers up to 100 MHz performance for Single Data Rate (SDR). The QuadSPI is also supported by the internal Kinetis BootROM.

3.8. External Bus Interface – FlexBus

The K80 device features a multi-function external bus interface called the FlexBus interface controller. This is capable of interfacing with slave-only devices. The FlexBus interface is not used directly on the TWR-K80F150M. Instead, a subset of the FlexBus is connected to the Primary Connector so that the external bus can access devices on Tower peripheral modules. Refer to Table 6 below and sheet 10 of the *TWR-K80F150M Schematics* (document TWR-K80F150M-SCH) for more details. Note that the Flexbus is muxed with the SDRAM signals.

3.9. SDRAM

The TWR-K80F150M board contains 64 Mb SDRAM (32-bit width) which is connected to the K80 SDRAM controller. The SDRAM signals are multiplexed with Flexbus signals. See the *K80 Family Reference Manual* (document K80P121M150SF5RM) "Flexbus signal multiplexing" section and "SDRAM SDR signal multiplexing" section on how to use the Flexbus and SDRAM in multiplexed mode.

To use the SDRAM, jumpers J6 and J8 should be removed. This is due to the UART TX/RX lines used on the TWR-K80F150M are muxed with the SDRAM signals. This does mean serial communication over OpenSDA is not possible while using the SDRAM.

3.10. Sensors

There are three Freescale sensors on the board, all connected via I2C0 via PTD8 (I2C0_SCL) and PTD9 (I2C0_SDA):

- FXOS8700CQ: Digital accelerometer and magnetometer
- MPL3115A2: Digital pressure sensor
- FXAS21002C: 3-axis gyroscope.

Each sensor also has two interrupt signals with the option to connect to the K80 device on PTA17 and PTA29. By default they are disconnected via DNP resistors.

Table 3. Sensor types and slave addresses

Sensor	I2C Slave Address
FXOS8700CQ 3D accelerometer and 3D magnetometer	0x1D
MPL3115A2 Digital pressure sensor	0x60
FXAS21002C 3-axis gyroscope	0x20

3.11. Potentiometer, pushbuttons, LEDs

The TWR-K80F150M features:

- A potentiometer connected to an ADC input signal (ADC0_DM3)
- Two pushbutton switches (SW2 and SW3 connected to PTA4 and PTA21)

- User controllable LEDs connected to GPIO signals
  - Red LED D1 connected to PTD11
  - Green LED D2 connected to PTD12
  - Blue LED D3 connected to PTD13
  - Green Touch LED D13 connected to PTD14
  - Blue Touch LED D14 connected to PTD15
  - RGB LED D5 connected via DNP resistor to PTD11, PTD12, and PTD13

3.12. Touch interface

The touch-sensing input (TSI) module of the Kinetis microcontrollers provides capacitive touch-sensing detection with high sensitivity and enhanced robustness. Each TSI pin implements the capacitive measurement of an electrode. There are two individual electrodes on-board the TWR-K80F150M that simulate pushbuttons. TSI0_CH9 (PTB16) and TSI0_CH10 (PTB17) are connected to the capacitive pads.

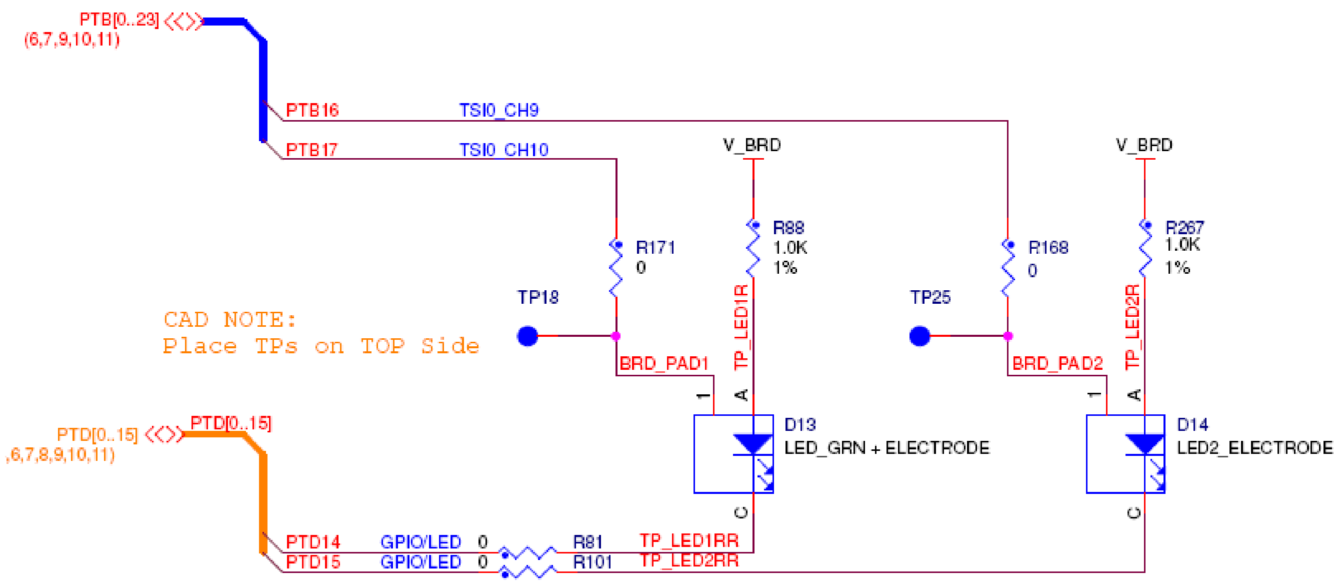

Figure 5. Touch pad circuitry

There is also a Touch TWRPI (Tower Plugin) header for a touch sensitive keypad to be attached on J12. For details on the connection see Table 5.

3.13. USB interface

The K80FN256VDC15 features a full-, low-speed USB controller with on-chip USB transceiver. The TWR-K80F150M board enables the USB to be host or device mode.

Jumper J20 is used to select whether the USB signals are connected to the on-board micro-B connector J19 (default), or sent down the elevator to be used in connection with a TWR-SER1 board or other peripheral board in a complete tower kit.

A MIC2005 device is used for over-current detection. PTC19 (connected via J28) is used to enable a 5 V VBUS signal, and PTC18 (connected via J18) is used as an over-current signal.

3.14. Secure digital card slot

A Micro SD card slot is available on the TWR-K80F150M connected to the SD host controller (SDHC) signals of the MCU. This slot will accept standard format SD memory cards. See Table 5 for connection details.

The SDHC signals are muxed with the QuadSPI signals, and therefore the microSD card slot is not connected to the K80 by default. To use the microSD card, populate the R198, R200, R208, R58, R196, R218, and R244 resistors on the board with 0 ohm resistors. Then remove the R231 and R227 resistors that power the QuadSPI. Finally because the microSD card slot needs to run at 3.3 V, on J31 the jumpers should be set to 1-3 and 2-4 to make both VDD and VDDIO_E at 3.3 V.

4 Jumper table

There are several jumpers provided for isolation, configuration, and feature selection. See the following table for details.

Table 4. TWR-K80F150M jumper table

Jumper	Option	Setting	Description	Default setting
J2	MCU reset connection on JTAG connector	ON	Connect MCU reset on pin10 of JTAG connector J11	ON
		OFF	Disconnect MCU reset on pin10 of JTAG connector J11	
J3	VBAT Power Selection	1-2	Connect VBAT to on board MCU supply from MCU_PWR	1-2
		2-3	Connect VBAT to the higher voltage between on board MCU_PWR supply or coin cell supply	
J4	JTAG Power Connection	ON	Connect on-board 5V supply to JTAG port (supports powering board from external JTAG probe)	OFF
		OFF	Disconnect on-board 5V supply from JTAG port	
J5	QuadSPI Power Enable	ON	Connect VDDIO_E domain to power QuadSPI flash. Should only be connected when VDDIO_E is at 1.8V	ON
		OFF	Disconnect VDDIO_E domain from QuadSPI flash.	
J6	UART RX Connection	1-2	Connect UART1_RX to elevator	2-3
		2-3	Connect UART1_RX to OpenSDA UART RX	
J8	UART TX Connection	1-2	Connect UART1_TX to elevator	2-3
		2-3	Connect UART1_TX to OpenSDA UART TX	
J9	MCU power connection	ON	Connect V_BRD and MCU_PWR to MCU_VDD	ON
		OFF	Disconnect V_BRD and MCU_PWR from MCU_VDD	
J10	VDD and VDDA connection	ON	Connect VDD and VDDA	ON
		OFF	Disconnect VDD and VDDA	
J15	USB ID connection	ON	Connect PTD7 to USB ID pin on micro-USB connector J19	OFF
		OFF	Disconnect PTD7 from USB ID pin on micro-USB connector J19	

Table 4. TWR-K80F150M jumper table (continued)

Jumper	Option	Setting	Description	Default setting
J16	SWD DIO OpenSDA Connection	ON	Connect SWD_DIO from OPENSDA circuit to K80 MCU to allow debugging using OPENSDA	ON
		OFF	Disconnect SWD_CLK from OPENSDA circuit to K80 MCU to allow J-Link or U-Link debug	
J17	SWD clock OpenSDA Connection	ON	Connect SWD_CLK from OPENSDA circuit to K80 MCU to allow debugging using OPENSDA	ON
		OFF	Disconnect SWD_CLK from OPENSDA circuit to K80 MCU to allow J-Link or U-Link debug	
J18	USB over-current flag connection	ON	Connect PTC18 to USB over-current flag for MIC2005	ON
		OFF	Disconnect PTC18 to USB over-current flag for MIC2005	
J20	USB Switch Selection	1-2	Use the on-board micro-USB connector J19	1-2
		2-3	USB signals come from elevator	
J21	RESET button connection	1-2	When powering the OPENSDA MCU, bootloader mode can be selected	1-2
		2-3	When OPENSDA MCU is not powered, RESET button can be used	
J22	VREGIN Selection	1-2	VREGIN comes from on-board 5V source	1-2
		2-3	VREGIN comes from elevator VBUS from signal A57.	
J23	5 V Connection	ON	Connect 5 V IN to the 3.3 V regulator	ON
		OFF	Disconnect 5 V IN from the 3.3 V regulator	
J25	Board Power and Regulator Selection	1-3	3V3_BRD connected to output of 3.3 V regulator	1-3 5-6
		2-4	Invalid configuration. Do not use.	
		3-4	Invalid configuration. Do not use.	
		4-6	1.8 V regulator uses output of Li-Ion Battery Domain	
		5-6	1.8 V regulator uses output of 3.3 V regulator	
		6-8	1.8 V regulator uses 5 V IN directory.	
J26	5 V Input Power Selection	1-3	VREGIN uses USB 5 V	1-3 5-6
		3-4	Raw 5 V input from K80 USB	
		5-6	Regulated 5 V output from OpenSDA 5V input	
		7-8	Power from P5V_ELEV input	
		9-10	Raw 5 V input from OpenSDA USB port J24	
J27	OpenSDA Reset	ON	Connect OpenSDA reset signal to board reset. There is a board trace that makes this connection even if jumper is not populated.	OFF
		OFF	Disconnect OpenSDA reset signal to board reset. *By default there is a board trace connecting this signal even though jumper is off.	
J28	USB power enable connection	ON	Connect PTC19 to USB power enable for MIC2005	
		OFF	Disconnect PTC19 to USB power enable for MIC2005	
J30	3.3 V and 1.8 V sequencing	1-2	Invalid configuration. Do not use.	3-5 4-6
		1-3	Option 2: 1.8 V comes up before 3.3 V. 3.3 V regulator enabled by output of 1.8 V regulator. Only used if VDD=1.8 V and VDDIO_E=3.3 V, which is not valid for QuadSPI on board.	
		2-4	Option 2: 1.8 V comes up before 3.3 V. 1.8 V regulator enabled by input to regulator. Only used if VDD=1.8 V and VDDIO_E=3.3 V, which is not valid for	

Table 4. TWR-K80F150M jumper table (continued)

Jumper	Option	Setting	Description	Default setting
			QuadSPI on board.	
		3-5	Option 1: 3.3 V comes up before 1.8 V. 3.3 V regulator enabled by input to regulator.	
		4-6	Option 1: 3.3 V comes up before 1.8 V. 1.8 V regulator enabled by 3.3 V board supply.	
		5-6	Invalid configuration. Do not use.	
J31	VDDIO_E and VDD Selection	1-3	V_BRD/MCU_VDD is 3.3 V	1-3 4-6
		2-4	VDDIO_E is 3.3 V	
		3-5	V_BRD/MCU_VDD is 1.8 V	
		4-6	VDDIO_E is 1.8 V	
J33	Battery Voltage Monitoring	ON	Connect ADC0_DP3 to battery voltage	OFF
		OFF	Disconnect ADC0_DP3 from battery voltage	
J34	Battery Boost Regulator Input	ON	Enable 5 V Boost	OFF
		OFF	Disconnect Boost Enable.	

5 Input/output connectors and pin usage table

The table below provides details on which K80F150M pins are used to communicate with the TWR-K80F150M sensors, LEDs, switches, and other I/O interfaces.

NOTE

Some port pins are used in multiple interfaces on-board and many are potentially connected to off-board resources via the primary and secondary Connectors. You must take care to avoid attempted simultaneous usage of mutually exclusive features.

Table 5. I/O Connectors and Pin Usage Table

Feature	Connection	Port Pin	Pin Function
OPENSDA USB-to-serial bridge	OPENSDA RX data	PTC3	UART1_RX
	OPENSDA TX data	PTC4	UART1_TX
SD Card Slot	SD clock	PTE2	SDHC0_DCLK
	SD Command	PTE3	SDHC0_CMD
	SD Data0	PTE1	SDHC0_D0
	SD Data1	PTE0	SDHC0_D1
	SD Data2	PTE5	SDHC0_D2

Table 5. I/O Connectors and Pin Usage Table (continued)

Feature	Connection	Port Pin	Pin Function
	SD Data3	PTE4	SDHC0_D3
	SD Card Detect	PTE7	PTE7
Pushbuttons	SW2 (NMI)	PTA4	PTA4
	SW3 (LLWU)	PTA21	PTA21
	SW1 (RESET)	RESET_b	RESET_b
Touch Pads	Touch	PTB16	TSI0_CH9
	Touch	PTB17	TSI0_CH10
LEDs	D1 / Red LED	PTD11	Red LED
	D2 / Green LED	PTD12	Green LED
	D3 / Blue LED	PTD13	Blue LED
	D13 / Touch Pad Green LED	PTD14	D13 Electrode LED
	D14 / Touch Pad Blue LED	PTD15	D14 Electrode LED
	D8	—	Power On
	D5	—	OpenSDA Power
Potentiometer	Potentiometer (R44)	—	ADC0_DM3
Sensors	I^2C SDA	PTD9	I^2C0_SDA
	I^2C SCL	PTD8	I^2C0_SCL
	IRQ1	PTA17	PTA17
	IRQ2	PTA29	PTA29
RTC	RTC bypass	PTA11	PTA11
Touch TWRPI Socket	Touch TWRPI1	—	5 V
	Touch TWRPI2	—	V_BRD
	Touch TWRPI3	PTA4	TSI0_CH5/Touch Pad ‘1’
	Touch TWRPI4	—	VDDA
	Touch TWRPI5	PTB0	TSI0_CH0/Touch Pad ‘2’
	Touch TWRPI6	—	GND
	Touch TWRPI7	PTB1	TSI0_CH6/Touch Pad ‘3’
	Touch TWRPI8	PTB2	TSI0_CH7/Touch Pad ‘4’
	Touch TWRPI9	PTB3	TSI0_CH8/Touch Pad ‘5’
	Touch TWRPI10	PTB16	TSI0_CH9/Touch Pad ‘6’
	Touch TWRPI11	PTB17	TSI0_CH10/Touch Pad ‘7’
	Touch TWRPI12	PTB18	TSI0_CH11/Touch Pad ‘8’
	Touch TWRPI13	PTB19	TSI0_CH12/Touch Pad ‘9’
	Touch TWRPI14	PTC0	TSI0_CH13/Touch Pad ‘*’
	Touch TWRPI15	PTC1	TSI0_CH14/Touch Pad ‘0’
	Touch TWRPI16	PTC2	TSI0_CH15/Touch Pad ‘#’
	Touch TWRPI17	ADC0_DP0	TWRPI_ID0
	Touch TWRPI18	ADC0_DM0	TWRPI_ID1

Table 5. I/O Connectors and Pin Usage Table (continued)

Feature	Connection	Port Pin	Pin Function
	Touch TWRPI19	—	GND
	Touch TWRPI20	Reset	Reset
EMVSIM	Reset	PTB8	EMVSIM_SRST
	CLK	PTB5	EMVSIM_SCLK
	I/O	PTB4	EMVSIM_IO
	VCC_EN	PTB6	EMVSIM_VCC_EN
	Card Detection	PTB7	EMVSIM_PD
Serial NOR Flash	QSPI_CLK1	PTE1	QPSI0A_SCLK
	QSPI_S_1	PTE5	QSPI0A_SS0_B
	QSPIA_DQ0	PTE2	QSPI0A_DATA0
	QSPIA_DQ1	PTE4	QSPI0A_DATA1
	QSPIA_DQ2	PTE3	QSPI0A_DATA2
	QSPIA_DQ3	PTE0	QPSI0A_DATA3
	QSPI_SCLK	PTE7	QSPI0B_SCLK
	QSPI_S_2	PTE11	QSPI0B_SS0_B
	QSPIB_DQ0	PTE8	QSPI0B_DATA0
	QSPIB_DQ1	PTE10	QSPI0B_DATA1
	QSPIB_DQ2	PTE9	QSPI0B_DATA2
	QSPIB_DQ3	PTE6	QSPI0B_DATA3
SDRAM	DQ0	PTB17	SDRAM_D16
	DQ1	PTB16	SDRAM_D17
	DQ2	PTB11	SDRAM_D18
	DQ3	PTB10	SDRAM_D19
	DQ4	PTB9	SDRAM_D20
	DQ5	PTB8	SDRAM_D21
	DQ6	PTB7	SDRAM_D22
	DQ7	PTB6	SDRAM_D23
	DQ8	PTC15	SDRAM_D24
	DQ9	PTC14	SDRAM_D25
	DQ10	PTC13	SDRAM_D26
	DQ11	PTC12	SDRAM_D27
	DQ12	PTB23	SDRAM_D28
	DQ13	PTB22	SDRAM_D29
	DQ14	PTB21	SDRAM_D30
	DQ15	PTB20	SDRAM_D31
	A0	PTC7	SDRAM_A16
	A1	PTC8	SDRAM_A15
	A2	PTC9	SDRAM_A14

Table 5. I/O Connectors and Pin Usage Table (continued)

Feature	Connection	Port Pin	Pin Function
	A3	PTC10	SDRAM_A13
	A4	PTD2	SDRAM_A12
	A5	PTD3	SDRAM_A11
	A6	PTD4	SDRAM_A10
	A7	PTD5	SDRAM_A9
	A8	PTC6	SDRAM_A17
	A9	PTC5	SDRAM_A18
	A10	PTC4	SDRAM_A19
	A11	PTC2	SDRAM_A20
	BA0	PTC1	SDRAM_A21
	BA1	PTC0	SDRAM_A22
	CKE	PTD7	SDRAM_CKE
	CLK	PTC3	CLKOUT
	CS_b	PTB3	SDRAM_CS0_b
	WE_b	PTB2	SDRAM_WE
	CAS_b	PTB0	SDRAM_CAS_b
	RAS_b	PTB1	SDRAM_RAS_b
	DQMH	PTC17	SDRAM_DQM3
	DQML	PTC16	SDRAM_DQM2

6 Elevator connections

The TWR-K80F150M features two expansion card-edge connectors that interface to Elevator boards in a Tower System: the primary and secondary Elevator connectors. The pinout for the primary Elevator Connector is provided in this table. The values in **bold** are either power or ground.

Table 6. TWR-K80F150M Primary Connector Pinout

Pin #	Side B		Pin #	Side A	
	Name	Usage		Name	Usage
B1	**5 V**	**5.0 V Power**	A1	**5 V**	**5.0 V Power**
B2	**GND**	**Ground**	A2	**GND**	**Ground**
B3	**3.3 V**	**3.3 V Power**	A3	**3.3 V**	**3.3 V Power**
B4	ELE_PS_SENSE	Elevator Power Sense	A4	**3.3 V**	**3.3 V Power**
B5	**GND**	**Ground**	A5	**GND**	**Ground**
B6	**GND**	**Ground**	A6	**GND**	**Ground**
B7	SDHC_CLK / SPI1_CLK	PTE2	A7	SCL0	PTD8
B8	SDHC_D3 / SPI1_CS1_b	PTE4	A8	SDA0	PTD9

Table 6. TWR-K80F150M Primary Connector Pinout (continued)

B9	SDHC_D3 / SPI1_CS0_b	PTE5	A9	GPIO9 / CTS1	PTC2
B10	SDHC_CMD / SPI1_MOSI	PTE3	A10	GPIO8 / SDHC_D2	PTE5
B11	SDHC_D0 / SPI1_MISO	PTE1	A11	GPIO7 / SD_WP_DET	PTD6
B12	ETH_COL	—-	A12	ETH_CRS	—
B13	ETH_RXER	—-	A13	ETH_MDC	—
B14	ETH_TXCLK	—	A14	ETH_MDIO	—
B15	ETH_TXEN	—-	A15	ETH_RXCLK	—
B16	ETH_TXER	—	A16	ETH_RXDV	—
B17	ETH_TXD3	—	A17	ETH_RXD3	—
B18	ETH_TXD2	—	A18	ETH_RXD2	—
B19	ETH_TXD1	—-	A19	ETH_RXD1	—
B20	ETH_TXD0	—-	A20	ETH_RXD0	—
B21	GPIO1 / RTS1	PTC1	A21	I2S0_MCLK	PTA17
B22	GPIO2 / SDHC_D1	PTE0	A22	I2S0_DOUT_BCLK	PTA5
B23	GPIO3	PTC9	A23	I2S0_DOUT_FS	PTA13
B24	CLKIN0	PTA5	A24	I2S0_RXD0	PTA15
B25	CLKOUT1	—-	A25	I2S0_TXD0	PTA12
B26	**GND**	**Ground**	A26	**GND**	**Ground**
B27	AN7	—-	A27	AN3	ADC0_SE6b
B28	AN6	—-	A28	AN2	AD0_SE9
B29	AN5	—-	A29	AN1	ADC0_DM0
B30	AN4	ADC0_SE7b	A30	AN0	ADC0_DP0
B31	**GND**	**Ground**	A31	**GND**	**Ground**
B32	DAC1	—-	A32	DAC0	DAC0_OUT
B33	TMR3	—-	A33	TMR1	PTB19
B34	TMR2	—-	A34	TMR0	PTB18
B35	GPIO4	PTD2	A35	GPIO6	—
B36	**3.3 V**	**3.3 V Power**	A36	**3.3 V**	**3.3 V Power**
B37	PWM7	PTA1	A37	PWM3	PTB1
B38	PWM6	PTA0	A38	PWM2	PTB0
B39	PWM5	PTA11	A39	PWM1	PTC2
B40	PWM4	PTA10	A40	PWM0	PTC1
B41	CANRX0	—-	A41	RXD0	PTA15
B42	CANTX0	—-	A42	TXD0	PTA14
B43	1WIRE	—	A43	RXD1	ELEV_UART_RX
B44	SPI0_MISO	PTC7	A44	TXD1	ELEV_UART_TX
B45	SPI0_MOSI	PTC6	A45	VSS	VSSA
B46	SPI0_CS0_b	PTD0	A46	VDDA	VDDA
B47	SPI0_CS1_b	PTD4	A47	CAN1_RX	—
B48	SPI0_CLK	PTD1	A48	CAN1_TX	—
B49	**GND**	**Ground**	A49	**GND**	**Ground**
B50	SCL1	PTC10	A50	GPIO14	—
B51	SDA1	PTC11	A51	GPIO15	—
B52	GPIO5 / SPI0_HOLD/IO3	PTD3	A52	GPIO16	—
B53	USB0_DP_PDOWN	—	A53	GPIO17	—
B54	USB0_DM_PDOWN	—	A54	USB0_DM	ELEV_USB_DN
B55	IRQ_H	—-	A55	USB0_DP	ELEV_USB_DP
B56	IRQ_G	—-	A56	USB0_ID	PTD7
B57	IRQ_F	PTB10	A57	USB0_VBUS	ELEV_USB_VBUS

Table 6. TWR-K80F150M Primary Connector Pinout (continued)

B58	IRQ_E	PTB9	A58	I2S0_DIN_BCLK	PTA14
B59	IRQ_D	PTB5	A59	I2S0_DIN_FS	PTA16
B60	IRQ_C	PTA14	A60	I2S0_RXD1	PTA14
B61	IRQ_B	PTA13	A61	I2S0_TXD1	PTA16
B62	IRQ_A	PTA12	A62	RSTIN_b	RESET_b
B63	EBI_ALE / EBI_CS1_b	PTD0	A63	RSTOUT_b	—
B64	EBI_CS0_b	PTD1	A64	CLKOUT0	PTC3
B65	**GND**	**Ground**	A65	**GND**	**Ground**
B66	EBI_AD15	PTB18	A66	EBI_AD14	PTC0
B67	EBI_AD16	PTB17	A67	EBI_AD13	PTC1
B68	EBI_AD17	PTB16	A68	EBI_AD12	PTC2
B69	EBI_AD18	PTB11	A69	EBI_AD11	PTC4
B70	EBI_AD19	PTB10	A70	EBI_AD10	PTC5
B71	EBI_R/W_b	PTC11	A71	EBI_AD9	PTC6
B72	EBI_OE_b	PTB19	A72	EBI_AD8	PTC7
B73	EBI_D7	PTB20	A73	EBI_AD7	PTC8
B74	EBI_D6	PTB21	A74	EBI_AD6	PTC9
B75	EBI_D5	PTB22	A75	EBI_AD5	PTC10
B76	EBI_D4	PTB23	A76	EBI_AD4	PTD2
B77	EBI_D3	PTC12	A77	EBI_AD3	PTD3
B78	EBI_D2	PTC13	A78	EBI_AD2	PTD4
B79	EBI_D1	PTC14	A79	EBI_AD1	PTD5
B80	EBI_D0	PTC15	A80	EBI_AD0	PTD6
B81	**GND**	**Ground**	A81	**GND**	**Ground**
B82	**3.3 V**	**3.3 V Power**	A82	**3.3 V**	**3.3 V Power**

7 References

The list below provides references for more information on the Kinetis family, Tower System and the MCU modules. These can be found in the documentation section of freescale.com/TWR-K80F150M or freescale.com/kinetis.

- *TWR-K80F150M Quick Start Guide* (document TWR-K80F150M-QSG)
- *TWR-K80F150M Schematics* (document TWR-K80F150M-SCH)
- *K80 Family Data Sheet* (document K80P121M150SF5)
- *K80 Family Reference Manual* (document K80P121M150SF5RM)
- *Kinetis Quick Reference User Guide* (document KQRUG)
- *Kinetis Software Development Kit* (http://freescale.com/ksdk)
- *Kinetis Bootloader* (http://freescale.com/kboot)

8 Revision history

Table 7. Revision history

Revision Number	Date	Substantive changes
0	11/2015	Initial release